Evaluation of the Medicare Care Choices Model

Fifth and Final Annual Evaluation Report

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List of Acronyms

CMS	Centers for Medicare & Medicaid Services
COVID-19	coronavirus disease 2019
HIV/AIDS	human immunodeficiency virus/acquired immunodeficiency syndrome
MCCM	Medicare Care Choices Model
N	number

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Executive Summary

The Centers for Medicare & Medicaid Services (CMS) launched the Medicare Care Choices Model (MCCM) in January 2016 and administered it for six years, through December 2021. The model tested whether offering eligible beneficiaries the option to receive supportive and palliative care services through hospice providers without forgoing payment for the treatment of their terminal conditions (which is required to enroll in the Medicare hospice benefit) improved beneficiaries' quality of life and care, increased their satisfaction, and reduced Medicare expenditures. CMS was also interested in whether MCCM led to earlier election of the Medicare hospice benefit. This fifth and final evaluation report uses mixed methods to evaluate model implementation, estimate the impact of MCCM on beneficiaries' outcomes, and identify the facility characteristics and implementation factors associated with successful outcomes.

MCCM participants. Medicare-certified hospices played a prominent role in implementing the model, training and employing their staff to market MCCM, manage it, and provide supportive and palliative care services for enrollees. These services included care coordination and case management, round-the-clock access to hospice professionals, person-and family-centered care planning, shared decision making, symptom management, and counseling. CMS accepted 141 hospices to participate in the model—about 3 percent of all hospices nationwide. Hospices that participated in the model tended to be larger than hospices nationally and were more often a nonprofit organization. Significant attrition occurred over time, partly because of low model payments and challenges recruiting eligible beneficiaries. Only 44 out of the 141 hospices (31 percent) participated in the model until it ended in December 2021 and received model payments from CMS. Over the six years of the model, 89 hospices (63 percent) enrolled at least 1 beneficiary in MCCM, and 32 hospices (23 percent) enrolled 50 or more beneficiaries. Enrollment was highly concentrated: just 5 hospices enrolled 46 percent of all MCCM enrollees.

MCCM enrollees. CMS' eligibility criteria allowed fee-for-service Medicare beneficiaries nearing the end of life (expected to live less than six months) with a diagnosis of cancer, congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS to enroll in MCCM if they (1) were referred to a participating hospice from January 2016 through June 2021, (2) met hospice and model-specific eligibility criteria, and (3) chose to enroll into MCCM. Enrolled beneficiaries received supportive and palliative care services through MCCM, while keeping their coverage under the Medicare Part A and B benefits for both their terminal illness and other health care needs.

About two-thirds (64 percent) of all eligible beneficiaries referred to the model chose to enroll in the model over other available options, and participating hospices enrolled 7,263 beneficiaries over 5.5 years—less than 1 percent of beneficiaries who lived in participating hospices' market areas and satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data. Enrollees tended to be relatively sicker than eligible non-enrollees (for example, they used more health care services and had higher hierarchical condition category scores before enrolling). A disproportionately higher percentage of enrolled beneficiaries had cancer, but relatively few were

non-White or Hispanic, dually eligible for Medicaid, or living in non-rural areas. Beneficiaries' lengths of enrollment in MCCM varied widely, from a single day to more than two years, with a median of about two months. Among MCCM enrollees who died, the average length of time from enrollment to death was 209 days (about seven months).

Many hospices struggled to obtain referrals and enroll beneficiaries. Hospices attributed this struggle to the model's relatively restrictive eligibility criteria, providers' discomfort with signing six-month certificates of terminal illness, and discouragement among providers when referred beneficiaries did not meet the model's eligibility criteria (due to, for example, CMS' decision to exclude beneficiaries in Medicare Advantage). Some eligible, referred beneficiaries (18 percent of eligible referrals) chose to enroll directly into hospice, while other beneficiaries declined to enroll in both hospice and MCCM (13 percent). Interviews with hospice staff indicated the latter group often included beneficiaries reluctant to acknowledge they had a terminal illness or who feared loss of independence. However, some hospices increased referrals and enrollments over time after identifying and implementing more effective strategies, such as adopting a "no wrong door" referral policy where providers refer beneficiaries to the hospice generally rather than to a specific service line; sending experienced staff to meet with beneficiaries and their families soon after a referral was made; and building trust through frequent follow-ups with referred beneficiaries.

MCCM services. MCCM provided a high-touch intervention, filling an essential need in end-of-life care. Enrollees received 2.6 encounters per week of enrollment, on average, mostly provided by clinically trained health professionals (employed by the participating hospices) and often delivered in the beneficiaries' homes. During these MCCM encounters, hospice staff provided a range of services that they identified as critical to keeping beneficiaries from seeking care in an emergency department and preventing hospitalizations. The most commonly provided MCCM services included assessment of health and health-related social needs, care coordination and case management, round-the-clock access to health care professionals, person- and family-centered care planning, shared decision making, symptom management, and counseling. Hospice staff we interviewed emphasized that successful management of enrollees' symptoms depended on gaining enrollees' trust, engaging enrollees and caregivers in ongoing education, and giving enrollees someone to call when they had medical concerns after hours.

Quality of service delivery and beneficiaries' experience of care. MCCM hospices almost universally achieved a high quality of service delivery based on a range of performance metrics self-reported by hospices to CMS, such as high rates of regular comprehensive assessments and screening and symptom management for pain, shortness of breath, and emotional well-being. Enrollees and caregivers, particularly those who subsequently entered hospice, reported high levels of satisfaction across many domains, including shared decision making, receiving care consistent with their wishes, and quality of life.

MCCM payments. In return for providing MCCM services, CMS typically paid participating hospices $400 per enrolled beneficiary per month, totaling $16.7 million over the six-year model period. Many hospices, including some that withdrew from the model, believed reimbursement levels were inadequate for providing the high-quality care that enrollees required.

Transitions from MCCM to hospice. MCCM served as a stepping stone to the Medicare hospice benefit for many enrollees. About two-thirds of MCCM enrollees voluntarily transitioned directly from MCCM to hospice. (Only 13 percent of MCCM enrollees remained in MCCM until their death.) Some hospice staff attributed this high transition rate to their ongoing conversations with MCCM enrollees about end-of-life care and the added benefits available through the Medicare hospice benefit.

Model's effects on beneficiaries' outcomes. Our impact analyses focused on 5,153 beneficiaries who began enrolling in MCCM in January 2016, when the model began; who died by December 2021, when the model ended; and who we could follow in Medicare claims and enrollment data. Our main impact analysis (Table ES.1) yielded several notable findings:

- *Reduced Medicare expenditures.* Medicare Part A and B expenditures per beneficiary for MCCM enrollees were $9,576 (17 percent) lower than expenditures for comparison group beneficiaries during the period between their MCCM enrollment and their death. Payments to participating hospices for providing MCCM services to enrollees were $1,971 on average per enrollee, so net Medicare expenditures per beneficiary decreased by $7,604 (13 percent).
- *Reduced use of resource-intensive services.* Model enrollees were less likely to use hospital services. For example, they had 26 percent fewer inpatient hospital admissions and 12 percent fewer outpatient emergency department visits and observation stays than beneficiaries in the comparison group. MCCM enrollees had fewer inpatient stays with surgeries and aggressive, life-prolonging procedures and tests in the last 30 days of life; fewer elective admissions; and fewer days in intensive care units compared with the matched comparison group. Decreases in inpatient expenditures drove overall reductions in Medicare expenditures.
- *Increased use of the Medicare hospice benefit.* MCCM enrollees were 18 percentage points more likely to use the Medicare hospice benefit before death than matched comparison beneficiaries (83 versus 65 percent). MCCM enrollees also entered hospice earlier, and ultimately spent more than twice as many days in hospice, on average, than matched comparison beneficiaries (42 versus 19 days). About half the Medicare Part A and B savings resulted from MCCM enrollees entering hospice earlier and more often.
- *Improved quality of end-of-life care.* Finally, MCCM enrollees were more likely to receive better-quality end-of-life care in the period between enrollment and death. For example, they were less likely to receive an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life (61 versus 76 percent) and spent about 5 more days at home than beneficiaries in the comparison group (a 3 percent increase).

Table ES.1. Estimated effects of MCCM on the evaluation's primary beneficiary outcome measures

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact
Average Medicare Part A and B expenditures ($ per beneficiary)	46,810	56,385	-9,576	-17
Average Medicare Part A and B expenditures plus MCCM payments ($ per beneficiary)	48,781	56,385	-7,604	-13
Average number of inpatient admissions (number per 1,000 beneficiaries)	1,242	1,676	-434	-26
Average number of outpatient emergency department visits and observation stays (number per 1,000 beneficiaries)	886	1,005	-119	-12
Percentage who used the Medicare hospice benefit	83	65	+18	+27
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	61	76	-15	-20
Average number of days at home[a]	183	178	+5	+3

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. It covers beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting). All seven impact estimates in this table were statistically significant at the $p < 0.001$ level. The rest of this report discuss methods and results in more detail.

[a] *Days at home* counts the number of days a beneficiary is alive and not admitted to a hospital, inpatient rehabilitation facility, long-term care hospital, skilled nursing facility, or inpatient hospice.

MCCM = Medicare Care Choices Model.

Subgroup analyses. MCCM's benefits were widespread, although analyses revealed variation in outcomes across subgroups of MCCM enrollees, based on the following factors:

- *Survival time.* Impacts on Medicare expenditures varied by the length of time beneficiaries lived after enrolling in MCCM. The largest reductions in net Medicare expenditures occurred among enrollees who lived 3 to 12 months after enrolling in MCCM.
- *Qualifying condition.* Effects of the model were remarkably similar for the subgroups of beneficiaries with cancer, congestive heart failure, and chronic obstructive pulmonary disease. The large, favorable estimated impacts across the three qualifying conditions suggest improvements depend less on beneficiaries' conditions or on model features specific to a particular illness.
- *Health equity.* The model improved outcomes for all subgroups, including MCCM beneficiaries from underserved communities—non-White or Hispanic beneficiaries, dually eligible

beneficiaries, and beneficiaries living in rural areas—although not always as much as it improved outcomes for other enrollees (depending on the outcome). Most notably, MCCM reduced disparities in the rate of hospice use for non-White or Hispanic (versus non-Hispanic White) enrollees and Medicare-Medicaid dually eligible (versus non-dually eligible) enrollees.

- *Hospice.* Although there was meaningful variation in hospice-specific impacts, virtually all MCCM hospices with at least one enrolled beneficiary had the intended effects on beneficiaries' outcomes. In exploratory analyses, some organizational characteristics and implementation metrics were associated with more favorable effects on beneficiary outcomes, including belonging to an accountable care organization, having experience with pre-hospice or bridge programs, using nurses to provide MCCM services, training staff on delivery of MCCM services, and having more MCCM enrollees.

In conclusion, MCCM provided access to supportive and palliative care services not normally covered through Medicare Part A or B. By providing high-quality services and increasing use of Medicare's hospice benefit, participating hospices achieved MCCM's goals of improving enrollees' quality of life and care, attaining high satisfaction, and reducing enrollees' Medicare expenditures and acute care service use for a limited group of enrolled beneficiaries. In subgroup analyses, the model had favorable impacts, regardless of the beneficiaries' qualifying conditions or whether they were from underserved communities. Our findings point to the importance of transforming care delivery to improve terminally ill beneficiaries' and caregivers' experiences and reduce costly usage of services that might be inconsistent with beneficiaries' preferences.

Although these evaluation results are promising, they might not generalize from MCCM to other hospice providers or beneficiaries. Caution should be taken when extrapolating these findings to other settings. In fact, CMS decided not to scale MCCM because of its low uptake, low market penetration, and lack of generalizability. Instead, CMS is using these evaluation results to enhance access to care, quality of care, and beneficiary and caregiver satisfaction, as well as to inform the design strategies for future models focused on care for persons with serious illness nearing the end of life.

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1. Introduction

Services available through the Medicare hospice benefit can greatly improve quality of life for people with life-limiting illnesses. Research has shown use of hospice services can improve quality of life and health care outcomes by providing symptom management, pain control, and supportive services to terminally ill beneficiaries and their caregivers (Connor et al. 2007; Temel et al. 2010; Aldridge et al. 2016).[1] However, Medicare beneficiaries have traditionally underused hospice services because of a requirement that beneficiaries forgo Medicare coverage and payment for treatment of their terminal conditions to receive Medicare hospice services. Only about half of Medicare beneficiaries who died in 2020 received any hospice care before their death, with a median length of enrollment in hospice of only 18 days among those who used the benefit (Medicare Payment Advisory Commission 2020). In fact, many of those who selected hospice enrolled in the last week of their life; persons with such short hospice stays might benefit less from hospice than those with longer stays (Medicare Payment Advisory Commission 2020; National Quality Forum 2016).

The Centers for Medicare & Medicaid Services (CMS) designed the Medicare Care Choices Model (MCCM) to test whether offering eligible beneficiaries the option to receive supportive and palliative care services without forgoing payment for treatment of their terminal conditions would improve their quality of life and care, increase beneficiaries' satisfaction, and reduce Medicare expenditures.[2] CMS also sought to determine whether MCCM led to earlier election of the Medicare hospice benefit. The model test ran from January 1, 2016, to December 31, 2021.

1.1. Overview of MCCM

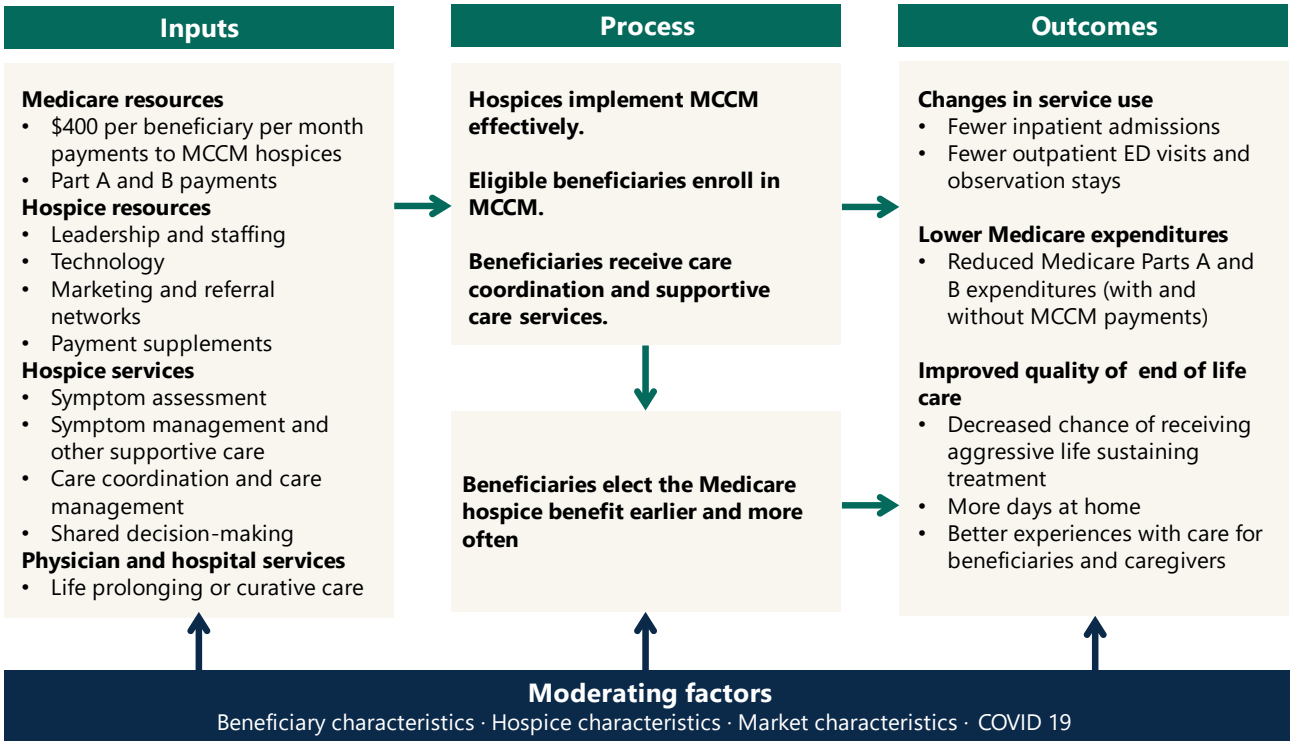
CMS intended for Medicare-certified hospices to play a prominent role in implementing MCCM (Figure 1) and involved a diverse group of hospices from various geographic areas, both urban and rural, and hospices of varying sizes.[3] The participating hospices employed their staff to market, manage, and provide services for MCCM enrollees. Simultaneously, beneficiaries received health care services under Medicare Part A and B for both their terminal illness and other health care needs.

[1] Although research suggests hospice benefits can improve the quality of life, studies have been mixed on whether hospice saves Medicare money in the aggregate compared with conventional care (Medicare Payment Advisory Commission 2020).

[2] CMS' Center for Medicare & Medicaid Innovation established MCCM under the authority of section 1115A of the Social Security Act. The Patient Protection and Affordable Care Act (Public Law 111-148, section 3140) directed the Secretary of Health and Human Services to establish a Medicare hospice concurrent care demonstration program under which Medicare beneficiaries were to be furnished hospice care and any other items or services covered under title XVIII of the Social Security Act.

[3] Participating hospices were required to be Medicare-certified and -enrolled hospice programs (based on Medicare provider number) and demonstrate capacity to perform the duties of the model and experience providing beneficiaries with care coordination or case management services and supporting shared decision making.

Figure 1. How MCCM was expected to improve care



MCCM = Medicare Care Choices Model.

CMS expected participating hospices to recruit MCCM beneficiaries, either through their current or new referral sources (for example, physicians that provide services to terminally ill beneficiaries and regularly refer beneficiaries to hospice). Hospices educated referral sources about the MCCM option, including the beneficiary eligibility criteria and the services that would be offered. After the hospice identified a potentially eligible MCCM enrollee, it offered the beneficiary a choice to enroll in either (1) the model, (2) the traditional Medicare hospice benefit, or (3) other palliative care programs offered by either the hospice or other providers, or (4) remain unenrolled from any of these programs.

For each beneficiary confirmed eligible and enrolled in the model, the hospice received $400 per month.[4] An exception was made for the first month of enrollment, when hospices received $200 if the beneficiary enrolled for fewer than 15 days. Beneficiaries who enrolled in MCCM received care coordination and supportive services similar to those provided under the Medicare hospice benefit, but they did not receive all services provided under the hospice benefit, including intensive services such as inpatient respite care or continuous care in the home, and durable medical equipment (Abt Associates 2020a; Exhibit I.3).[5]

[4] Participating hospices more often received $392 per month rather than $400 per month because of 2 percent Medicare sequester cuts in effect for much of the model's implementation period. MCCM payments were otherwise held constant over the six model years.

[5] Beneficiaries in MCCM received durable medical equipment under their usual Part B benefit.

The hospices had some flexibility in designing their care choices programs but were expected to provide the following types of supportive and palliative care services:

1. **Care coordination and case management.** Organize health care services for the care of the beneficiaries' qualifying illnesses and share information among the participants' interdisciplinary team to achieve safe, effective, and coordinated care.
2. **24/7 access to hospice team.** Provide access to health care professionals on a round-the-clock basis.
3. **Person- and family-centered care planning.** Empower the enrollee to be involved in care planning and ensure health care goals and preferences are designed for the enrollee.
4. **Shared decision making.** Share treatment options with the beneficiaries, elicit information, and work together with them to ensure care plans support their values and preferences.
5. **Symptom management.** Manage the beneficiaries' pain and symptoms by making periodic comprehensive assessments and create individual care plans to alleviate those symptoms.
6. **Counseling.** Offer appropriate counseling, including bereavement, spiritual, and dietary counseling, to beneficiaries and their families based on assessments and the individual's plan of care.

Hospices that implemented the model effectively provided these services to MCCM beneficiaries, and CMS expected to achieve the following outcomes from the services provided:

- Symptom assessment and management, along with 24/7 access to health care professionals, would support families and keep enrollees comfortable in their homes, avoiding unnecessary use of hospital services.
- Care coordination, care planning, and counseling would enable beneficiaries and families to learn how supportive and palliative care services work and ease the transition into the Medicare hospice benefit. Beneficiaries were expected to enroll in the Medicare hospice benefit more often (or earlier), reducing inpatient service use and aggressive treatments for terminal conditions.
- Care coordination and supportive and palliative care services would improve terminally ill enrollees' and caregivers' experiences, improving both the quality of health care and beneficiaries' satisfaction with it.

The model sought to enroll beneficiaries who were eligible for the traditional hospice benefit but had not selected it. However, the model focused on a subset of all beneficiaries eligible for hospice—namely those with cancer, congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS—and who met other model-specific eligibility requirements listed in Exhibit 1.

Exhibit 1. Requirements for beneficiaries to be eligible for MCCM

- Have been enrolled in Medicare Part A and B (traditional Medicare) for the past 12 months
- Have Medicare as primary payer at the time of enrollment
- Have a diagnosis of cancer, congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS
- Be expected to live six months or less if the beneficiary's terminal illness ran its normal course (as attested to by a physician)
- Have had at least one hospital encounter and three office visits covered by Medicare in the past 12 months
- Have not elected to enroll in either the Medicare or Medicaid hospice benefit in the past 30 days
- Reside within the service area of the participating hospice and in a traditional home (not including assisted-living facilities)

1.2. Model implementation

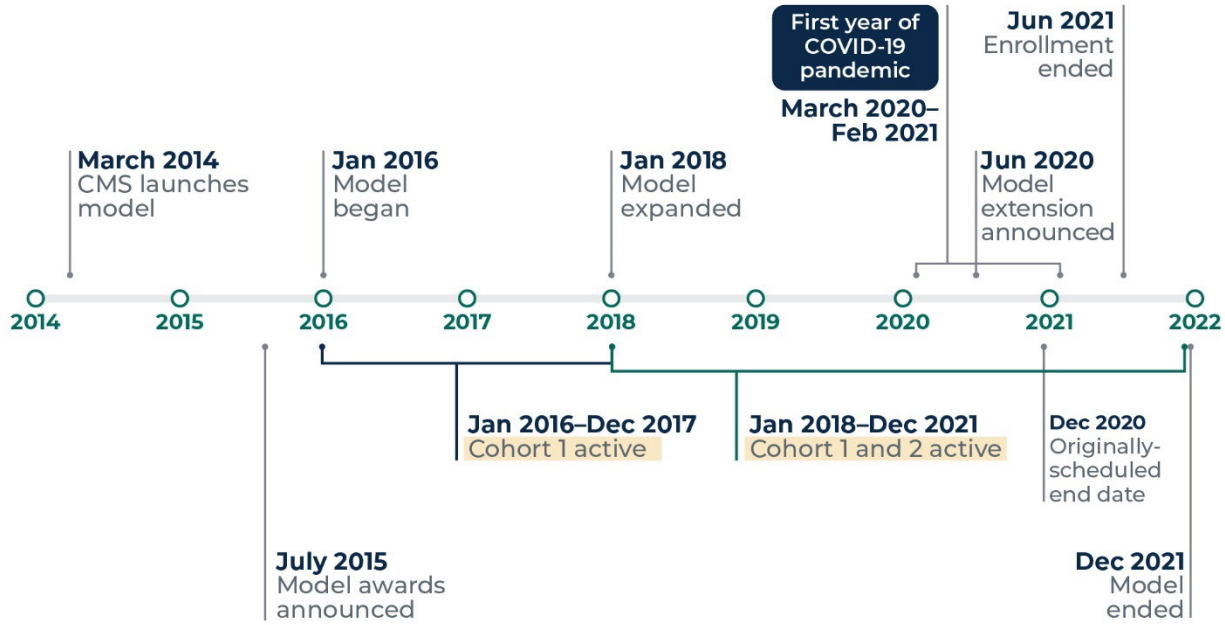
MCCM was announced in March 2014 (Figure 2). In July 2015, CMS accepted 141 hospices to participate in the model.[6] It randomly assigned 71 hospices to Cohort 1, which started enrolling beneficiaries in January 2016, and 70 to Cohort 2, which started enrolling beneficiaries in January 2018. As we discuss in the following chapter, 89 hospices (63 percent of the original 141 hospices) enrolled at least one beneficiary in the model.[7]

CMS originally planned to test the model through December 31, 2020, but in June 2020—in the early months of the coronavirus disease 2019 (COVID-19) pandemic—the agency extended the model until December 31, 2021. Under the one-year extension, participating MCCM hospices enrolled eligible beneficiaries through June 30, 2021, and provided supportive and palliative care services to enrollees through December 31, 2021. CMS also extended the evaluation to include this additional experience. There were 49 hospices (35 percent of the original 141) that formally participated through the end of the model on December 31, 2021; 44 of these 49 hospices received payments from CMS for providing MCCM services.

[6] CMS received a robust response to the model's request for applications and, in July 2015, expanded MCCM from 30 Medicare-certified hospices to 141 Medicare-certified hospices, with the goal of enrolling 150,000 eligible Medicare beneficiaries. CMS concurrently increased the length of the model from three to five years and decided to issue MCCM payments through the standard Medicare claims process (CMS 2015). We understand the CMS model team later revised their enrollment goal to the minimum amount required for a robust evaluation.

[7] Hospices were randomized into two cohorts at the start of the model. However, we could not make use of this design in the evaluation because (1) enrollment in MCCM was low and (2) Cohort 2 hospices did not collect data during the first two years of the model.

Figure 2. MCCM timeline



CMS = Centers for Medicare & Medicaid Services; MCCM = Medicare Care Choices Model.

1.3. Overview of the evaluation approach

A previous CMS contractor provided three evaluation reports that covered nearly four years of MCCM. The first two reports covered the implementation of the model, and the third included both implementation findings and early impact results (Abt Associates 2018, 2020a, 2020b). In addition, Mathematica provided a fourth evaluation report focused on the effects of MCCM on Medicare expenditures, service use, and quality outcomes through March 31, 2021 (Kranker et al. 2022). This is the fifth and final report planned for the independent evaluation of MCCM.

Research questions. This report focuses on implementation of MCCM; its effects on Medicare expenditures, service use, and quality outcomes; and the model, hospice, and market characteristics associated with successful model performance and outcomes. In particular, we designed the evaluation to address the guiding research questions listed in Exhibit 2.

Exhibit 2. Guiding evaluation research questions

1. What were the reasons for beneficiary enrollment or non-enrollment? What were the pathways through which beneficiaries enrolled in the model?
2. How did participating hospices serve beneficiaries in the model and address their needs?
3. How did participating hospices implement the model? What barriers and facilitators did they face in doing so?
4. How did the per beneficiary per month payment structure affect participating hospices in achieving the model's goals? What other billing practices or financial support did hospices use to achieve results under the model?
5. Did MCCM result in decreased Medicare service use and expenditures, better quality of care, or better experiences of care for terminally ill beneficiaries?
6. Did beneficiaries in the model elect the Medicare hospice benefit at a higher rate and earlier in their disease trajectory compared with those not in the model?
7. Did beneficiaries in the model receive different patterns of supportive services and life-prolonging or curative care compared with those not in the model?
8. What were the differential impacts on beneficiaries based on their demographic characteristics, terminal disease type, and other important factors?
9. What factors were associated with the pattern of results (Question 5)? Which hospices performed the best and what drove their success?
10. What unintended consequences were observed, if any?

Data source and methods. We used mixed-method analytic techniques to answer these research questions. Some of the most important aspects of our evaluation include the following:

- We used quantitative analysis of MCCM program data to describe model participants and enrollees, the services provided to beneficiaries through the model, and patterns of disenrollment.
- To identify effective strategies for addressing commonly cited challenges to implementing MCCM, we conducted a final set of interviews with staff from a sample of 10 exemplar hospices—that is, hospices that met several criteria for successful implementation—and a convenience sample of providers who referred beneficiaries to those hospices.
- We interviewed administrative and clinical staff from six hospices that elected not to participate in the model during the one-year extension to understand why they decided not to participate.
- To assess the effects of MCCM using Medicare claims data, we calculated the regression-adjusted differences in outcome measures between beneficiaries enrolled in MCCM and a matched comparison group of eligible beneficiaries who were not referred to or enrolled in MCCM. Matched comparison beneficiaries lived in regions served by MCCM hospices and

resembled MCCM enrollees in terms of prognosis (that is, died within our analysis period in the same length of time), health conditions, prior experience of care, and other observed characteristics. This report provides impact estimates for beneficiaries who enrolled in MCCM, met all observable claims-based eligibility criteria, and died during the period from January 1, 2016, when the model began, through December 31, 2021, when it ended.

- We conducted a quantitative synthesis analysis to identify model, hospice, and market characteristics associated with successful model performance and outcomes.
- Finally, we summarized and synthesized relevant findings from previous MCCM evaluation annual reports, including primary data collected by the previous evaluation contractor through interviews, an organizational survey, and a beneficiary caregiver survey.

The following chapters in this report describe the model hospice participants (Chapter 2) and enrollees (Chapter 3); describe the services provided to beneficiaries through the model (Chapter 4) and patterns of disenrollment (Chapter 5); present the results of our impact analyses—overall (Chapter 6) and for subgroups of MCCM enrollees (Chapter 7); synthesize implementation and impact results (Chapter 8); and draw conclusions (Chapter 9). The chapters offer additional information on our data sources and methods, which we detail in the appendices.

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2. Hospices' Participation in MCCM

Key takeaways

- A limited group of hospices participated in MCCM. The 141 participating hospices represented about 3 percent of hospices nationwide.
- Significant attrition occurred over time, and few hospices participated in MCCM robustly.
  - 31 percent (44 out of 141 hospices) participated in the model until it ended in December 2021.
  - 57 percent (81 out of 141 hospices) received payments for providing MCCM services, while the remaining 43 percent (60 hospice) did not provide MCCM-paid services.
- A variety of organizations participated in the model, but they were not representative of all hospices nationwide.
  - Hospices that participated in MCCM tended to be larger than hospices nationwide, and were more often a nonprofit organization.

This chapter provides an overview of the hospices that participated in the model. We describe participating hospices' characteristics, attrition over time, and reasons for withdrawal.[8]

2.1. Hospices' participation in the model and withdrawal over time

CMS accepted 141 hospices to participate in the model. Thus, CMS tested MCCM among a limited group of hospices—about 3 percent of all hospices nationwide—that voluntarily applied to be in the model.

Relatively few of the accepted hospices participated in MCCM robustly, after we account for limited beneficiary enrollment and the significant attrition that occurred during the model. Over the full six years of the model, only 81 of the 141 accepted hospices (57 percent) received payments for providing MCCM services to enrollees, and just 32 MCCM hospices (23 percent) enrolled 50 or more beneficiaries in the model.[9] Only 49 of the hospices (35 percent) participated in the model until it ended in December 2021; 44 of these 49 hospices (31 percent of the original 141 hospices) received payments for providing MCCM services to beneficiaries (Table 1). Another 23 hospices (16 percent)

[8] Appendix A describes the secondary data and methods we used to profile MCCM hospices and their level of participation and presents supplemental results. Our principal data source was MCCM program data linked to Medicare claims and enrollment data. The description of reasons for withdrawal in Section 2.1 drew on our interviews with hospice staff, described in Appendix B, and the first two annual MCCM evaluation reports (Abt Associates 2018 and 2020a).

[9] According to MCCM program data, 89 of the hospices (63 percent) enrolled at least one beneficiary. In Chapter 3, we will discuss model enrollees and the concentration of model enrollees at a small group of hospices.

who received MCCM payments withdrew in December 2020, the model's originally scheduled end date. The remaining hospices withdrew before the model began for their cohort (17 percent), never enrolled beneficiaries and received payments for MCCM services (26 percent), or received some payments but withdrew sometime between their cohort's start date and late 2020 (10 percent).[10,11]

Table 1. Number of hospices, overall, by date of withdrawal from MCCM (if applicable) and receipt of MCCM payments, overall and by cohort: ***CMS selected 141 hospices to participate in MCCM; most withdrew before the model ended.***

Participation in MCCM	Cohort 1 hospices	Cohort 2 hospices	Total number (percentage)
Withdrew before the cohort's start date	5	19	24 (17%)
Did not receive payments for providing MCCM services[a]	19	17	36 (26%)
At least one paid claim for providing MCCM services	47	34	81 (57%)
Withdrew after the cohort's start date and before December 2020	13	1	14 (10%)
Participated through December 2020 (but not in 2021)	13	10	23 (16%)
Participated in the one-year (2021) model extension	21	23	44 (31%)
Total number of hospices	**71**	**70**	**141** (100%)

Sources: MCCM program data merged with claims data for paid MCCM services, January 1, 2016 to December 31, 2021.

Note: The start date was January 2016 for Cohort 1 and January 2018 for Cohort 2.

[a] Twenty-four hospices that did not receive payments for providing MCCM services withdrew between their cohort's start date and December 2020, seven hospices participated through December 2020, and five hospices participated in the one-year (2021) model extension.

MCCM = Medicare Care Choices Model.

Disengaged hospices could choose to formally withdraw from the model or officially remain participants.[12] Most hospices formally withdrew from MCCM before the model ended. Officially, 24 of the original 141 hospices (17 percent) withdrew before their cohort's start date, and another 38 (27 percent) withdrew between the cohort's start date and the end of 2020. Overall, there was a steady downward trend in the official number of model participants through late 2018, followed by a period of relative stability until December 2020 when 30 hospices (21 percent) chose not to participate in the one-year (2021) model extension (Figure 3). The remaining 49 hospices (35

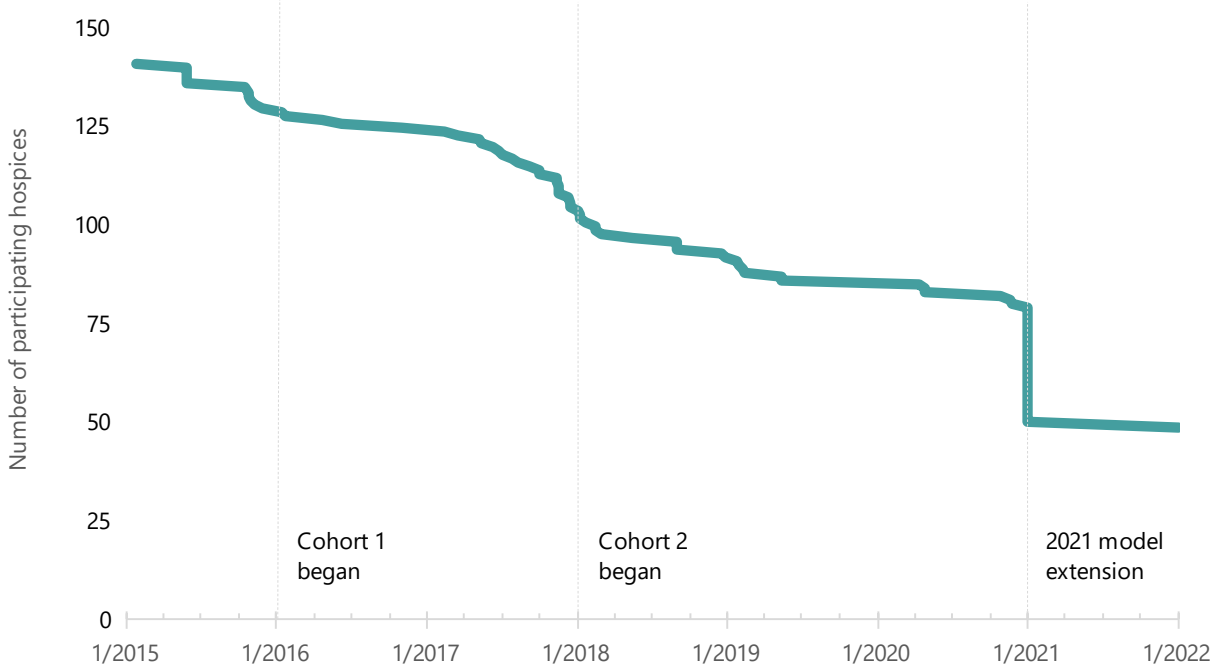
[10] As mentioned in Chapter 1, the 141 accepted hospices were randomly assigned to start MCCM in January 2016 (Cohort 1) or January 2018 (Cohort 2).

[11] There were not large differences in the characteristics of hospices that participated in the model through 2020 or 2021, compared with those that withdrew earlier (Appendix A, Table A.6). Further, hospices that did and did not receive MCCM payments were broadly similar (Appendix A, Table A.7).

[12] Twelve hospices did not withdraw from the model before December 2020 but received $0 in MCCM payments. According to MCCM program data, 1 of these 12 hospices had 28 enrollees, and the other 11 enrolled no beneficiaries. CMS allowed hospices to formally participate in the model even when they were not actively enrolling beneficiaries or providing MCCM services.

percent) officially participated in the model extension. However, 5 of these hospices neither enrolled beneficiaries nor received model payments.

Figure 3. Number of hospices participating in MCCM over time: ***There was significant attrition of hospices from MCCM over time.***



Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: *Participating hospices* includes all hospices that had not formally withdrawn from MCCM as of a given date. It includes hospices that never received payments for providing MCCM services.

MCCM = Medicare Care Choices Model.

There were several commonly cited reasons for withdrawal, including challenges with enrollment and negative financial impacts. During our interviews with staff from hospices that chose not to participate in the one-year model extension, staff cited various reasons for initially deciding to participate in MCCM. These included wanting to create better pathways to hospice care; wanting to reach additional beneficiaries beyond those served by traditional hospice; wanting to improve quality of life and reduce hospitalizations; and wanting to be involved in health care payment and delivery reform.

Despite these potential benefits of participation, many hospices chose to withdraw from MCCM or elected not to participate in the one-year model extension. Hospices' reasons for electing not to participate in the model extension were similar to hospices' reasons for withdrawing from the model. They included the model's relatively restrictive eligibility criteria; the negative financial impact and administrative burden of participating; overlap with other hospice programs; and lack of buy-in from leadership.

- *Eligibility criteria*. Across hospices that withdrew from the model or elected not to participate in the model extension, the most cited reason was the restrictive model eligibility criteria. The model eligibility criterion that was often most problematic to hospices was the requirement that beneficiaries be enrolled in traditional Medicare rather than a Medicare Advantage (managed care) plan. This criterion made it challenging for hospices to enroll beneficiaries in MCCM, especially in regions that have high Medicare Advantage penetration. Other criteria hospices mentioned include the requirements that beneficiaries have one of four qualifying medical diagnoses and the requirement that beneficiaries have a prognosis of six months or less.

> "I think most of our patients in this area are in managed care; there's just really a handful that are not… So, we've always had a fairly minimal census on [the MCCM program], which is a lot of work… I just don't think we found it as a huge benefit given that most of our patients are managed care, and we couldn't offer them the services."
>
> —Hospice staff member

- *Financial impact and administrative burden*. The second reason hospices chose to discontinue their participation was the financial impact and administrative burden associated with participating. Hospice representatives reported that the $400 per beneficiary per month payments were insufficient to cover the costs associated with administering MCCM within their hospice and caring for beneficiaries enrolled in the model. Hospice representatives mentioned administrative tasks including reporting requirements, confirming beneficiary eligibility, documenting activities in the MCCM program data, and participating in learning and implementation activities.
- *Overlap with other hospice programs*. Several hospices that withdrew from the model early said that MCCM offered services similar to their existing palliative care programs and that Medicare beneficiaries eligible for MCCM tended to prefer these other programs over MCCM. As a result, these hospices had low enrollment in their MCCM program.
- *Other reasons*. Other reasons hospices withdrew from the model include a lack of interest in MCCM from leadership, especially when staff involved in the MCCM application subsequently left the organization. The COVID-19 pandemic did not appear to be a primary reason that hospices chose not to participate in the one-year model extension.

Based on the challenges they experienced with the model, hospice representatives provided recommendations for improving the model eligibility criteria and payment structure. Specifically, hospice staff recommended increasing the $400 per beneficiary per month payment, because many commented that the current payments were not sufficient to cover the costs of caring for MCCM enrollees. In addition, hospice staff recommended revising the MCCM eligibility criteria to include individuals enrolled in Medicare managed care plans; expanding the qualifying medical conditions to include diagnoses such as renal failure, end-stage pulmonary and liver diseases, and certain neurological conditions; expanding the prognosis from 6 months to 12 months; removing the requirement that a beneficiary have a hospital encounter within the past 12 months; and expanding

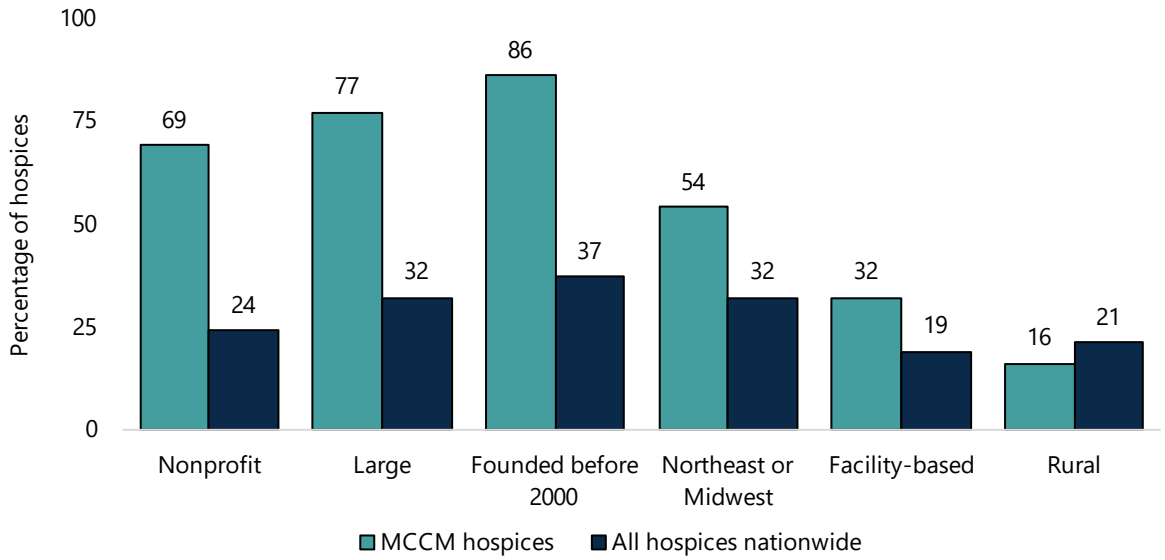
the criteria to include beneficiaries living in non-institutional living arrangements (as opposed to restricting the model only to those who lived in a traditional home for the previous 30 days).

2.2. Characteristics of participating hospices

To understand whether the effects of MCCM presented in this report might generalize to hospices nationwide, we must determine whether the model hospices have the same characteristics as those nationwide. Hospices' organizational characteristics, such as mission and size, can serve as a proxy for their approach to providing care and underlying cost structures. Thus, these factors can affect how the hospices implemented the model and, in turn, the outcomes they achieved. To examine this issue, we compared the characteristics of MCCM hospices with hospices nationwide and those that participated in the extension of MCCM.

The characteristics of MCCM hospices participating at the beginning of the model differed from the characteristics of all hospices nationwide. Notably, MCCM overrepresented nonprofit and facility-based hospices (Figure 4). Only about 17 percent of all MCCM hospices were for-profit compared with more than 60 percent of nationwide hospices. (Perhaps for-profit hospitals were less likely to participate because they anticipated financial losses or other difficulties implementing the model discussed earlier in the chapter.) Slightly fewer MCCM hospices were freestanding facilities than nationwide hospices, which might have different referral sources than facility-based hospices. MCCM hospices had a more significant proportion of enrollees with hospice stays lasting fewer than 7 days. In contrast, nationwide hospices had a slightly higher proportion of enrollees with hospice stays longer than 180 days.

Figure 4. Hospice characteristics for all MCCM hospices and all hospices nationwide: ***A variety of organizations participated in the model, but they were not representative of all hospices nationwide.***



Sources: MCCM program data, January 1, 2016 to December 31, 2021, merged with a data set constructed by Abt Associates for previous MCCM evaluation reports (Abt Associates 2020a, 2020b).

Note: We imputed missing data for a small number of non-MCCM hospices; see Appendix A for more details about these methods. Additional hospice characteristics, and the characteristics of hospice subgroups are presented in Appendix A, Section 5.1.

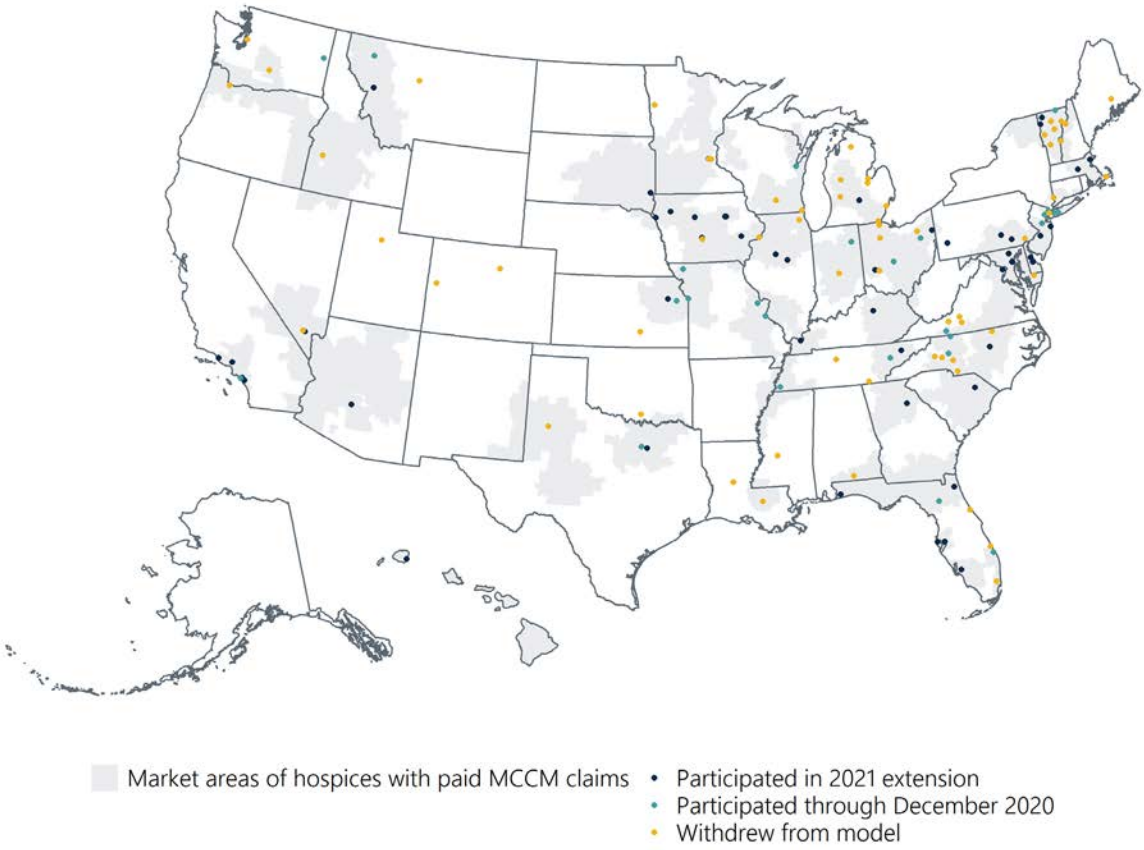
MCCM = Medicare Care Choices Model.

Furthermore, MCCM hospices were more likely to be larger, older, and more geographically consolidated than hospices nationwide. Large-sized hospices accounted for almost 80 percent of all MCCM hospices, whereas about one-third of all hospices nationwide are large. Smaller hospices might have anticipated unique challenges fulfilling the requirements of the model described in CMS' Request for Applications (CMS 2014), relative to larger hospices that potentially had more capacity to implement the model or could reach necessary economies of scale. Geographically, the 141 hospices were located in 41 states (Figure 5). Both MCCM and nationwide hospices had similar proportions in the South, but proportionately more of the MCCM hospices were in the Midwest and Northeast, whereas the hospices nationwide are more likely to be in the West. However, MCCM hospices were similar to hospices nationwide in some other characteristics. They were just as likely to be affiliated with a chain and be in a non-rural area. Further, MCCM had similar Consumer Assessment of Healthcare Providers and Systems hospice survey quality-of-care ratings and percentages of days spent on routine home care compared with all hospices.

About half of the MCCM hospices that responded to organizational survey by Abt Associates had experience with community- or hospital-based palliative care or bridge programs before MCCM, and more than two-thirds used electronic health records. About one out of five hospices participated in an accountable care organization. Hospices with community- or hospital-based palliative care or bridge programs, who used electronic health records, or who belonged to an accountable care organization before MCCM might have planned to leverage this experience and infrastructure to help implement MCCM (as we discuss in Chapters 4 and 8).

The MCCM hospices that remained through the model extension in 2021 had similar characteristics to those that started the model. Hospices participating in the extension were large, nonprofit organizations mostly located outside rural areas, disproportionately located in the Northeast and Midwest (Appendix A, Table A.5). These characteristics were not dissimilar to the patterns we saw among all 141 MCCM hospices. Hospices that participated in the 2021 model extension were located in 25 states (Figure 5).

Figure 5. Locations of MCCM hospices participating in MCCM: ***The 141 participating hospices were from 41 states; there were 49 hospices from 25 states in the 2021 model extension.***



Source: Geocoded MCCM program data, January 1, 2016, to December 31, 2021.

Notes: We describe our approach for identifying market areas of participating hospices in Appendix A, Section B.3.

MCCM = Medicare Care Choices Model.

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3. Beneficiaries Who Enrolled in MCCM

Key takeaways

- MCCM enrolled a very small percentage of eligible beneficiaries:
  - 7,263 beneficiaries enrolled in MCCM over 5.5 years.
  - Enrollment was concentrated: just 5 hospices enrolled 46 percent of all MCCM enrollees.
- Many hospices struggled to obtain referrals and enroll beneficiaries. However, some hospices improved as they identified and implemented more effective referral and enrollment strategies.
- Nearly half of eligible beneficiaries who declined enrollment in MCCM said they were not ready for hospice or palliative care.
- Those who chose to enroll in MCCM were less than one percent of the larger eligible population who lived in participating hospices' market areas and satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data. Further, the enrollees were not representative:
  - Beneficiaries who enrolled in MCCM used more health care services and had higher hierarchical condition category scores before enrolling than beneficiaries who did not enroll. This finding indicates relatively sicker beneficiaries tended to be referred to the model and enrolled.
  - A disproportionately high percentage of enrolled beneficiaries had cancer, but relatively few were non-White or Hispanic, dually eligible for Medicaid, or living in non-rural areas.
- Beneficiaries' lengths of enrollment in MCCM varied widely, from a single day to more than two years (with a median of about two months).
- Evaluation findings might not generalize to other hospice settings and populations, given the small number of hospices that participated in MCCM, the small percentage of eligible beneficiaries that enrolled, and how model participants differed from nonparticipants.

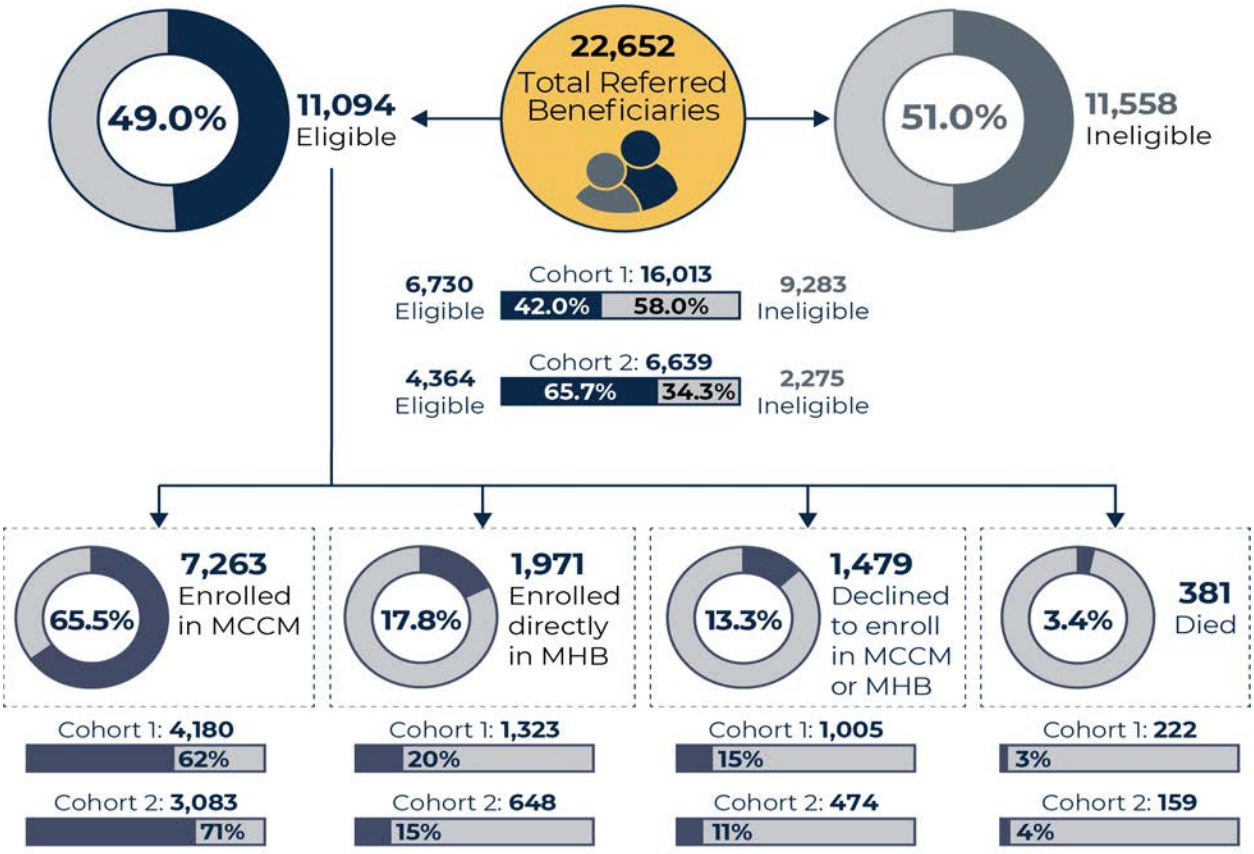
This chapter profiles the beneficiaries who were referred to or enrolled in MCCM.[13] We quantify the levels of enrollment in MCCM overall, across hospices, and over time. We then discuss the participating hospices' approaches to enrollment and beneficiaries' considerations when deciding about enrollment. We describe the characteristics of those who enrolled in the model and compare them with those who did not enroll. Finally, we discuss their length of enrollment in the model. Together, Chapters 2 and 3 provide insight into which results might be generalizable.

[13] This chapter relies largely on analysis of MCCM program data linked to Medicare claims and enrollment data (described in Appendix A), supplemented with primary data (described in Appendix B) and the first two annual MCCM evaluation reports (Abt Associates 2018, 2020a).

3.1. Number of beneficiaries referred to, eligible for, and enrolled in MCCM

Providers referred 22,652 Medicare beneficiaries to MCCM hospices through June 30, 2021, and about 49 percent of these beneficiaries met the model's eligibility criteria (Figure 6). Beneficiaries referred to Cohort 2 hospices were more likely to be eligible than those referred to Cohort 1 hospices (66 versus 42 percent). This finding is likely the result of several factors, including the loosening of eligibility requirements before Cohort 2 started enrolling beneficiaries and improvements in how participating hospices screened beneficiaries. One-third of all enrollees were referred by oncologists, more than 40 percent were referred by specialists in family or internal medicine, and the remainder were referred by other types of providers (Appendix A, Table A.8).

Figure 6. Eligibility status and enrollment decisions among referrals, overall and by cohort*: 65 percent of referred, eligible beneficiaries chose to enroll in MCCM.*



Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: Updated graphic previously reported by Abt Associates in 2020. This figure is based on MCCM program data alone. For some beneficiaries, these data differ from our assessment of eligibility based on Medicare claims and enrollment data; see Appendix A for details.

MCCM = Medicare Care Choices Model; MHB = the Medicare hospice benefit.

Over the 5.5 years of enrollment, 7,263 (65 percent) of all eligible referrals resulted in an MCCM enrollment. That is, about two-thirds of eligible beneficiaries referred to a participating hospice chose to enroll in MCCM. Among the other eligible, referred beneficiaries, 1,971 (18 percent) enrolled directly in the Medicare hospice benefit; 1,479 (13 percent) declined to enroll in either MCCM or hospice; and 381 (3 percent) died before making a choice. Some referred beneficiaries declining MCCM in favor of hospice can be viewed as a positive outcome (see Section 3.5 and Chapter 5).

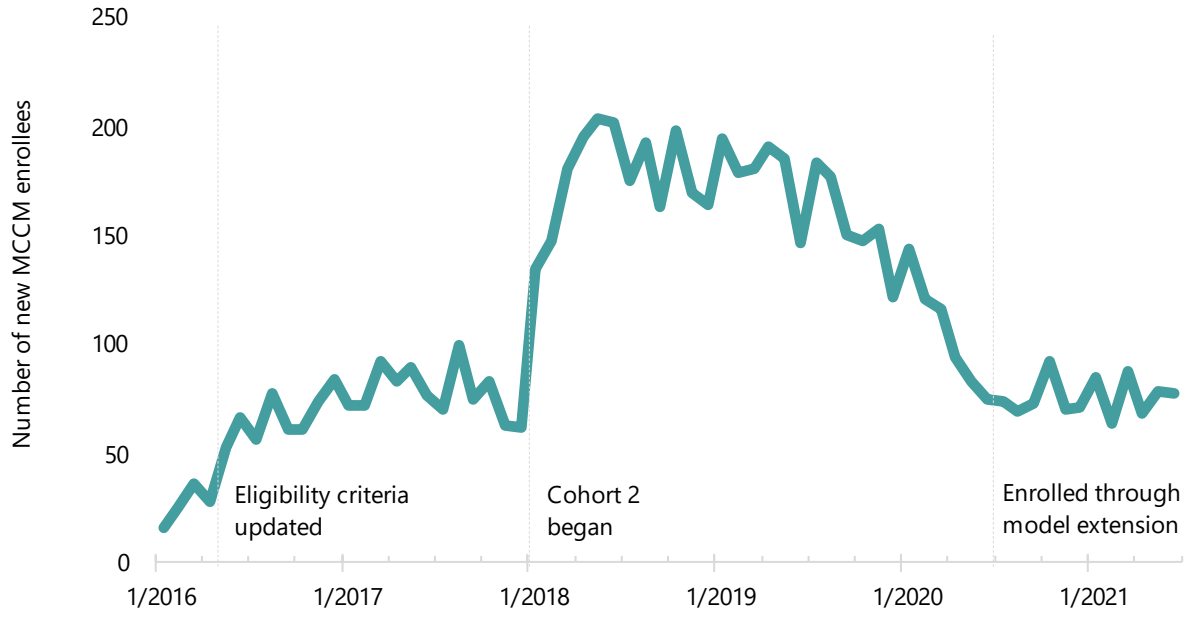
MCCM hospices enrolled only a small fraction of Medicare beneficiaries in the hospice service areas who met the model's eligibility criteria. Less than 1 percent of eligible beneficiaries enrolled in MCCM, according to our analysis for beneficiaries who did not enroll in MCCM but lived in the market areas of the hospices that participate in the model and satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data.[14] With fewer than 8,000 beneficiaries total, or about 110 new enrollees per month on average, enrollment in MCCM was lower than CMS originally anticipated.[15] MCCM also ranks among the smallest of the CMS Innovation Center's models (CMS 2022a). Of course, both the original goals for enrollment and the realized enrollment rate reflect CMS' decision to focus MCCM on a small and very ill beneficiary population, with only four clinical conditions, in fee-for-service Medicare, and less than six months to live (see Chapter 1). It also reflects the number of hospices that participated in the model and the size of their referral networks (see Chapter 2). Total MCCM enrollment could potentially have been higher if CMS had alternatively designed MCCM in ways that made more beneficiaries eligible to enroll in MCCM, encouraged additional organizations to voluntarily participate in the model, or increased referral rates in other ways (for example, broadened the use of best practices discussed later in this chapter).

Monthly enrollment was highest in 2018 and 2019. MCCM averaged 66 new enrollees per month from January 2016 to December 2017; monthly enrollment increased notably after April 2016, when CMS expanded the model's eligibility criteria (Figure 7). Monthly enrollment more than doubled when Cohort 2 hospices joined the model in January 2018, and MCCM averaged about 175 new enrollees per month from January 2018 to December 2019. In all, 4,141 beneficiaries (57 percent of enrollees) enrolled in 2018 or 2019. Monthly enrollment decreased in early 2020 as some hospices exited the model and the COVID-19 pandemic made it more difficult to meet in person with referred

[14] In this chapter, we use the impact analysis's potential comparison group as a benchmark for (1) estimating the number and (2) describing the characteristics of beneficiaries potentially eligible to participate in MCCM. This group consisted of deceased fee-for-service Medicare beneficiaries who lived in the market areas of the hospices that participated in the model, and satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data, but were neither referred to nor enrolled in MCCM. By construction, we start observing these beneficiaries and MCCM enrollees a similar average length of time before death. The following eligibility criteria were not directly observable in CMS administrative data: (1) six-month prognosis, which requires clinical judgment, and (2) residing in a traditional home and not a long-term care or assisted-living facility. The 7,263 MCCM enrollees were 0.37 percent the size of the potential comparison group (N=1,959,525 unique beneficiaries). See Appendix C, Section 2.4, for additional details.

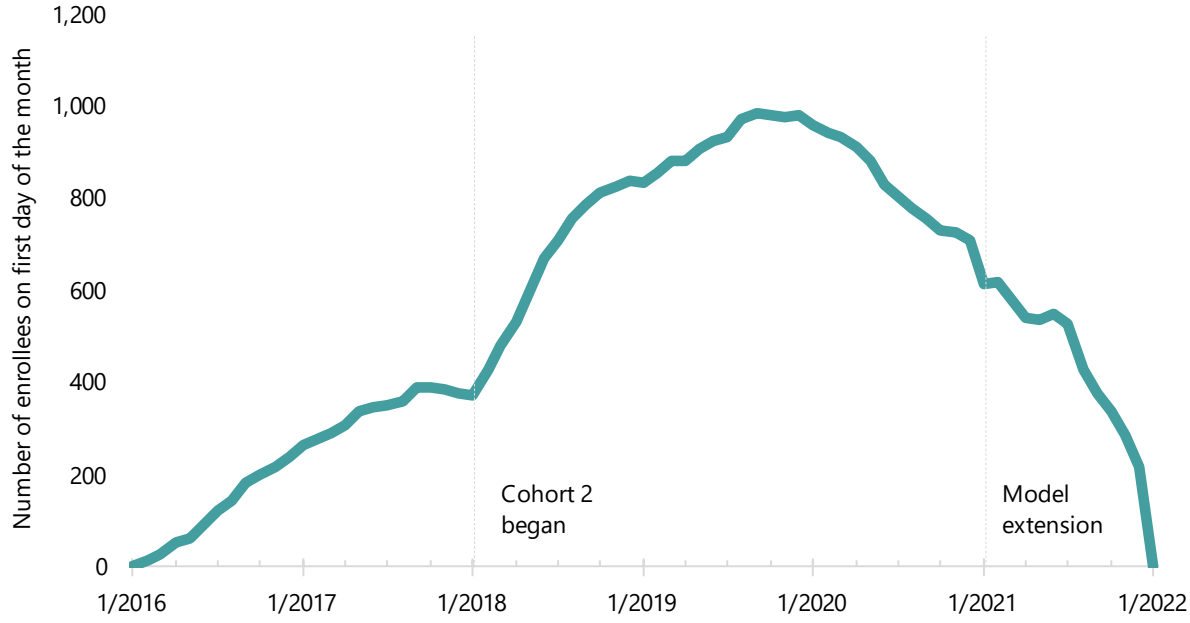
[15] Before the model launched, CMS set a goal to enroll 150,000 eligible Medicare beneficiaries over five years (see Footnote 6 in Chapter 1). Despite the model being extended a sixth year, only 7,263 beneficiaries enrolled in MCCM—4.8 percent of the initial goal for five years.

Figure 7. Number of new MCCM enrollees each month: ***New monthly enrollment varied substantially over the 5.5 years of the model.***



Source: MCCM program data, January 1, 2016 to December 31, 2021.
MCCM = Medicare Care Choices Model.

Figure 8. Number of MCCM enrollees on the first day of each month: ***Enrollment in MCCM was highest in 2019 and 2020.***



Source: MCCM program data, January 1, 2016 to December 31, 2021.
MCCM = Medicare Care Choices Model.

beneficiaries to explain the program's benefits. Specifically, monthly enrollment decreased to about 105 new enrollees per month during the first half of 2020, perhaps in part because potential enrollees were concerned about virus transmission during in-home MCCM encounters. For the last 12 months of enrollment (July 2020 to June 2021), fewer hospices remained in the model (see Chapter 2), and about 75 beneficiaries enrolled per month.[16] Because some enrollees remained in the model for some time, the total number of beneficiaries enrolled in the model on a given day peaked in late 2019 and early 2020 (Figure 8).

The number of enrollees varied widely across hospices, and enrollment was concentrated among a small group of hospices. As mentioned earlier, 89 hospices enrolled at least one beneficiary in MCCM. These hospices averaged 81 beneficiaries each. However, their enrollment varied widely (Table 2). Eight hospices enrolled only one beneficiary, the 25th percentile was 8 enrollees, the median was 31 enrollees, and the maximum was 1,149 enrollees. The five hospices with the most enrollees together accounted for 46 percent of all MCCM enrollees.

Table 2. Distribution of MCCM enrollees across participating hospices: *Just five hospices enrolled 46 percent of all MCCM enrollees.*

Estimate	Quartiles of enrollment				Five hospices with the highest MCCM enrollment	All hospices with at least one enrollee
	Lowest 25%	Lower middle 25%	Upper middle 25%	Highest 25%		
Number of hospices[a]	24	22	21	22	5	89
Number of enrollees						
Range	1 to 8	9 to 30	35 to 75	78 to 1,149	378 to 1,149	1 to 1,149
Average	4	21	51	257	665	81
Subtotal	89	453	1,076	5,645	3,324	7,263
Percentage of total	1%	6%	15%	78%	46%	100%

Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: Of the 141 hospices selected to participate in the model, only 89 enrolled at least one beneficiary in MCCM.

[a] The four quantiles are not equally sized due to ties.

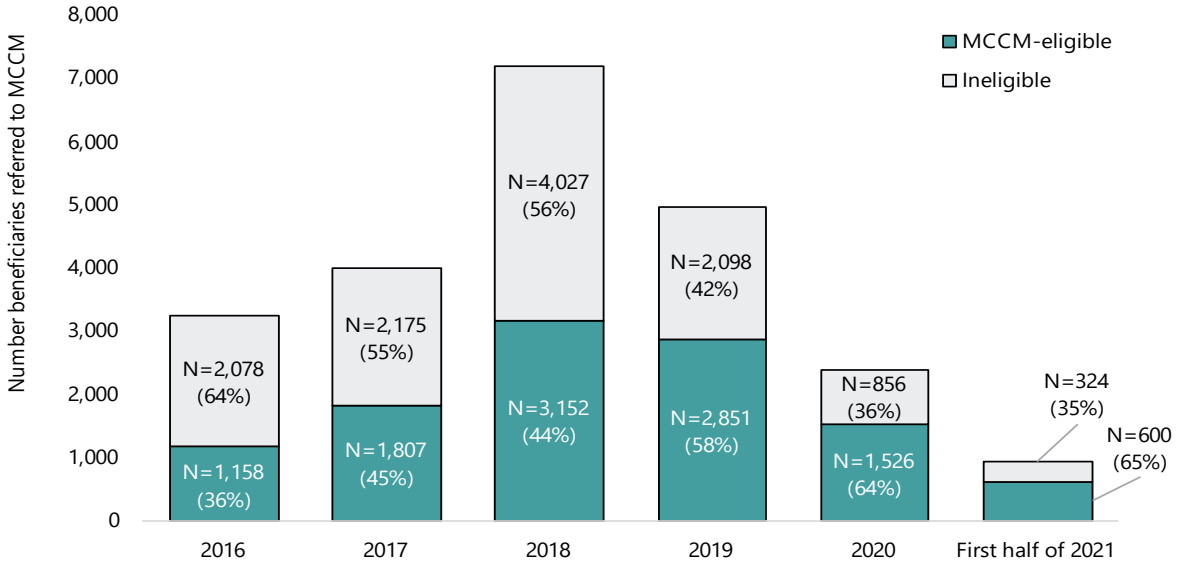
MCCM = Medicare Care Choices Model.

During each consecutive program year, the percentage of referrals who were eligible and the percentage of eligible referrals who enrolled in MCCM increased. According to MCCM program data reported by participating hospices, the *number* of beneficiaries referred to MCCM varied over time, with the highest number in 2018 (Figure 9). That is, monthly referrals peaked in the first year after Cohort 2 hospices began implementing the model. However, the *percentage* of referred beneficiaries who were eligible for MCCM enrollment increased steadily over the model period, from 36 percent in 2016 to 65 percent in early 2021. Further, the share of eligible, referred beneficiaries

[16] CMS did not allow beneficiaries to begin participation in the last six months of the model. The originally planned enrollment cutoff date was June 30, 2020, but CMS changed that date to June 30, 2021 for hospices that participated in the one-year model extension.

who chose to enroll in MCCM increased—from 55 percent in 2016 to 77 percent in early 2021 (Figure 10). Several factors might have driven these trends, including expanded eligibility criteria (beginning in early 2016), the withdrawal of numerous hospices (see Chapter 2), and improvements in how participating hospices screened beneficiary eligibility before referral (see Section 3.2).

Figure 9. Number of eligible and non-eligible referrals to MCCM, by year: *The percentage of referred beneficiaries who were eligible increased over time.*

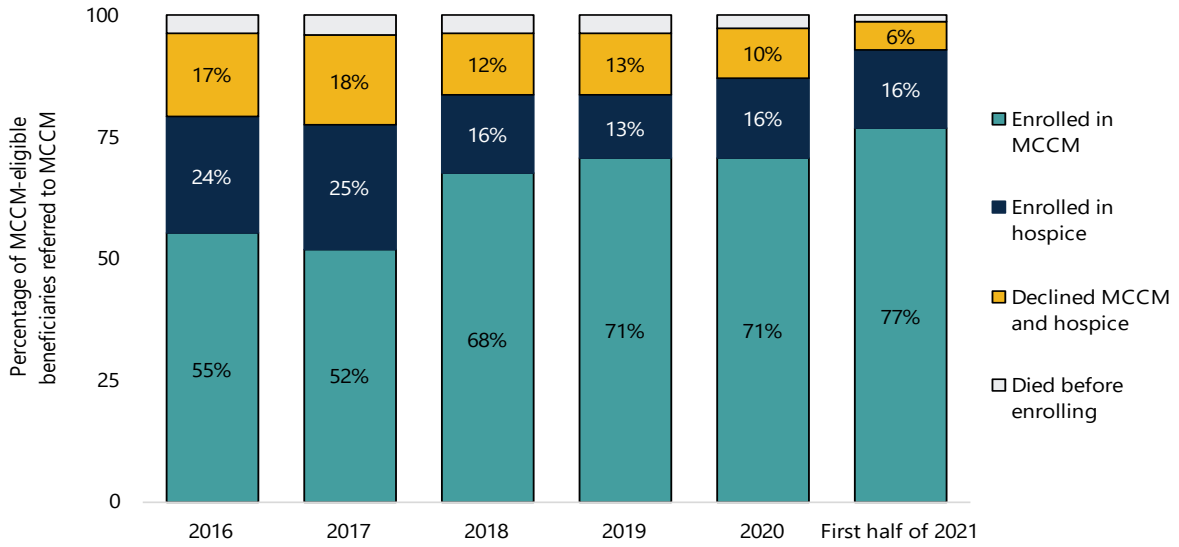


Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: The number of referred beneficiaries could be under-reported if some MCCM hospices submitted MCCM program data for only some of the beneficiaries referred to them.

MCCM = Medicare Care Choices Model.

Figure 10. Enrollment decisions among eligible beneficiaries referred to MCCM, by year: *The percentage of eligible referrals who chose to enroll in MCCM increased over time.*



Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: This figure shows the enrollment decisions for these MCCM-eligible beneficiaries referred to MCCM. Figure 9 presents the denominators for the percentage calculations.

MCCM = Medicare Care Choices Model.

3.2. Effective referral and enrollment strategies

Many participating hospices struggled to obtain referrals and enroll eligible beneficiaries. Hospices had difficulty marketing the model among referring sources, recruiting eligible beneficiaries, and determining eligibility quickly.[17] Barriers to obtaining referrals include challenges explaining the differences between MCCM and a hospice's other service lines to referring providers; general discomfort among referring providers with signing a six-month certificate of terminal illness and referring their patients to end-of-life care; and discouragement among providers because many beneficiaries referred to MCCM ultimately did not meet the model's eligibility criteria.

Exemplar hospices we interviewed identified two strategies for increasing referrals.[18] The hospices identified two strategies to overcome these barriers and increase referrals: (1) educating

[17] The first annual evaluation report (Abt Associates 2018) focused on drivers of referrals and enrollment, among other topics.

[18] We interviewed staff from ten *exemplar* hospices that achieved relatively high performance on various quality metrics. See Appendix B for additional details.

referring providers about the differences between MCCM and other hospice services lines and (2) adopting a "no wrong door" referral policy. Specifically, these hospices focused on providing their existing referral sources with in-person education to explain the unique aspects of MCCM. Even though this education was beneficial, these hospices also requested that providers refer beneficiaries to the hospice generally rather than to a specific service line. This approach alleviated the need for referring providers to remember the model's eligibility criteria and allowed hospice staff to speak with beneficiaries and their families to determine what services and supports they require, and, ultimately, which of the hospice service lines that they qualify for would be most appropriate to meet those needs.

> "[Referring patients who were not eligible] could be significantly disappointing to [referring providers] to the point where they wouldn't want to refer because they're like, "Oh, everyone I send you guys, they don't qualify."
>
> —Staff member at a hospice that chose not to participate in the model extension

Exemplar hospices also identified several strategies for improving enrollment. When beneficiaries were referred, hospices also experienced barriers to enrolling those beneficiaries—often because beneficiaries and their families or caregivers indicated that they were not ready for hospice or palliative care (see Section 3.3). To overcome these barriers, exemplar hospices sent staff experienced in having conversations about enrolling in hospice care to meet with beneficiaries and their families or caregivers soon after a referral was made. During that initial in-person visit, the staff calmly and compassionately discussed the beneficiary's needs and explained how the hospice's service lines (palliative care, MCCM, or hospice) could support those needs. This practice was important to enrolling beneficiaries, because it enabled the staff to establish a personal connection with those individuals and caregivers. Hospice staff would highlight features of MCCM during these conversations, including coverage of their treatments through Medicare Part A and B, round-the-clock access to an on-call nurse, the interdisciplinary team approach, and access to nurse and aide support in the home. If a beneficiary expressed interest in MCCM during the initial visit, these hospices would schedule a follow-up appointment with hospice staff—often a nurse and social worker—to complete a comprehensive assessment and establish a care plan. If a beneficiary indicated that they were not ready to enroll, staff from some exemplar hospices would offer to follow up with the beneficiary by phone to reintroduce the program and discuss whether the beneficiary's needs had changed. Sometimes, this practice resulted in additional beneficiaries deciding to enroll.

3.3. Beneficiaries' considerations for enrollment

About two-thirds of eligible, referred beneficiaries chose to enroll in MCCM, whereas about one-third did not enroll (Figure 6 and Figure 10). As previously reported (Abt Associates 2020a), enrollees (and their caregivers) highlighted several reasons for choosing to enroll in MCCM:

- A discharge planner or other acute or post-acute care provider recommended MCCM, because of an acute change in condition.

- Beneficiary had reached a point in their disease trajectory where they needed extra support in addition to the assistance of their primary caregiver.
- Beneficiary was eligible for, but unwilling to accept, hospice.
- A palliative care provider or specialist recommended MCCM.

Staff from exemplar hospices also acknowledged that beneficiaries who chose to enroll had a fundamentally different attitude or mindset about their condition compared with those who declined. Staff from nearly all exemplar hospices said that most referred and eligible beneficiaries who chose not to enroll in the model were much less willing than those who enrolled to have accepted their terminal prognosis. As a result, they were unwilling to forgo continued aggressive treatment for their illness. Despite efforts to explain to beneficiaries and caregivers that the model allowed enrollees to continue receiving Medicare payments for curative care, staff from these hospices observed that beneficiaries (or their families) who were in denial of their condition *often felt that MCCM was a slippery slope to hospice*. These beneficiaries simply did not want to consider they were dying or to engage in a discussion about palliative or other types of supportive care. Staff noted that this attitude (sometimes expressed as "giving up hope") could reflect beneficiaries' religious beliefs or cultural norms. However, in all cases, it made beneficiaries reluctant to accept their prognosis and consider requesting palliative care and other supports. At least one hospice staff member we interviewed said *some physicians unwittingly reinforce this attitude by refusing to talk with beneficiaries about their end-of-life care needs*.

> "I think a lot of it is the patient's and the family's perception of how poorly or how well they're doing. Some of that perception I think can come from their provider, and … how honest that provider is being with them about how they're doing. You know, some people are just going to be in denial and believe… '[I've] been in the hospital four times over the last two months, but this last hospitalization fixed me, so I don't need anybody coming into my house.'"
>
> —Hospice staff member

The remaining one-third of eligible, referred beneficiaries chose not to enroll in MCCM for several reasons (Table 3), including not being ready for palliative care (49 percent), not wanting care coordination (12 percent), and not wanting hospice staff in their homes (8 percent). Hospice staff also described similar reasons beneficiaries chose not to enroll in MCCM: not wanting people inside their homes; fear of losing their independence, particularly if service providers were to determine that their home environments were unsafe or they were unable to continue taking care of themselves; fear of losing their pets; not believing they needed additional supports; and feeling overwhelmed by the medical system already and not wanting to have to accommodate a new provider or set of services. Staff from exemplar hospices emphasized that these feelings were common among people facing end-of-life decisions and part of their job was to listen to beneficiaries' and caregivers' concerns, build trust, and explain that enrolling in MCCM did not necessarily mean giving up their independence.

Table 3. Reasons for declining MCCM enrollment among eligible beneficiaries who were referred and did not enroll in MCCM or hospice: *Half of eligible beneficiaries who declined enrollment said they were not ready for hospice or palliative care.*

Reason for declining	Eligible beneficiaries who were referred to MCCM but declined to enroll in MCCM or hospice	
	Number	Percentage
Not ready for hospice or palliative care	729	49%
Declined care coordination	181	12%
Declined staff in home	115	8%
Other or unknown	454	31%
Total	**1,479**	**100%**

Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: Of the 22,652 beneficiaries referred to, 11,094 were eligible and among those 1,479 declined to enroll in MCCM or hospice.

MCCM = Medicare Care Choices Model.

3.4. Characteristics of beneficiaries referred to and enrolled in MCCM

Beneficiaries who enrolled in MCCM were a select group, with different characteristics than beneficiaries who met MCCM eligibility criteria and lived in participating hospices' market areas but were not referred to the model (see Footnote 14 in Section 3.1). Non-Hispanic White beneficiaries, beneficiaries who were not dually eligible for Medicaid, beneficiaries living in non-rural areas, and younger beneficiaries were somewhat *over-represented* among MCCM enrollees (Table 4, Column 1 versus Column 3). Specifically, 86 percent of MCCM enrollees were non-Hispanic White (compared with 82 percent of non-referred beneficiaries), 13 percent were dually eligible (compared with 20 percent), 13 percent lived in rural areas (compared with 22 percent), and 43 percent were 80 or older (compared with 51 percent). About 66 percent of MCCM enrollees had cancer, whereas 44 percent of eligible beneficiaries not referred to MCCM had cancer. Conversely, MCCM beneficiaries had lower rates of congestive heart failure and dementia than non-referred beneficiaries (38 versus 50 percent).[19]

MCCM enrollees used more health care services and had higher Medicare expenditures before enrollment than eligible beneficiaries who were not referred, suggesting they had more health care needs (that is, they were sicker). Further, the average hierarchical condition category scores for MCCM enrollees were nearly 20 percent higher (5.4 versus 4.7) than for eligible beneficiaries who were not referred. In the 90 days before enrollment, MCCM enrollees had higher Medicare expenditures ($29,431 versus $25,982), Part B drug expenditures ($4,308 versus $1,431), inpatient admissions (1.0 versus 0.8), outpatient emergency department visits (0.6 versus 0.5), and ambulatory visits with primary care clinicians and specialist physicians (9 versus 6). MCCM enrollees were more

[19] The percentages with chronic obstructive pulmonary disease were relatively similar for the two groups, as were the percentages with kidney disease, diabetes, and dementia.

likely to have had an advance care planning visit in the previous two years, which might have made them more aware of their stage of illness and therefore potentially more willing to enter MCCM.

Overall, enrolled beneficiaries (Table 4, Column 1) resembled beneficiaries referred to MCCM who were eligible but did not enroll (Column 2). However, both groups were different from beneficiaries who were eligible but not referred to MCCM (Column 3). **Thus, many of the differences in beneficiary characteristics between enrollees and non-enrollees emerged in the referral process, rather than from enrollment choices among referred beneficiaries**. This is likely rooted in the types of hospices who participated in the model (see Chapter 2) and their referral networks, among other factors. Among eligible beneficiaries referred to MCCM, the most notable difference between beneficiaries who did and did not choose to enroll in MCCM was that the enrollees had lower Medicare expenditures and a higher average number of days since being discharged from a hospital.

Table 4. Characteristics of MCCM enrollees, referred and eligible beneficiaries, and beneficiaries who satisfied MCCM eligibility criteria but were neither referred nor enrolled: ***MCCM enrollees were more likely to have cancer; had higher prior health care expenditures; and were less likely to be Hispanic and non-White, be dually eligible for Medicaid, or reside in rural areas.***

Beneficiaries' characteristics	Enrolled (N = 7,069)	Referred and eligible but not enrolled (N = 3,485)	Eligible but neither referred nor enrolled[a] (N = 1,959,527)
Demographics			
Average age (years)	77	77	79
Age 80 or older (%)	43	42	51
Female (%)	52	50	50
Race and ethnicity (%)			
Non-Hispanic White	86	84	82
Non-Hispanic Black or African American	8	10	10
Other or unknown	5	6	8
Whether dually eligible for Medicaid (%)	13	13	20
Resides in rural area (%)	13	12	22
MCCM-qualifying diagnosis (%)			
Cancer	66	66	44
Congestive heart failure	38	38	50
Chronic obstructive pulmonary disease	34	34	36
HIV/AIDS	<1	<1	<1
Health status			
Average hierarchical condition category score	5.4	5.6	4.7
Ischemic or unspecified stroke (%)	9.2	8.6	11
Kidney disease (%)	50	52	52
Diabetes with acute or chronic complications (%)	34	33	36
Dementia with or without complication (%)	16	15	24
Cardio-respiratory failure and shock (%)	37	40	34
Acute myocardial infarction (%)	12	14	14

Beneficiaries' characteristics	Enrolled (N = 7,069)	Referred and eligible but not enrolled (N = 3,485)	Eligible but neither referred nor enrolled[a] (N = 1,959,527)
Average Medicare service use in the 90 days before enrollment			
Total Medicare expenditures ($)	29,431	36,004	25,982
Part B drug expenditures ($)	4,308	3,409	1,431
Number of inpatient admissions	1.0	1.3	0.8
Days from most recent inpatient discharge and enrollment[b]	70	46	88
Number of outpatient emergency department visits and observation stays	0.6	0.6	0.5
Number of ambulatory visits with primary care clinicians	4.3	4.0	3.5
Number of ambulatory visits with specialist physicians	4.6	4.0	2.8
Drugs for advanced stage cancer (%)	33	30	13
Advance care planning visit in previous 2 years (%)	21	23	12

Sources: MCCM program data, Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021.

Note: The first two columns are limited to the 7,069 enrollees (97 percent) and 3,485 referred but not enrolled beneficiaries (91 percent) who were linked to Medicare claims and observable in claims for the 12 months before their enrollment or referral.

[a] *Eligible, but neither referred nor enrolled* beneficiaries include 1,959,527 unique beneficiaries from our potential comparison group (23,687,256 observations, with beneficiaries weighted equally). In this chapter, we use the impact analysis's potential comparison group as a benchmark for describing the characteristics of beneficiaries potentially eligible to participate in MCCM. This group consisted of deceased fee-for-service Medicare beneficiaries who lived in the market areas of the hospices that participated in the model and satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data but were neither referred to nor enrolled in MCCM. See Appendix C, Section 2 for additional information about the MCCM enrollees and potential comparison group beneficiaries.

[b] We used a referral date or pseudo-enrollment date for non-MCCM enrollees. See Appendix C, Sections 2 and 3, for additional details. By construction, we start observing potential comparison beneficiaries and MCCM enrollees a similar average length of time before death.

MCCM = Medicare Care Choices Model.

About half of enrollees lived with another person (often a spouse) and needed assistance. MCCM enrollees varied in functional status, availability of a caregiver, and living arrangement (Table 5). Enrollees tended to need assistance: 3 percent were disabled, 23 percent were dependent, and 48 percent required some assistance. About half of enrollees (53 percent) lived with their caregiver. Most enrollees were cared for by a spouse (43 percent) or an immediate family member (26 percent).

Table 5. Characteristics of MCCM enrollees at the time of enrollment: ***Most enrollees lived with another person (often a spouse) and needed assistance or were dependent or disabled.***

Characteristic	MCCM enrollees	
	Number	Percentage
Total beneficiaries	7,263	100
Functional status		
Disabled	237	3
Dependent	1,673	23
Needs some assistance	3,482	48
Independent	1,302	18
Unknown	569	8
Caregiver		
Spouse/partner	3,093	43
Immediate family member (parent, child, or sibling)	1,921	26
Friend or neighbor	607	8
Other relative	163	2
Other	527	7
Unknown	952	13
Living arrangement		
Lives with caregiver	3,873	53
Lives alone	1,550	21
Other	1,334	18
Unknown	506	7
Marital status		
Married	3,643	50
Partner	64	1
Widowed	2,051	28
Divorced	670	9
Never married	421	6
Unknown	414	6

Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: Of the 22,652 beneficiaries referred to MCCM, 11,094 were eligible and among those 7,263 enrolled in MCCM. See Appendix A for additional methodological details and results.

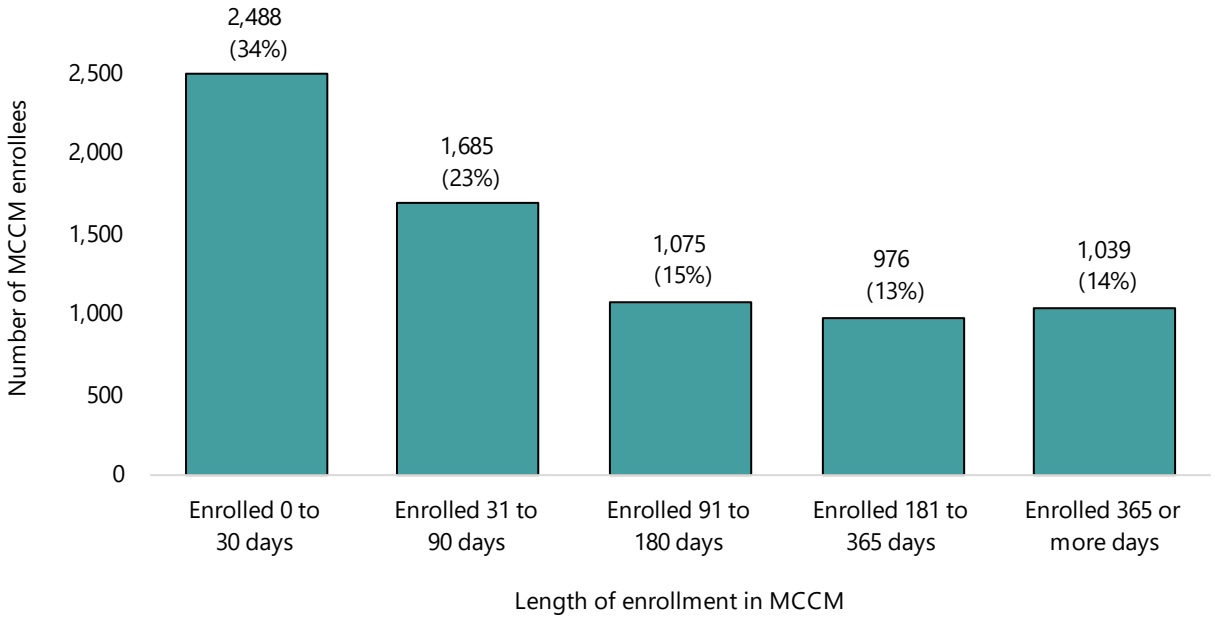
MCCM = Medicare Care Choices Model.

3.5. Length of enrollment

Beneficiaries could remain in MCCM as long as they maintained eligibility.[20] They could choose to disenroll at any point. Importantly, they could voluntarily disenroll from MCCM and elect to receive the Medicare hospice benefit—that is, transition from MCCM to hospice. Beneficiaries could also voluntarily disenroll without choosing hospice, and some were automatically discharged when the model ended in December 2021. (See Chapter 5 for details.)

The length of time spent in MCCM varied widely across enrollees. About one-third of enrollees remained in the model one month or less, while 14 percent were enrolled for more than a year (Figure 11). The median length of enrollment was 64 days (just over 9 weeks), and the mean was 167 days (about 24 weeks). Length of enrollment also varied by beneficiaries' characteristics. For example, the length of enrollment tended to be shorter for beneficiaries with cancer, with lower functional status, whose caregiver was a family member, who enrolled in the last few years of the model, or who were not identified as non-Hispanic White (Figure 12).

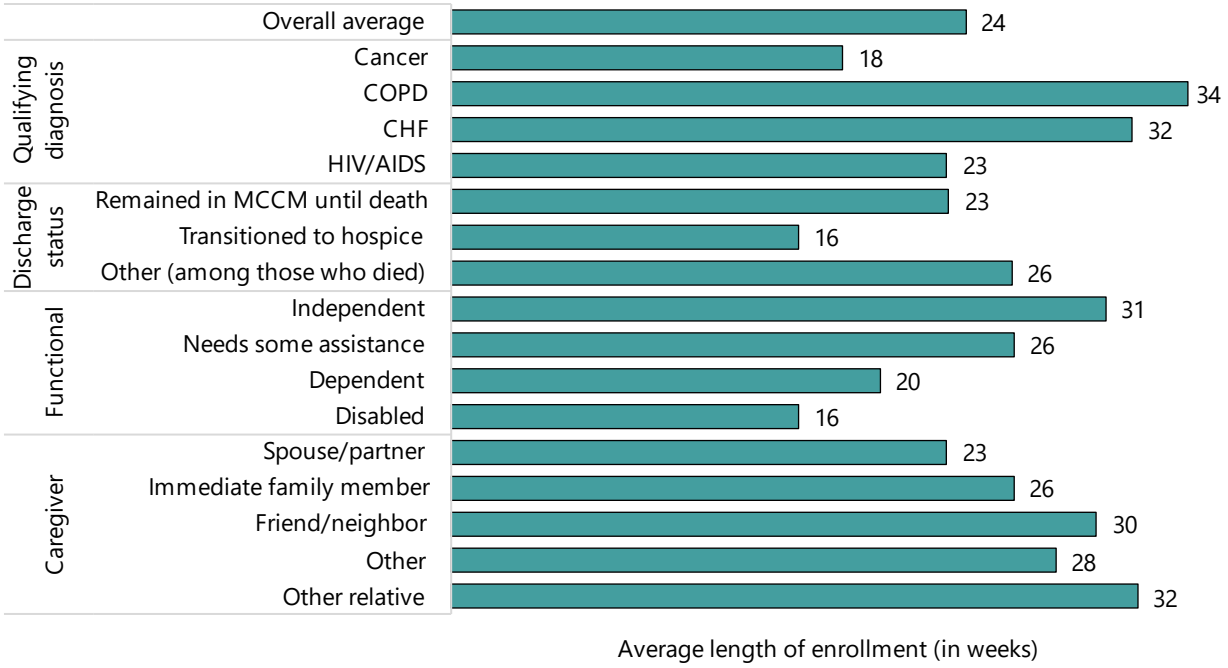
Figure 11. Distribution of length of enrollment in MCCM: ***One-third of beneficiaries were enrolled in MCCM less than one month, and three-quarters were enrolled less than six months.***



Sources: MCCM program data, Medicare Enrollment Database, January 1, 2016, to December 31, 2021.
Note: For additional details, see Chapter 5.
MCCM = Medicare Care Choices Model.

[20] There were circumstances in which enrollees lost eligibility to participate in the model, such as when they had lengthy stays in a nursing home, assisted living facility, hospice inpatient facility, or other institutional setting (other than a hospital). A beneficiary who left the model was not eligible to return to MCCM.

Figure 12. Average length of enrollment, by enrollee characteristic: ***Enrollment tended to be shorter for beneficiaries with cancer or with a lower functional status.***



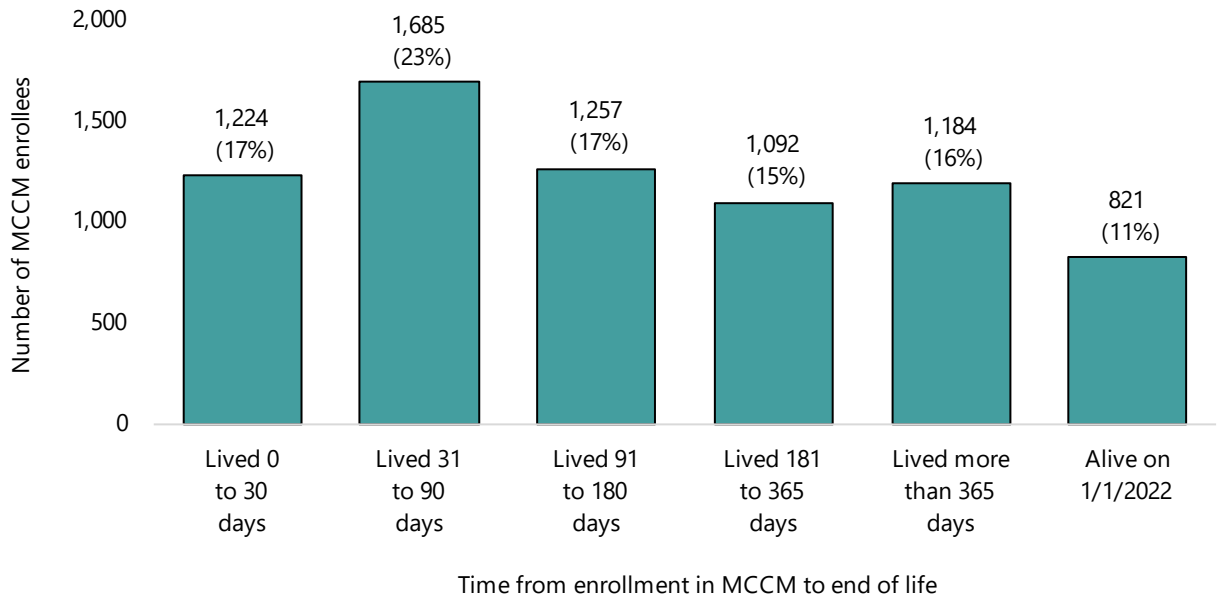
Source: MCCM program data, January 1, 2016 to December 31, 2021.

Notes: For additional details, see Chapter 5 and Appendix A, Section 5.2. See Appendix A for additional methodological details and results.

MCCM = Medicare Care Choices Model.

Length of enrollment in MCCM was driven in part by length of survival—longer enrollment lengths were possible only among those who lived longer—and the number of days from MCCM enrollment to death varied widely among enrollees (Figure 13). The median length of survival was 108 days among beneficiaries who died, and the mean was 209 days. (MCCM enrollees sometimes lived longer than six months, even though their providers had signed six-month certificates of terminal illness.)

Figure 13. Distribution of time from enrollment in MCCM to end of life among enrollees: ***More than half of enrollees lived less than six months, and 16 percent lived longer than one year.***



Sources: MCCM program data, Medicare Enrollment Database, January 1, 2016, to December 31, 2021.

Note: For additional details, see Chapter 5 and Appendix A, Section 5.2.

MCCM = Medicare Care Choices Model.

3.6. Evaluation findings' generalizability

Overall, the results in Chapters 2 and 3 suggest the model attracted a relatively small, nonrepresentative group of hospice participants, and these hospices enrolled relatively few eligible beneficiaries. Furthermore, the enrollees did not have the same characteristics as eligible beneficiaries who were not referred in ways that are observed and potentially unobserved (for example, whether clinicians would have attested to a prognosis of less than six months). This suggests **evaluation findings might not generalize to other hospice settings and populations**. Although the following evaluation results can be interpreted only in the context of this model, they do reflect the outcomes for these beneficiaries and the evaluation can offer important lessons on how CMS can improve end-of-life care for Medicare beneficiaries (see Chapter 9).

4. Services and Quality of Service Delivery under MCCM

Key takeaways

Enrollees received high quality care supportive and palliative care services through MCCM.

- MCCM provided a high-touch intervention, filling an essential need in end-of-life care.
  - Enrollees received about 2.6 encounters per week of enrollment, on average, mostly provided by clinically trained health professionals and often delivered in person and in the beneficiaries' homes.
- MCCM provided a variety of services that hospice staff identified as critical for keeping beneficiaries from seeking care in an emergency department and preventing hospitalizations.
- MCCM hospices achieved high-quality service delivery across many domains. Hospices almost universally performed well on these measures.
- Beneficiaries and their caregivers reported high levels of satisfaction with shared decision making, receiving care consistent with their wishes, and quality of life.
- Several MCCM hospices we interviewed identified having a pre-existing palliative care program and a "no wrong door" referral policy as critical to the success of their programs' implementation.
- CMS paid participating hospices $16.7 million for providing MCCM services, which averaged about $2,551 per enrollee, or $77 per encounter. Some hospices, including some of those that withdrew from the model, believed reimbursements were inadequate.

This chapter provides an overview of the frequency and types of MCCM encounters and services that participating hospices delivered, the overall quality of service delivery, and the variation in care by hospice type, based on a review of MCCM program data from January 2016 through December 2021 (see Appendix A). It also presents findings on caregivers' satisfaction with the model based on the Caregiver Experience of Care Survey conducted by the previous evaluation contractor and the factors associated with successful implementation based on previous evaluation reports and interviews with 10 hospices that achieved relatively high rates of performance on various quality metrics. (These 10 hospices are called *exemplar* hospices below. See Appendix B for details.)

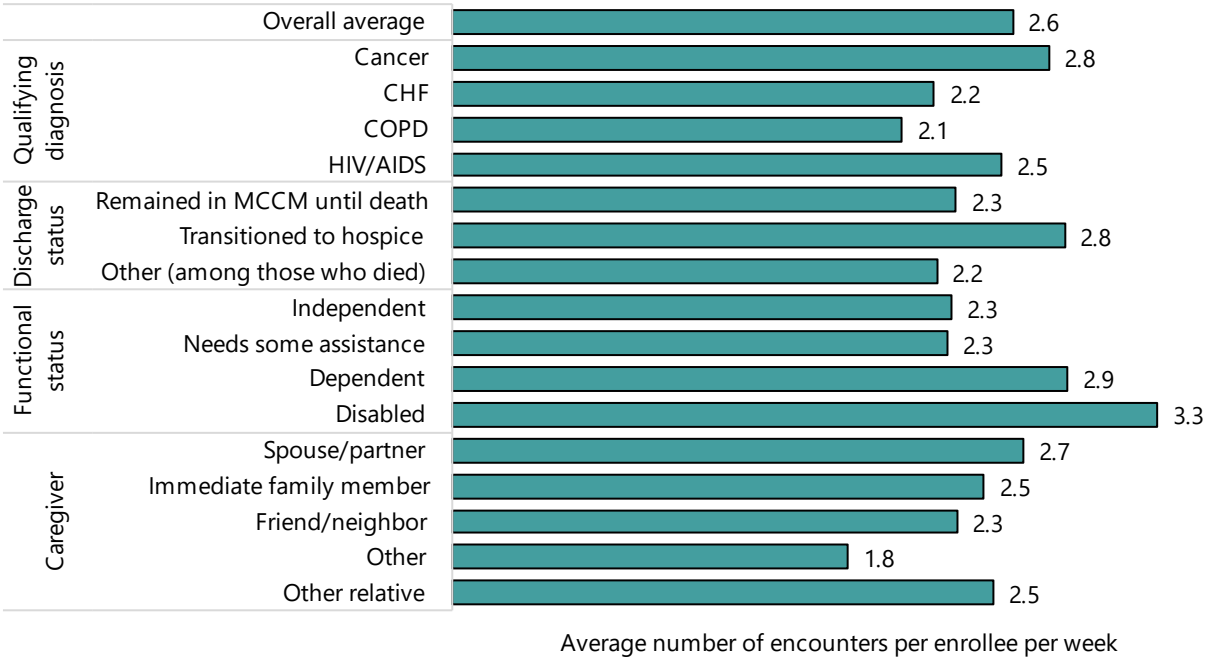
4.1. Frequency and types of MCCM encounters

MCCM represented a high-touch intervention, addressing an important need in end-of-life care for MCCM enrollees. CMS designed MCCM for Medicare beneficiaries who wanted to continue receiving curative treatment for their terminal illnesses, and who therefore would not have qualified for Medicare's hospice benefit. Thus, MCCM opened an avenue for certain Medicare beneficiaries to receive services and supports (palliative care) they would not have received through fee-for-service Medicare. MCCM hospices provided 217,156 encounters to enrollees over six years. Monthly encounters largely tracked trends in enrollment (see Chapter 3), increasing steadily in the first few

years, peaking in late 2019, and declining as the COVID-19 pandemic set in and hospices withdrew from the model (Appendix A, Figure A.4).[21]

On average, each MCCM enrollee received 30 encounters with a hospice staff member while enrolled in the model, representing 2.6 encounters per week. Average intensity—measured as the number of encounters per week—varied across beneficiaries with different characteristics (Figure 14). For example, MCCM enrollees with cancer had more encounters per week than those with other diagnoses, and beneficiaries who transitioned to hospice had more encounters per week than others. Beneficiaries with lower functional status or whose caregiver was a family member also had more encounters per week than those with higher functional status and without a family caregiver.

Figure 14. Average number of encounters per enrollee per week, by enrollee characteristic: ***Enrollees had nearly three encounters with hospice staff per week on average while enrolled in MCCM.***



Source: MCCM program data, January 1, 2016, to December 31, 2021.

Note: Encounters represent a documented action between an individual provider and an enrolled beneficiary or caregiver. Most encounters included multiple services delivered by a member of the hospice staff. The number of encounters reported in this chapter excludes interdisciplinary group meetings, which did not involve beneficiaries. See Appendix A for additional methodological details and results (Table A.16).

MCCM = Medicare Care Choices Model.

However, differences in the intensity of encounters stemmed partly from the varied lengths of MCCM enrollment. MCCM encounters were provided most frequently in the first few months of enrollment, then tapered off for all beneficiaries. For example, MCCM enrollees averaged nearly 7 visits per

[21] In Appendix E, Section 5.5, we estimate how impacts of MCCM varied between beneficiaries enrolled in MCCM before the COVID-19 pandemic and those enrolled during the pandemic.

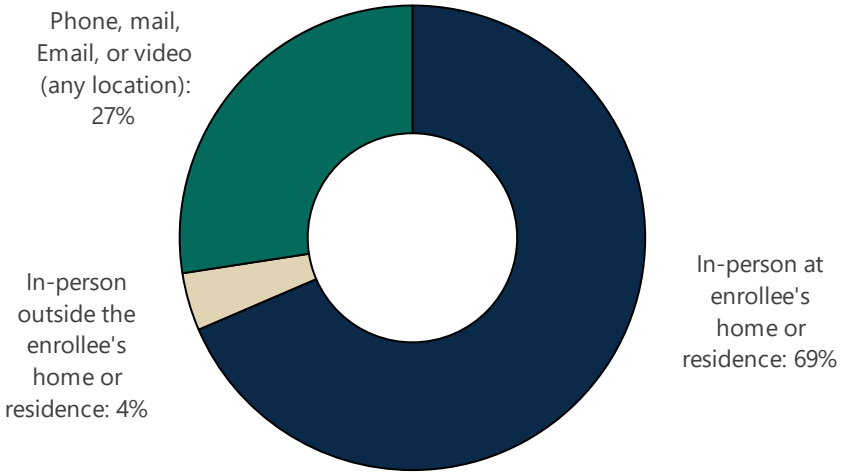
month during their first month of enrollment and 4.5 visits per month during their sixth month of enrollment (Appendix A, Table A.17). As a result, groups of beneficiaries with shorter enrollment (and lengths of survival) appear to have received more intensive services on average than beneficiaries with longer enrollments. In any given week after enrollment, there were only minor differences in service intensity across enrollee subgroups (Appendix A, Figure A.5 and Table A.17). This finding suggests that *the principal driver of intensity of services was length of enrollment rather than beneficiaries' qualifying conditions (for example, cancer) and other characteristics*.

A review of the types of encounters provided under MCCM suggests that, in addition to being a high-touch intervention, the model filled an essential role in end-of-life care for MCCM enrollees.

- First, *clinically trained staff provided* most MCCM services. Nearly 30 percent of all MCCM encounters were delivered by an MCCM registered nurse care coordinator, and another one-half of all MCCM encounters were provided by a hospice nurse or nurse aide (Appendix A, Table A.18). This finding indicates that intervention services focused on clinical care needs that, according to interviews with hospice staff, might have resulted in emergency care or hospitalizations, if unaddressed.[22]
- Second, almost three-quarters of encounters *occurred in person*, and nearly all enrollees had at least one encounter in person (Figure 15). During interviews, hospice staff emphasized the importance of in-person visits to directly observe and monitor changes in a beneficiary's needs and supports. About 27 percent of all encounters were conducted by telephone, mail, email, or video rather than in person. The COVID-19 pandemic was associated with a decline in the percentage of encounters that took place in person, from 76 percent of encounters before March 2020 to 65 percent of encounters in March 2020 and later (Appendix A, Table A.19).
- Third, nearly 70 percent of all encounters *were in-person visits that took place in enrollees' homes or residences* (Figure 15). Hospice staff highlighted the importance of visiting beneficiaries in their homes to address mobility issues, assess risks to their health and safety (such as falls), identify the extent of family and caregiver supports, provide education on self-care and management, and monitor symptoms and identify potential warning signs in the person's typical environment. Several hospices acknowledged that some of these benefits can be provided through telehealth, but telehealth encounters are not a substitute for directly observing and interacting with beneficiaries in their homes.

[22] Interviews with hospices indicated there were two common approaches to staffing MCCM: (1) using existing hospice staff, who were typically organized geographically, to serve MCCM enrollees; and (2) using a dedicated MCCM team.

Figure 15. Delivery mode and place of service for MCCM encounters (2018 through 2021): *More than 90 percent of all encounters took place in enrollees' homes or residences.*



Source: MCCM program data, January 1, 2018, to December 31, 2021.

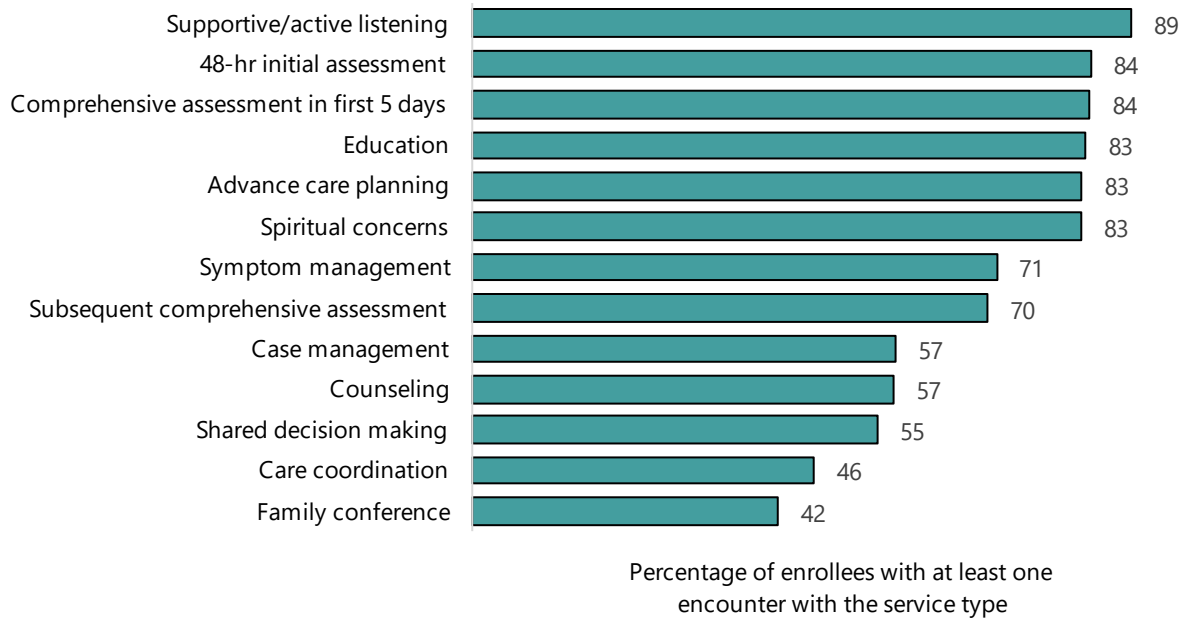
Note: CMS updated the MCCM program data collection protocol on January 1, 2018, limiting the comparability of services delivered before and after that date. Therefore, the data in this figure were restricted to encounters on or after January 1, 2018 for 5,685 MCCM enrollees who enrolled on or after January 1, 2018 who had at least one encounter. See Appendix A, Table A.18 for additional details.

MCCM = Medicare Care Choices Model.

4.2. Frequency and types of MCCM services

Hospice staff provided a range of clinical and non-clinical services during MCCM encounters. More than one service could be provided during an encounter, and we found MCCM enrollees received a range of clinical and non-clinical services during their MCCM encounters. These services included supportive and active listening, initial and subsequent comprehensive assessments, beneficiary and caregiver education, symptom management, case management, care coordination, and discussions about advance care planning and spiritual concerns (Figure 16).

Figure 16. Percentage of enrollees receiving each type of service through MCCM (2018 through 2021): *Most enrollees received multiple services that, combined, offset the need for emergency care or hospitalization.*



Source: MCCM program data, January 1, 2018, to December 31, 2021.

Note: CMS updated the MCCM program data collection protocol on January 1, 2018, limiting the comparability of services delivered before and after that date. Therefore, the data in this figure were restricted to encounters on or after January 1, 2018 for 5,685 MCCM enrollees who enrolled on or after January 1, 2018 who had at least one encounter. See Appendix A, Table A.20, for additional details on services provided through MCCM.

MCCM = Medicare Care Choices Model.

Preventing acute health care. Hospice staff we interviewed identified five interrelated MCCM services they believed were critical for keeping beneficiaries from seeking care in the emergency department and preventing hospitalizations:

1. Early and frequent assessment of needs, so beneficiaries and their care teams understand the beneficiaries' medical issues and how to care for them when symptoms arise
2. Direct observation of beneficiaries in their homes to identify risks, assess level of personal support, identify health-related social needs of which beneficiaries' regular doctors might not be aware, and educate beneficiaries and caregivers on proper self-care
3. Immediate responses to beneficiaries' medical complaints (such as diarrhea, rash, pain, reaction to medication, and shortness of breath) before early symptoms become more serious
4. Round-the-clock telephone access to nursing staff for symptom and care management
5. Communication and coordination of care with primary care physicians and specialists, including requesting changes in medications or scheduling appointments

Gaining enrollees' trust. Several hospices we interviewed also emphasized that successfully managing symptoms in beneficiaries' homes, in a way that keeps them out of the hospital, depends on (1) gaining beneficiaries' trust through supportive and active listening; (2) engaging beneficiaries and caregivers in ongoing education about how to manage their health, including developing a care plan so caregivers understand what to do when symptoms arise; and (3) having an interdisciplinary team of trained nurses and social workers who can help address beneficiaries' medical and nonmedical social needs. Hospice staff stressed that beneficiaries and caregivers need to trust the medical judgment of the hospice nurse. Without that trust, beneficiaries will continue to seek care in an emergency department when their primary care physician is not available.

Someone to call. Finally, although staff at several hospices we interviewed said MCCM was not as effective as hospice care at keeping beneficiaries out of the hospital, because hospice provides more extensive services, they all agreed that MCCM gave enrollees someone to call when they had medical concerns after hours, rather than visiting an urgent care facility or a hospital emergency department. It also helped them better manage symptoms, so a nurse could address problems at home before they became major issues requiring acute care. Staff said MCCM did not eliminate the need for all acute services, but it was helpful with some symptoms that could be handled at home.

4.3. Quality of MCCM service delivery

MCCM hospices achieved high-quality of service delivery based on a range of performance metrics related to: (1) screening and symptom management, (2) health and health-related social need assessments, (3) interdisciplinary group meetings, (4) advance care planning and spiritual counseling, and (5) gaps in care.[23]

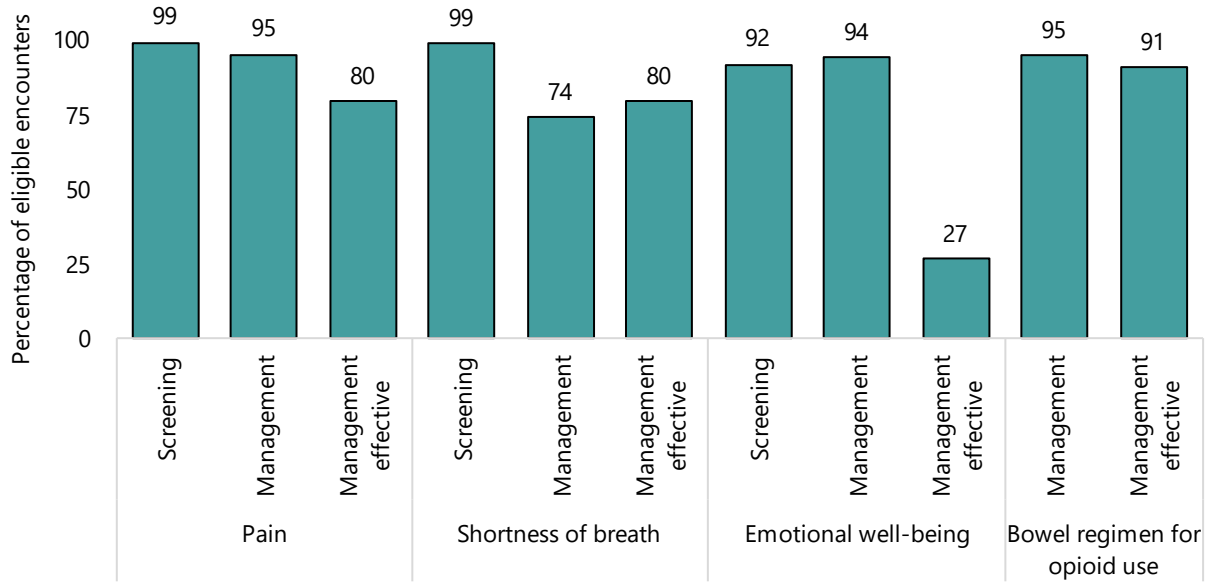
First, hospices achieved generally high rates of symptom screening and management, important components of end-of-life care plans. Providers documented symptoms that could worsen and lead to emergency care or hospitalization, if unaddressed; treatment initiated when appropriate; and treatment effectiveness. More than 92 percent of eligible encounters included a screening and symptom management activity for pain, shortness of breath, and psychological and emotional well-being (Figure 17).[24] Hospices reported that, among enrollees with symptoms of pain or shortness of breath, symptom management was effective for nearly 80 percent of eligible encounters. In addition,

[23] Our analysis of MCCM program data submitted by participating hospices from 2016 through 2021 is consistent with the findings from previous evaluation reports, which used less complete data but found hospices delivered high-quality services (Abt Associates 2018, 2020a, 2020b).

[24] Hospices were expected to screen enrollees and provide symptom management services during each eligible encounter (for example, those delivered in person and by a medical staff member). As a result, screenings and symptom management rates were calculated over eligible encounters rather than individual beneficiaries. About 71 percent of *all* enrollees had one or more encounters with symptom management (Figure 16).

nearly 95 percent of encounters for enrollees on opioids included managing a bowel regimen, and the regimens were effective for 90 percent of the time.[25]

Figure 17. Percentage of eligible encounters for which screening and symptom management care occurred (2018 to 2021): *More than 90 percent of enrollees were screened and received symptom management for pain, shortness of breath, and emotional well-being.*



Source: MCCM program data, January 1, 2018, to December 31, 2021.

Note: CMS updated the MCCM program data collection protocol on January 1, 2018, limiting the comparability of services delivered before and after that date. Therefore, the data in this figure were restricted to encounters on or after January 1, 2018 for 5,685 MCCM enrollees who enrolled on or after January 1, 2018 who had at least one encounter. See Appendix A, Section 4.2 for the measures' definitions and Appendix A, Table A.21, for the denominator size for each measure.

Second, hospices achieved a high assessment completion rate overall. Comprehensive assessments are important for identifying and monitoring enrollees' health and health-related social needs and to tailor individual care plans to those needs. CMS expected hospices to conduct an initial assessment within 48 hours of enrollment, and a first comprehensive assessment within five days of enrollment and twice per month thereafter.[26] Nearly 85 percent of all enrollees received an initial assessment

[25] The relatively small number of enrollees eligible for symptom management, together with the challenges of collecting treatment follow-up data among terminally ill beneficiaries, likely result in an undercount of those whose symptoms were managed effectively. This is particularly true for emotional well-being, for which the data show a 27 percent management effectiveness rate. Only 3,218 of nearly 170,000 encounters (less than 2 percent) were eligible for symptom management for emotional well-being, making it difficult to obtain a robust estimate of management effectiveness for this symptom.

[26] CMS' guidance for participating hospices stated that the number and frequency of the services provided is based on the beneficiary's patient-centered goals and the individualized plan of care (CMS 2020a). However, a plan of care based on a comprehensive assessment would be reviewed (and revised, if needed) no more than every 15 calendar days.

within 48 hours of enrollment, and a similar percentage received a comprehensive assessment within five days (Figure 16). In addition, 70 percent received at least one subsequent comprehensive assessment. In total, hospices documented that 92 percent of all expected subsequent comprehensive assessments were provided.

Third, hospices held at least one interdisciplinary group meeting for most enrollees who were enrolled for more than one month. CMS expected interdisciplinary teams of hospice staff to review and, if needed, revise enrollee's end-of-life care plans as beneficiary and family needs changed or every 15 calendar days, whichever came first (CMS 2020a). Specifically, hospices were required to designate a registered nurse as a member of the interdisciplinary group to coordinate care and ensure continuous assessment and implementation of the plan of care. Hospices held at least one interdisciplinary group meeting for more than 90 percent of beneficiaries who were enrolled in the model for more than one month and, on average, the first interdisciplinary group meeting occurred about two weeks after enrollment.[27]

Fourth, MCCM hospices attempted to engage enrollees and caregivers in discussions about advance care planning and spiritual or religious concerns. These discussions covered end-of-life care goals and treatment preferences, transitioning to hospice, and identifying a health care agent to make treatment decisions on behalf of the beneficiary when needed. MCCM hospices conducted advance care planning discussions with enrollees in nearly 80 percent of encounters eligible for these discussions. In about three-quarters of eligible encounters among enrollees, hospice staff attempted to discuss spiritual or religious concerns (Appendix A, Table A.4 and Table A.20). Over 80 percent of all enrollees had at least one encounter where they received advance care planning or discussed spiritual or religious concerns (Figure 16).[28]

Finally, MCCM hospices succeeded in providing timely and consistent care to most MCCM enrollees. Nearly one-third of all enrollees received weekly encounters, and more than half of enrollees received biweekly encounters.[29] In addition, 12 percent of enrollees had a gap in care of more than 30 days. Enrollees diagnosed with cancer and those whose functional status was listed as disabled or dependent were slightly more likely to have weekly or biweekly visits compared with other enrollees.

[27] We restricted this analysis to enrollees who were enrolled after January 1, 2018, and remained enrolled at least 30 days.

[28] Some MCCM enrollees might not have been enrolled in MCCM long enough to meaningfully engage in a discussion with hospice staff about their advance care and spiritual concerns, while others may have been either too sick to receive them or believed they did not want or need them.

[29] Specifically, 32 percent of enrollees received at least one encounter every 7 days, and 58 percent received at least one every 14 days. See Appendix A, Table A.22, for details. This analysis was limited to services in the first 6 months of enrollment and excluded interdisciplinary group meetings because only providers participate in these meetings; meetings do not entail an encounter between a provider an enrollee or caregiver.

4.4. Variation in the quality of service delivery across participating hospices

Hospices almost universally performed well on CMS-defined quality of service delivery measures. The quality of service delivery appeared similar for MCCM hospices by ownership statuses (for profit, nonprofit, and government-owned); size (based on number of hospice enrollees); geographic region; facility type (freestanding versus facility-based); and affiliation (chain-affiliated versus independent).[30] Nor were there discernible differences in quality of service delivery between hospices with a pre-existing MCCM-like program and those offering palliative care services. The generally high performance on most quality-of-care measures available in the MCCM program data makes it difficult to identify meaningful differences.

4.5. Beneficiaries' experience of care with MCCM

Enrollees and their caregivers, particularly those who subsequently entered hospice, reported high levels of satisfaction with the services they received under MCCM.[31]

4.5.1. Shared decision making

Shared decision making is a process through which individuals and their care team work together to develop a plan of care that centers on the beneficiary's experiences and values while reflecting clinical evidence (National Learning Consortium 2013). *Among MCCM enrollees who transitioned to hospice, 9 out 10 caregivers reported that the enrollee decided to transition to hospice at the right time and free of any pressure from the MCCM or hospice team.* Most MCCM enrollees who did not transition to hospice before they died had caregivers who reported that the enrollee preferred not to make this transition, they died too soon to enter hospice, or they or their family did not perceive the need for additional services through the Medicare hospice benefit. Although most MCCM enrollees eventually transitioned to hospice, these caregiver survey findings suggest that MCCM promoted shared decision making that prioritized the beneficiary's preferences for receiving care, achieving one of the goals of the model.

[30] We compared these (self-reported) quality of service delivery measures across different types of MCCM hospices, but did not find notable differences (Appendix A, Table A.23 and Table A.24).

[31] This section discusses two types of primary data sources collected by the previous evaluation contractor: (1) 78 interviews with MCCM enrollees and caregivers from 2017 to 2019 and (2) a caregiver experience of care survey. The Caregiver Experience of Care Survey was a mailed survey supplement to the Consumer Assessment of Healthcare Providers and Systems Hospice Survey. It was sent to caregivers of beneficiaries who died between October 2017 and March 2020 and received care from MCCM hospices or a selection of comparison hospices. The overall response rate was 50 percent, ranging from 36 percent for MCCM-only caregivers to 54 percent for caregivers of MCCM enrollees who transitioned to hospice. Results of the survey were based on an analysis of 3,242 completed surveys across the four sampled groups: 963 respondents received MCCM and Medicare hospice benefits; 161 were only in MCCM; 1,078 were in hospice (but not MCCM) at MCCM hospices; and 1,040 were in hospice at a matched comparison hospice. Appendix H of the third annual evaluation report (Abt Associates 2020b) explains the survey content, sampling frame, and analytic approach.

4.5.2. Care consistent with enrollees' preferences

Across the board, caregivers of MCCM enrollees reported that the care they received from MCCM hospices was respectful and consistent with the wishes of the MCCM enrollee. *Among caregivers of MCCM enrollees who transitioned to hospice, 88 percent reported care consistent with enrollees' preferences, and nearly all (97 percent) reported that the staff from the MCCM hospice provided care that respected enrollees' wishes.*

> "Both MCCM and hospice are very helpful and very upfront with helping us with his condition. Everyone at both levels we were in contact with was professional and compassionate."
>
> —Caregiver of MCCM enrollee

4.5.3. Quality of life

Among MCCM enrollees who transitioned to hospice, the mean quality-of-life rating was an 8.6 out of 10.[32] This rating is consistent with the mean quality-of-life ratings among beneficiaries enrolled in the Medicare hospice benefit both at MCCM and at comparison hospices. Among the small subset of MCCM enrollees who did not transition to hospice, the mean rating was a 7.1 out of 10. Within this group of MCCM enrollees who did not transition to hospice, the mean rating was slightly higher (7.3 out of 10) for those who received care under the model for more than 30 days and lower (6.2 out of 10) for enrollees who received care for 30 or fewer days.

> "MCCM gave her the support she needed while still getting treated for her cancer. It helped her have a better quality of life for the time she had left, until she made the decision about full hospice."
>
> —Caregiver of MCCM enrollee

4.5.4. Experiences of care in MCCM and hospice

Among MCCM enrollees who did not transition to hospice, caregivers reported room for improving the care experience with regard to symptom management, training caregivers to care for beneficiaries at home, and timeliness of care.[33] Among MCCM enrollees who did not transition to hospice:

> "My specialists look at only one thing, but my MCCM nurse looks at the whole picture. [MCCM] services have enabled me to stay ahead of the pain."
>
> —MCCM enrollee

- 56 percent of caregivers reported that the enrollee "always" or "definitely" got help needed for pain and symptoms;

[32] The caregiver survey asked respondents to provide a quality-of-life rating on a 10-point scale, where higher scores indicate higher quality.

[33] There were 161 completed surveys from caregivers of MCCM enrollees who did not transition to hospice. This group represents 14 percent of all survey responses.

- 57 percent reported that they "definitely" got the training needed to care for the enrollee at home; and
- 63 percent reported that they "always" received timely care.

Reported care experiences were lower for MCCM enrollees who did not transition to hospice who received care from the top decile of highest-enrolling MCCM hospices compared with all other MCCM hospices. For example, among caregivers of MCCM enrollees who did not transition to hospice:

- 56 percent of caregivers of MCCM-only enrollees from the highest-enrollment hospices reported that the beneficiary "always" got timely help compared with 70 percent in all other MCCM hospices; and
- 47 percent of caregivers of these enrollees from the highest-enrollment hospices reported that the beneficiary "always" or "definitely" got help for pain and symptoms compared with 65 percent in all other MCCM hospices.

The hospices in the top decile of enrollment had similar performance to other MCCM hospices on the measures from the Consumer Assessment of Healthcare Providers and Systems Hospice Survey, suggesting these differences might be driven by differences in how they structured the programs they delivered under MCCM.[34]

The evaluation did not find differences in reported experiences of care across enrollees with the four MCCM-qualifying diagnoses.

4.6. Factors associated with implementation performance

Hospice staff identified six factors as important to their program's implementation success:

1. **Drawing on experiences with pre-existing palliative care programs.** Many exemplar hospices indicated they had a pre-existing palliative care program.[35] These hospices were able to use their staff and services from these existing programs when implementing MCCM, because their staff viewed MCCM as being more similar to palliative care than hospice. Having these programs meant hospice staff was familiar with palliative care models and experienced having conversations with beneficiaries and caregivers about palliative care and how it differs from hospice.
2. **Conducting staff training on MCCM.** Many exemplar hospices provided training on MCCM to all staff, regardless of whether those staff members would be primarily responsible for caring for MCCM enrollees. They adopted this approach knowing that most staff members could encounter an MCCM enrollee and caregiver while they were on call during nights or weekends. As a result,

[34] The Consumer Assessment of Healthcare Providers and Systems, or CAHPS, Hospice Survey instrument covers the following domains: communication with family, getting timely help, treating patient with respect, emotional and spiritual support, help for pain and symptoms, training family to care for patient, rating of hospice, and willingness to recommend this hospice. The Caregiver Experience of Care Survey added MCCM-specific questions to the Consumer Assessment of Healthcare Providers and Systems (CAHPS) Hospice Survey, making it easy to compare the standardized CAHPS Hospice Survey measures across MCCM and non-MCCM hospices.

[35] Among 71 MCCM hospices that responded to an organizational survey, 55 percent and 65 percent of hospices operated or were affiliated with a community-based or hospital-based palliative care programs, respectively, and 45 percent had experience with pre-hospice or bridge programs (Appendix A, Table A.5).

it was important for all staff to understand the MCCM care delivery model. Several exemplar hospices also prepared written fact sheets that described the differences between the hospice service lines and the MCCM care delivery model for staff to reference while providing care.

3. **Using existing hospice marketing and training infrastructure.** Staff from exemplar hospices shared that being able to use the hospices' pre-existing marketing and training infrastructure and resources enabled them to efficiently inform potential referral sources about MCCM and educate staff about the model and its requirements.
4. **Using revenue from other service lines and funding streams to help cover MCCM costs.** As previously noted, a primary reason hospices reported for discontinuing their participation in MCCM was that the per beneficiary per month payments were insufficient to cover the costs of caring for MCCM enrollees. Staff from exemplar hospices reported that they were able to use revenue from other existing service lines and funding streams (including charitable donations) to compensate for those financial losses. Several hospices also said they made up the losses incurred when caring for beneficiaries enrolled in MCCM after they transitioned to higher-rate hospice-level care.
5. **Educating existing referral sources in person about MCCM and its benefits.** Exemplar hospices generally provided in-person education to providers who care for beneficiaries who could benefit from MCCM, focusing on their existing referral sources. These hospices also developed marketing materials and other information sheets that described the difference between MCCM and other service lines. Some exemplar hospices also developed case studies to demonstrate the types of services and supports they could provide to MCCM enrollees.
6. **Adopting a "no wrong door" policy** by asking referring providers to refer beneficiaries to the hospice generally, rather than to a specific services line. As discussed in Chapter 3, although exemplar hospices generally educated referring providers about MCCM, they also communicated to those providers that it was preferable for them to refer beneficiaries to the hospices generally rather than to a specific service line. This simplified the referral process and meant referring providers did not have to remember specific eligibility criteria for different services. Instead, the hospice staff could speak with referred beneficiaries and their families to determine the service lines that best fit their needs and whether they met specified eligibility criteria.

> "After that initial introduction of the information, if the referring physician just knows that [hospice organization] has a variety of programs that can be beneficial and provide value added services to their patients, then they can just kind of refer to us, and we can figure out what program may be most appropriate"
>
> —Staff from exemplar hospice

The 10 exemplar hospices we interviewed tended to be larger, and larger hospices are more likely than small hospices to have infrastructure, such as marketing teams and pre-existing palliative care programs, to support the implementation of MCCM. Larger hospices might also be more likely to have other funding sources that they could use to cover the costs of MCCM.

4.7. MCCM payments to participating hospices

CMS paid $16.7 million to 81 participating hospices for providing MCCM services (Exhibit 3). This figure represents the sum of all per beneficiary per month MCCM payments in Medicare claims data for 6,559 enrollees. On average, the 81 hospices that received MCCM payments each received $206,566 through the model.[36] This corresponds to about $2,551 per beneficiary, or $395 per beneficiary per month and $13 per day.[37] Dividing the total payments by the number of MCCM encounters reported in MCCM program data, we estimate an average payment of $77 per MCCM encounter. As previously noted, there was wide variation in the number of enrollees across participating hospices. The top 5 hospices with the most enrollees received 48 percent of all MCCM payments, while the 27 hospices with fewer than 25 enrollees received less than 5 percent of total payments under the model. Hospices with low, medium, and high enrollment received similar payments per beneficiary, per beneficiary per month, and per encounter.

Exhibit 3. Payments to participating hospices for providing MCCM services

- Total payments ..... $ 16,731,828
- Average payments
  - per hospice ..... $ 206,566
  - per enrollee ..... $ 2,551
  - per enrollee per month ..... $ 395
  - per encounter ..... $ 77

Some hospices noted that the MCCM reimbursement rate was insufficient to cover the costs associated with MCCM, including care delivery and administrative costs, such as start-up and training costs and inputting program data (Abt Associates 2018, 2020a, 2020b). However, some hospices said they considered MCCM a "loss leader," with revenue generated by additional (and sooner) hospice enrollments helping offset the costs of operating the model (Abt Associates 2020b). As discussed in Chapter 2, the financial impact of participating in MCCM was a key reason that many hospices chose to withdraw from the model. Hospices described data entry as time-intensive and an unexpected cost associated with the model. Hospices said they either absorbed these additional costs directly or through a larger health system or funded them through charity funds and donations.

Nevertheless, hospices could control their costs, and therefore profitability, under the fixed per beneficiary per month (capitated) reimbursement design, because CMS gave them flexibility in determining the quantity, types, and quality of MCCM services they provided. That is, CMS did not set an explicit requirement for hospices to provide a certain number or intensity of MCCM encounters to all enrollees.[38] When comparing MCCM payment rates with those paid under the Medicare home health and hospice benefits, we found the following:

[36] There were 81 MCCM hospices that received any MCCM payments. Appendix A, Table A.25, includes additional details about MCCM payments.

[37] The $395 average payments per beneficiary per month were less than $400 due to Medicare sequestration (see Footnote 4).

[38] According to CMS' MCCM Request for Applications (CMS 2014), hospices had a series of intake requirements for new MCCM enrollees, and a requirement to conduct reassessments and conduct interdisciplinary group meetings biweekly to update care plans. In addition, CMS mandated certain services to be available round-the-clock.

- At $395 per beneficiary per month ($13 per day or $77 per encounter), average MCCM payments were lower than 2020 average Medicare payment amounts for either home health care services per month or hospice services per day. Average Medicare payment amounts for home health care services were $2,047 per 30-day episode ($68 per day or $180 per visit) for freestanding agencies in 2020, whereas per diem rates for providing routine home care hospice services were $203, for the first 60 days of an episode and $161 thereafter (Medicare Payment Advisory Commission 2022).[39]
- The 2.6 encounters per enrollee per week, or roughly 10 per month, that MCCM enrollees received (see Section 4.1) was more than the 6.6 in-person therapy visits per 30-day period typically provided through home health care services, but fewer than the 3.5 in-person visits per week received by hospice beneficiaries, on average (Medicare Payment Advisory Commission 2022).

[39] In home health, there were 6.6 in-person therapy visits per 30-day period for periods with at least one in-person therapy visit on average in 2020 (Medicare Payment Advisory Commission 2022). In 2019, the average was 7.6 visits per month.

5. Transitions from MCCM to the Medicare Hospice Benefit and Model Discharge

Key takeaways

- MCCM served as a stepping stone to the Medicare hospice benefit for many enrollees:
  - After spending time in MCCM, about two-thirds of enrollees (voluntarily) transitioned directly from MCCM to hospice.
  - Only 13 percent of MCCM enrollees remained in MCCM until their death.
- MCCM enrollees decided to transition to hospice when their conditions deteriorated and their care needs increased.
- Helping enrollees to transition to hospice sooner required ongoing discussions about end-of-life care.

Enrollment in MCCM was voluntary, and beneficiaries could exit at any time, as we discussed previously (Chapter 3, Section 3.5). This chapter describes enrolled beneficiaries' experiences as they transitioned out of MCCM.[40] It focuses on the most common discharge status: transitions from MCCM to hospice.

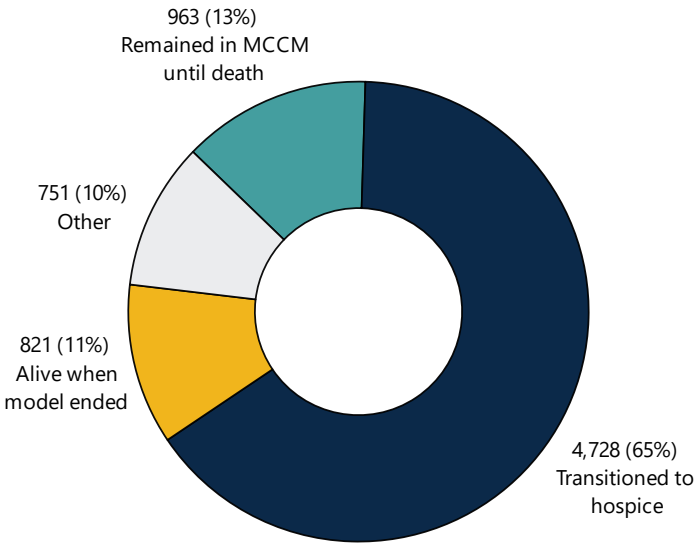
5.1. Model discharge status

Model enrollees were discharged under a variety of circumstances, and discharge status was related to both length of enrollment and survival times (time from enrollment in MCCM until death). By definition, transitioning out of MCCM reduced the length of time a beneficiary spent in MCCM. Survival times also drove length of enrollment in MCCM, because long enrollments were possible among only those who lived longer. Changes in terminally ill beneficiaries' care needs might also have contributed to decisions to transition.

About two-thirds (65 percent) of MCCM enrollees transitioned from MCCM and immediately entered hospice (Figure 18). These Medicare beneficiaries spent an average of 113 days in MCCM, with a median of 45 days (Table 6). About two-thirds of the beneficiaries who transitioned to hospice were enrolled in MCCM for fewer than 90 days, and 8 percent were enrolled in MCCM for more than one year before they transitioned. More than two-thirds of beneficiaries who transitioned from MCCM to hospice (69 percent) survived for less than 6 months after they enrolled in MCCM, but 15 percent lived for more than one year.

[40] Primary sources for this chapter are MCCM program data (see Appendix A), interviews with exemplar hospices (see Appendix B), and the second annual MCCM evaluation report (Abt Associates 2020a).

Figure 18. Discharge status among MCCM enrollees: ***Most MCCM enrollees transitioned from MCCM to hospice before they died.***



Sources: MCCM program data, January 1, 2016, to December 31, 2021.

Note: Discharge status is based on MCCM program data. See footnotes to Table 6 for details.

MCCM = Medicare Care Choices Model.

The one-third of enrollees who did not transition directly to hospice fell into one of three groups:

1. **About 13 percent of MCCM enrollees remained in MCCM until their death**. These beneficiaries spent more time on average in MCCM than those who transitioned directly to hospice (161 versus 113 days). About 14 percent were enrolled in MCCM for over one year. However, those who remained enrolled in MCCM until their death had similar survival times as those who transitioned directly to hospice (173 versus 181 days).
2. **About 10 percent of enrollees exited MCCM for reasons other than transitioning directly to hospice or dying.** The reasons for these discharges included beneficiaries requesting to disenroll from the model, moving out of the hospice service area, or losing MCCM eligibility. These exiting enrollees spent a relatively small fraction their days alive in MCCM (183 out of 436 days, or 42 percent, on average, compared with 62 percent of days among those who transitioned from MCCM to hospice).
3. **About 11 percent of MCCM enrollees were still alive when MCCM ended on December 31, 2021.** We analyzed these beneficiaries separately in Table 6 because we cannot know whether they were voluntarily discharged from the model—whether to hospice or elsewhere—or the discharges happened as hospices winded down their MCCM programs and (2) we do not know how long these beneficiaries survived after the model ended.[41] The MCCM enrollees who were

[41] Among the 821 MCCM enrollees who remained alive when the model ended, only about 20 percent immediately entered hospice after being discharged from MCCM (Appendix A, Table A.3). In Medicare claims

alive when the model ended spent the longest length of time in MCCM compared with the other groups, with a mean enrollment in MCCM of more than one year (472 days) and a median of almost one year (359 days).

Table 6. Length of MCCM enrollment and time from enrollment in MCCM to end of life among enrollees, overall and by discharge status: ***MCCM enrollees who transitioned directly to hospice spent fewer days enrolled in MCCM than those who remained in MCCM until their death, those who were alive when the model ended, and those who exited for other reasons.***

Measure	Discharge status				Total (all MCCM enrollees)
	Remained in MCCM until death[a]	Transitioned to hospice[a]	Alive when model ended	Other[a,b]	
Sample size					
Number of enrollees	963	4,728	821	751	7,263
Percentage of enrollees	13%	65%	11%	10%	100%
Length of MCCM enrollment					
Mean number of days	161	113	472	183	167
Median number of days	66	45	359	99	64
Maximum number of days	1,567	1,858	1,959	1,710	1,959
Number (and percentage) of beneficiaries:					
Enrolled 0 to 30 days	321 (33%)	1,929 (41%)	39 (5%)	200 (27%)	2,488 (34%)
Enrolled 31 to 90 days	233 (24%)	1,219 (26%)	83 (10%)	150 (20%)	1,685 (23%)
Enrolled 91 to 180 days	151 (16%)	671 (14%)	98 (12%)	155 (21%)	1,075 (15%)
Enrolled 181 to 365 days	126 (13%)	531 (11%)	195 (24%)	124 (17%)	976 (13%)
Enrolled 365 or more days	132 (14%)	379 (8%)	406 (49%)	122 (16%)	1,039 (14%)
Time from enrollment to end of life (survival time)					
Mean number of days[a]	173	181	n.a.	436	209
Median number of days[a]	78	98	n.a.	337	108
Maximum number of days[a]	1,570	1,923	n.a.	1,899	1,923
Number (and percentage) of beneficiaries:					
Lived 0 to 30 days	286 (30%)	902 (19%)	n.a.	36 (5%)	1,224 (17%)
Lived 31 to 90 days	234 (24%)	1,363 (29%)	n.a.	88 (12%)	1,685 (23%)
Lived 91 to 180 days	168 (17%)	987 (21%)	n.a.	102 (14%)	1,257 (17%)
Lived 181 to 365 days	132 (14%)	786 (17%)	n.a.	174 (23%)	1,092 (15%)
Lived 365 or more days	143 (15%)	690 (15%)	n.a.	351 (47%)	1,184 (16%)
Did not die before January 1, 2022	0	0	821 (100%)	0	821 (11%)

Sources: MCCM program data, January 1, 2016 to December 31, 2021, and MCCM enrollment data (for date of death).

Note: Discharge status is based on MCCM program data, and beneficiaries' use of hospice reported in this data source does not necessarily align with Medicare claims data. Percentages may not sum to 100 percent due to rounding.

[a] Does not include beneficiaries who were alive on January 1, 2022, after the model ended.

[b] This category includes beneficiaries who (1) voluntarily withdrew from MCCM, (2) moved out of hospice service area, (3) lived outside the home for more than 90 days, (4) transferred to another MCCM hospice, (4) were discharged for cause, and (5) unspecified reasons (besides enrolling in hospice or dying).

MCCM = Medicare Care Choices Model.

data, about 25 percent of these beneficiaries had a hospice claim on or before December 31, 2021 (Appendix A, Table A.10).

We take these results as evidence that **MCCM served as a stepping stone to the Medicare hospice benefit** for most enrollees. Although *all* enrolled beneficiaries initially chose MCCM (over hospice), most of them decided later that hospice was better for them and transitioned out of MCCM. More than half the transitions to hospice occurred within three months of MCCM enrollment. However, some transitions to hospice occurred much later, when beneficiaries' conditions could have worsened. On the other hand, a relatively small number of enrollees (13 percent) remained in MCCM, with the option of receiving treatments for their terminal condition, up until the time of death. However, the relatively low percentage of MCCM enrollees who remained in the model until death suggests that most enrollees ultimately recognized the benefit of receiving end-of-life care through hospice (compared to remaining in MCCM).

5.2. Helping beneficiaries transition from MCCM to hospice

MCCM provided supportive and palliative care to beneficiaries nearing the end of life, allowing them to continue to receive Medicare payment for treatment for their terminal illnesses. The previous section showed MCCM worked as a stepping stone to hospice. This section focuses on how participating hospices helped enrollees transition out of MCCM and into hospice and examines how services changed after the transition.

Caregivers of MCCM enrollees indicated that MCCM enrollees typically decided to transition to the Medicare hospice benefit when their care needs increased. Specifically, MCCM enrollees would decide to transition when their condition declined or their disease progressed; when they needed more care than MCCM could provide, such as medication management; when medical treatment was no longer working, resulting in the beneficiary being willing to stop that treatment; or when medical providers recommended that the beneficiary switch to hospice (Abt Associates 2020b).

The most important strategy identified by hospice staff for supporting MCCM enrollees in considering whether to transition to the Medicare hospice benefit was having ongoing conversations with those enrollees about their care goals and the additional services and supports the hospice could provide under the Medicare hospice benefit to help meet their needs. Hospice staff sometimes began having these conversations during their first visit with a beneficiary and emphasized these discussions when certain events occurred, such as when an MCCM enrollee experienced a pain crisis, was hospitalized, experienced increasing care needs or symptom burden, or experienced a decline in health.

When speaking with beneficiaries about transitioning from MCCM to the hospice benefit, staff from exemplar hospices emphasized that the hospice benefit provides beneficiaries with durable medical equipment, medications, and more hands-on care to keep them out of the hospital.[42] Staff from some exemplar hospices felt that being able to have ongoing discussions about the benefits of hospice while providing MCCM services resulted in more beneficiaries entering hospice sooner than they would have without regular contact. Referring providers agreed that the model encouraged

[42] *Exemplar hospices* are the 10 hospices we interviewed because they achieved relatively high rates of performance on various quality metrics. See Appendix B for details.

eventual transitions to hospice, and that the transition to hospice was smoother for having been in MCCM first.

The intensity of encounters increased when beneficiaries transitioned from MCCM to hospice. For MCCM enrollees who transitioned from MCCM to hospice, we compared the number of encounters received (1) per beneficiary and (2) per beneficiary per week during periods they were in MCCM (before the transition) and in hospice (after the transition) in Table 7. The numbers of encounters under MCCM and the hospice benefit are not directly comparable because MCCM portal data contain the number of discrete encounters whereas hospices bill Medicare in 15-minute increments when providing services under the hospice benefit. Therefore, we could not count the number of discrete encounters provided under the hospice benefit. On average, beneficiaries had fewer than 3 discrete encounters per week while enrolled in MCCM but received 74 encounters per week of 15 minutes each after they transitioned to hospice. Even though the length of MCCM encounters varied, and some encounters were longer than 15 minutes, this finding suggests average service intensity was considerably higher when beneficiaries were in hospice compared with when they were in MCCM—even when considering the limitations of this analysis.[43] Beneficiaries were also more likely to have at least one encounter with the hospice physician once they entered hospice. (By design, MCCM enrollees would often receive care from other physicians, who submitted separate Medicare claims.) In all, this analysis supports the hypothesis that MCCM enrollees decided to transition from MCCM to hospice to receive higher-intensity services or different types of services.

To ensure a smooth transition from MCCM to the Medicare hospice benefit, exemplar hospices ensured that the beneficiary maintained the same care team or facilitated a warm handoff between MCCM staff and hospice staff caring for the beneficiary. Staff from hospices where beneficiaries maintain the same care team felt that maintaining continuity with the team that the beneficiary and caregiver trusted ensured a smooth transition to hospice. Most of these hospices either had staff who worked across all service lines or had their hospice staff care for MCCM enrollees. Hospices that used a warm handoff between MCCM and hospice staff introduced the beneficiary to a new care team when they transitioned to the Medicare hospice benefit but ensured the MCCM care team informed the hospice team about the beneficiary's needs and other relevant background. In some cases, the MCCM team also combined visits with the hospice team. These hospices typically had palliative care staff care for MCCM enrollees.

[43] The average MCCM encounter would need to last over 6 hours for 2.9 MCCM encounters per week to equal the intensity of 74 (15-minute) hospice encounters per week. Such long MCCM encounters are implausible.

Table 7. Average frequency of MCCM and hospice encounters for beneficiaries who transitioned from MCCM to hospice: ***The intensity of encounters was substantially higher after transitioning to hospice compared with before (in MCCM).***

Measure	Average per enrollee	Average per enrollee per week	Percentage of enrollees with at least one
MCCM encounters			
Number of discrete encounters	22.9	2.9	100%
Number of encounters by provider type:[a]			
Hospice physician	0.02	< 0.01	1%
Nurse, registered nurse care coordinator, or licensed practical nurse	10.1	1.4	83%
Social worker	3.4	0.5	68%
Home health hospice aide or nurse aide	4.5	0.2	23%
Other	1.2	0.2	33%
Medicare payments	$ 1,850	$ 253	--
Hospice encounters			
Number of 15-minute encounters[b]	207.6	73.9	100%
Number of 15-minute encounters by provider type:[a,b]			
Hospice physician	1.5	0.6	33%
Nurse, registered nurse care coordinator, or licensed practical nurse	102.8	36.6	96%
Social worker	23.9	11.7	93%
Home health hospice aide or nurse aide	79.5	25.0	72%
Medicare payments	$ 10,558	$ 2,148	--

Sources: MCCM program data linked with Medicare claims and enrollment data, January 1, 2016, to December 31, 2021.

Note: The analyses in this table were limited to 4,551 MCCM enrollees (with encounters for MCCM services and payments for MCCM services) who transitioned to hospice before death (with paid claims for hospice services).

[a] Each MCCM or hospice encounter is associated with a single provider type in In MCCM portal data and claims, respectively. However, multiple encounters could be recorded on a single day (having the same or different provider types).

[b] In Medicare claims, hospice services are billed in 15-minute increments. Beneficiaries may have multiple encounters per day, and hospices may bill a single encounter lasting more than 15 minutes as multiple service items. For example, a visit that lasts 35 minutes would be counted as three encounters. Because hospice encounters are measured in 15-minute increments while MCCM encounters are counted independent of duration, the two table panels are not directly comparable.

MCCM = Medicare Care Choices Model.

6. Effects of MCCM on Beneficiary Outcomes

Key takeaways

Patterns in beneficiaries' outcomes between enrollment and death indicate that MCCM produced its intended effects. Notable findings include the following:

- MCCM decreased net Medicare expenditures (Medicare Part A and B expenditures plus model payments) by $7,604 per beneficiary, on average, relative to the matched comparison group—a 13 percent net decrease.
  - Decreases in inpatient expenditures (38 percent) primarily drove the difference.
  - MCCM generated net savings of $39.2 million among enrollees in our analysis population.
- MCCM decreased acute health care service use. Inpatient hospitalizations decreased by 26 percent, days spent in an intensive care unit decreased by 38 percent, and outpatient emergency department visits and observation stays decreased by 12 percent.
- MCCM enrollees were 18 percentage points more likely to use the Medicare hospice benefit than comparison beneficiaries (83 versus 65 percent) and spent more than twice as many days in hospice.
  - Increased use of hospice accounted for about half of the reduction in Medicare Part A and B expenditures.
- MCCM enrollees were more likely to receive better-quality of end-of-life care. For example, they were 15 percentage points less likely to receive an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life (61 versus 76 percent) and they spent an additional 5.5 days at home before death (183 days versus 178 days).

MCCM tested whether offering eligible beneficiaries the option to receive supportive and palliative care services without forgoing payment for treatment of their terminal conditions would improve their quality of life and care, lead to earlier use of the Medicare hospice benefit, or reduce Medicare expenditures. This chapter evaluates impacts of the model on these beneficiary outcomes.

We estimated impacts for 5,153 Medicare beneficiaries who enrolled in the model on or before June 30, 2021 (the last date of enrollment); died on or before December 31, 2021 (the end of the model); and satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data. We measured outcomes using claims through December 31, 2021, and estimated impacts of the model by comparing outcomes for enrolled MCCM beneficiaries with regression-adjusted outcomes for a matched comparison group of deceased fee-for-service Medicare beneficiaries who (1) lived in the market area of a hospice participating in MCCM; (2) were not referred to or enrolled in MCCM; (3) satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data; and (4) resembled MCCM enrollees in terms of demographics, health conditions, prior experience of care,

and other observed characteristics. We assigned pseudo-enrollment dates to the comparison beneficiaries, so the distribution of survival times (number of days until death) and other characteristics were similar for MCCM and matched comparison beneficiaries. We designed this comparison group to show what would have happened to beneficiaries' outcomes for the period from enrollment to death had they not enrolled in MCCM and, thus, received usual care (possibly receiving hospice care).

Appendix C provides additional details about our analytic approach and describes how we defined the analytic population for the analyses, identified the matched comparison group, and estimated impacts using regression modeling. Appendix D includes additional details about our analytic file construction, and Appendix E provides supplementary results.

6.1. Effects on Medicare expenditures

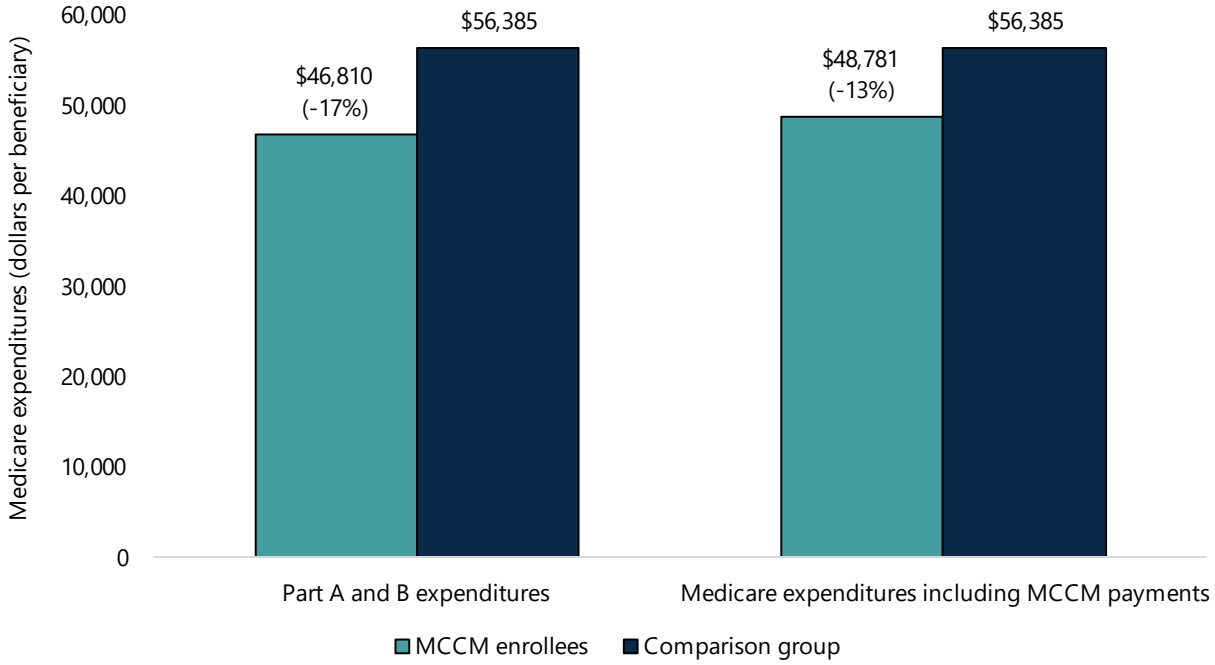
MCCM enrollees had lower Medicare expenditures than the comparison group. Medicare Part A and B expenditures were $46,810 for MCCM enrollees and $56,385 in the comparison group (Figure 19); that is, expenditures decreased by $9,576, or 17 percent, for enrollees. After accounting for the payments made to the hospices for MCCM services ($1,971 on average, or about 4 percent of total expenditures), we found MCCM enrollees' expenditures were $7,604 (13 percent) lower on net per enrollee. Total expenditures including model payments were $48,781, on average, for MCCM enrollees.

Another way to understand the magnitude of the estimates in Figure 19 is that a $9,576 decrease in Medicare Part A and B expenditures *per beneficiary* corresponds to a decrease of $1,914 *for each month* CMS paid a hospice for providing MCCM services to an enrollee.[44] This reduction in Medicare Part A and B expenditures is substantially larger than the $400 per month CMS paid to participating hospices, leading to a net reduction in expenditures.[45]

[44] The estimated $1,914 reduction per beneficiary-month in MCCM is the estimated impact on Medicare Part A and B expenditures per beneficiary ($9,576) divided by the average number of months per beneficiary that hospices received payments for (5.0 months, the average among enrollees in this analysis). The 90 percent confidence interval is $1,646 to $2,182.

[45] Our definition of MCCM payments does not capture some costs incurred by CMS for designing, implementing, and monitoring the model. In addition, our analyses do not capture potential effects on either Part D expenditures or non-claims payments for other CMS Innovation Center models.

Figure 19. Average Medicare expenditures for deceased MCCM enrollees and matched comparison beneficiaries: *MCCM enrollees had lower Medicare expenditures, even when accounting for model payments.*



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

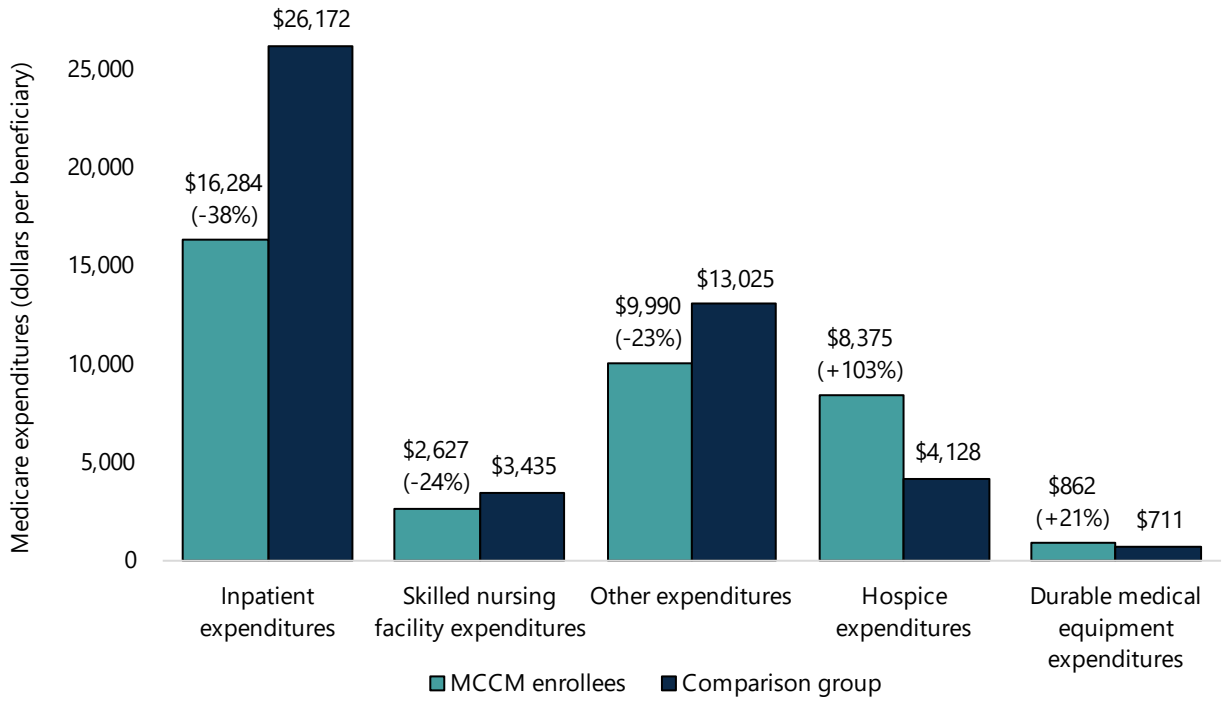
Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting). Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. Impacts estimates for Medicare expenditures were statistically significant at the $p < 0.01$ level. See Appendix E, Table E.1, for full impact analysis results for these outcome measures.

MCCM = Medicare Care Choices Model.

Reductions in inpatient expenditures drove the overall decrease in Medicare expenditures despite higher hospice expenditures among MCCM enrollees. MCCM enrollees' average inpatient expenditures were $16,284 compared with $26,172 in the comparison group—a reduction of $9,887, or 38 percent (Figure 20). Skilled nursing facility expenditures were also lower among beneficiaries enrolled in MCCM by $808, or 24 percent, and we estimated that the model reduced the category of "other expenditures" by $3,035, or 23 percent. Other expenditures include outpatient emergency department visits, ambulatory care visits, and other medically necessary services, which totaled $9,990, on average, among MCCM enrollees and $13,025 for the comparison group. In contrast, Medicare expenditures for hospice and durable medical equipment were *higher* among MCCM enrollees by $4,248 (103 percent) and $151 (21 percent), respectively. Average hospice expenditures were $8,375, and average durable medical equipment expenditures were $862 among MCCM

enrollees. (We discuss the model's impacts on health care service and hospice use in more detail in Sections 6.2 and 6.3, respectively.)

Figure 20. Average Medicare expenditures, by type of health care service, for deceased MCCM enrollees and matched comparison beneficiaries: *MCCM enrollees had lower inpatient, skilled nursing facility, and other expenditures and higher hospice and durable medical equipment expenditures.*



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting). Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. Impacts estimates for Medicare expenditures were statistically significant at the $p < 0.01$ level. See Appendix E, Table E.1, for full impact analysis results for these outcome measures.

MCCM = Medicare Care Choices Model.

Enrollment in MCCM was intended for Medicare beneficiaries with a prognosis of six months or less, but as noted in Chapter 3, Section 3.5, survival times differed substantially across enrollees. Because survival time affected total expenditures, it also likely affects the model's estimated impacts on expenditures. To assess how MCCM affected expenditures independent of survival time, we estimated impacts on Medicare expenditures *per day* by dividing total expenditures by the number of days that elapsed between enrollment and death.[46] We estimated daily Medicare Part A and B

[46] In Chapter 7, Section 7.1, we report estimated impacts on Medicare for subgroups of model enrollees with longer versus shorter survival times.

expenditures (excluding model payments) were $158 lower among model enrollees, which corresponds to 30 percent of the comparison group mean (Appendix E, Table E.1). After accounting for model payments, we estimated MCCM reduced average daily total expenditures from $520 to $362 per day, a net reduction of $141 (27 percent).

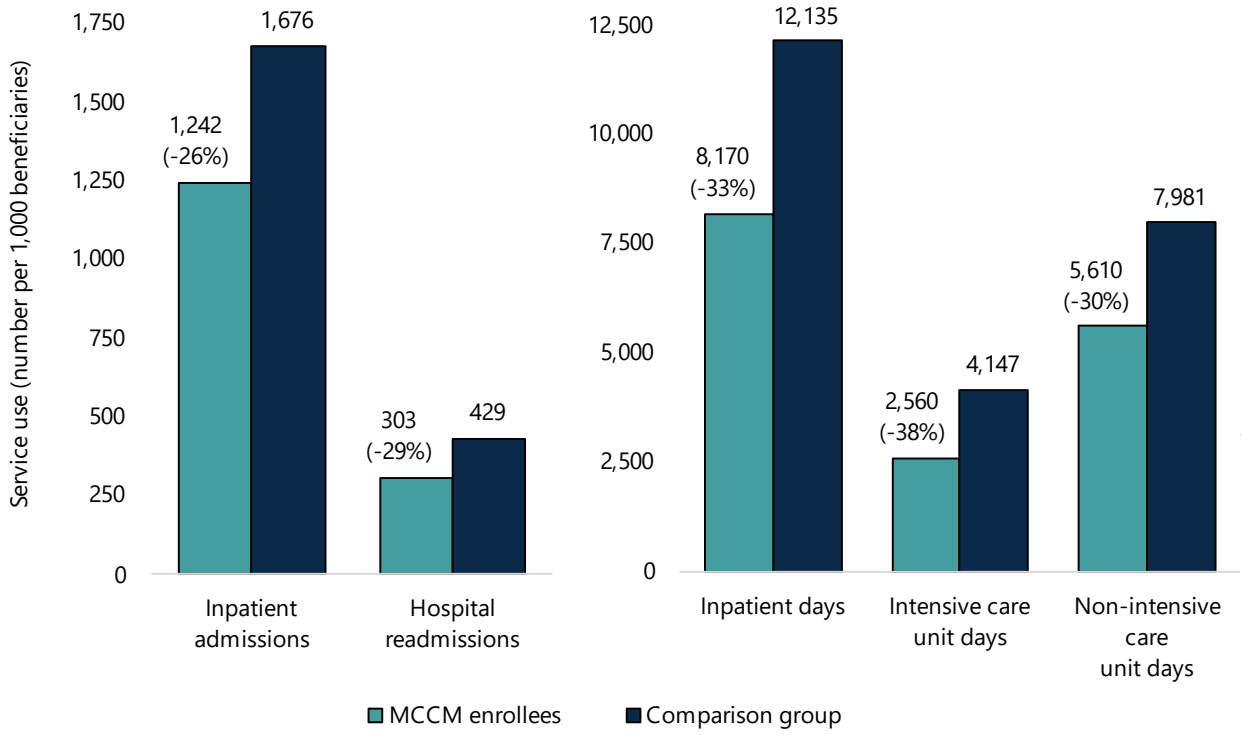
The estimated impacts on Medicare expenditures suggest that the model generated $39.2 million net savings for Medicare among beneficiaries in our analytic sample. Adding the estimate of the average impact on Medicare expenditures (from Figure 19) across the 5,153 MCCM enrollees included in the impact analyses implies that MCCM reduced Medicare Part A and B expenditures by about $49.3 million (90 percent confidence interval: $42.6 to $56.1 million) and generated about $39.2 million in net Medicare savings (90 percent confidence interval: $32.5 to $45.9 million). However, our impact analyses included only 79 percent of the 6,559 beneficiaries who received paid MCCM services. We were unable to estimate impacts for the remaining beneficiaries because no comparison group was available.[47] Although we cannot assess the net Medicare savings for MCCM enrollees not included in the impact analyses, who accrued $6.6 million in model payments, MCCM would have generated net savings of $32.6 million even if we assume the model had *no* impacts on Medicare expenditures for this group. However, it is not unreasonable to presume (extrapolate) MCCM reduced Medicare expenditures among these excluded beneficiaries, making the net Medicare savings even larger than $39.2 million.

6.2. Effects on health care service use

MCCM enrollees had fewer inpatient admissions and readmissions and spent less time in hospitals between enrollment and death than matched comparison beneficiaries (Figure 21). Specifically, we estimated a reduction in the average number of inpatient admissions between enrollment and death from 1,676 to 1,242 per 1,000 beneficiaries, a reduction of 434 admissions per 1,000 beneficiaries. This represents a 26 percent decrease in the admission rate relative to the comparison group mean. We also found beneficiaries enrolled in MCCM had 3,965 (33 percent) fewer inpatient days per 1,000 beneficiaries, on average, than matched comparison beneficiaries (8,170 versus 12,135). We can attribute this estimated reduction in inpatient stay length to 1,586 (38 percent) fewer days in intensive care units and 2,371 (30 percent) fewer non-intensive care hospital unit days per 1,000 beneficiaries. In addition, we estimated MCCM enrollees had, on average, 126 or 29 percent fewer hospital readmissions per 1,000 beneficiaries after they enrolled in the model.

[47] See Appendix C, Section 2.2 for details on impact analysis inclusion criteria. The 5,153 beneficiaries we included in the impact analysis (79 percent of beneficiaries) accounted for $10.2 million in MCCM payments (61 percent of total payments), while the 1,406 excluded beneficiaries (21 percent) had $6.6 million in MCCM payments (39 percent). Of note, we excluded 785 enrollees because they were alive on January 1, 2022; these enrollees tended to have above-average MCCM payments. Deceased beneficiaries represent about 88 percent of MCCM enrollees who met the other inclusion criteria for the impact analysis.

Figure 21. Average inpatient care service use for deceased MCCM enrollees and matched comparison beneficiaries: ***MCCM enrollees had fewer inpatient admissions and readmissions and spent less time in hospitals than comparison beneficiaries.***



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting). Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. Impacts estimates for Medicare expenditures were statistically significant at the $p < 0.01$ level. See Appendix E, Table E.2, for full impact analysis results for these outcome measures.

MCCM = Medicare Care Choices Model.

We further assessed differences in health care use between MCCM enrollees and comparison beneficiaries by type of inpatient admission or emergency department visit (Table 8). Compared with the overall impact on hospital stays (a 26 percent reduction), the model disproportionately decreased the rates of admissions with a surgery (40 percent reduction) and elective admissions (51 percent reduction). There was also a 50 percent reduction in the rate of admissions in the last 30 days of life with an aggressive life-prolonging procedure, surgery, or diagnostic test and a 27 percent reduction in potentially preventable admissions. The number of days admitted for these types of inpatient hospital stays also substantially decreased for MCCM enrollees, in percentage terms, relative to comparison beneficiaries (Appendix E, Table E.3).

Table 8. Additional differences in inpatient service use between deceased MCCM enrollees and matched comparison beneficiaries: *MCCM disproportionately reduced certain categories of inpatient admissions.*

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact
Inpatient care: Number of inpatient admissions per 1,000 beneficiaries				
All inpatient admissions	1,242	1,676	-434	-26
Admissions with a surgery	267	447	-180	-40
Elective admissions[a]	48	99	-50	-51
Admissions with a potentially preventable diagnosis[b]	437	598	-161	-27
Admissions in the last 30 days of life with an aggressive life-prolonging procedure, surgery, or diagnostic test[c]	170	337	-167	-50

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting). All impact estimates in this table were statistically significant at the $p < 0.10$ level. See Appendix E, Table E.3, for full impact analysis results for these outcome measures.

[a] *Elective* admissions are defined at the claim level using the claim admission type code and are distinguished from urgent, emergency or trauma center admissions. In general, for "elective" admissions, the beneficiary's condition permits adequate time to schedule the availability of a suitable accommodation. Scheduled surgeries, for example, are usually classified as elective admissions. Urgent, emergency, and trauma center admissions generally require more immediate attention, and include people admitted through the emergency room or involving a trauma unit activation.

[b] Admissions with *potentially preventable diagnoses* include admissions with a primary diagnosis of anemia, dehydration, diarrhea, emesis, fever, nausea, neutropenia, pain, pneumonia, and sepsis; or with a secondary diagnosis of one of these 10 potentially preventable diagnoses and a primary diagnosis of cancer, chronic obstructive pulmonary disease, congestive heart failure, or HIV/AIDS. This measure is based on quality-of-care chemotherapy measure OP-35 (see Appendix D).

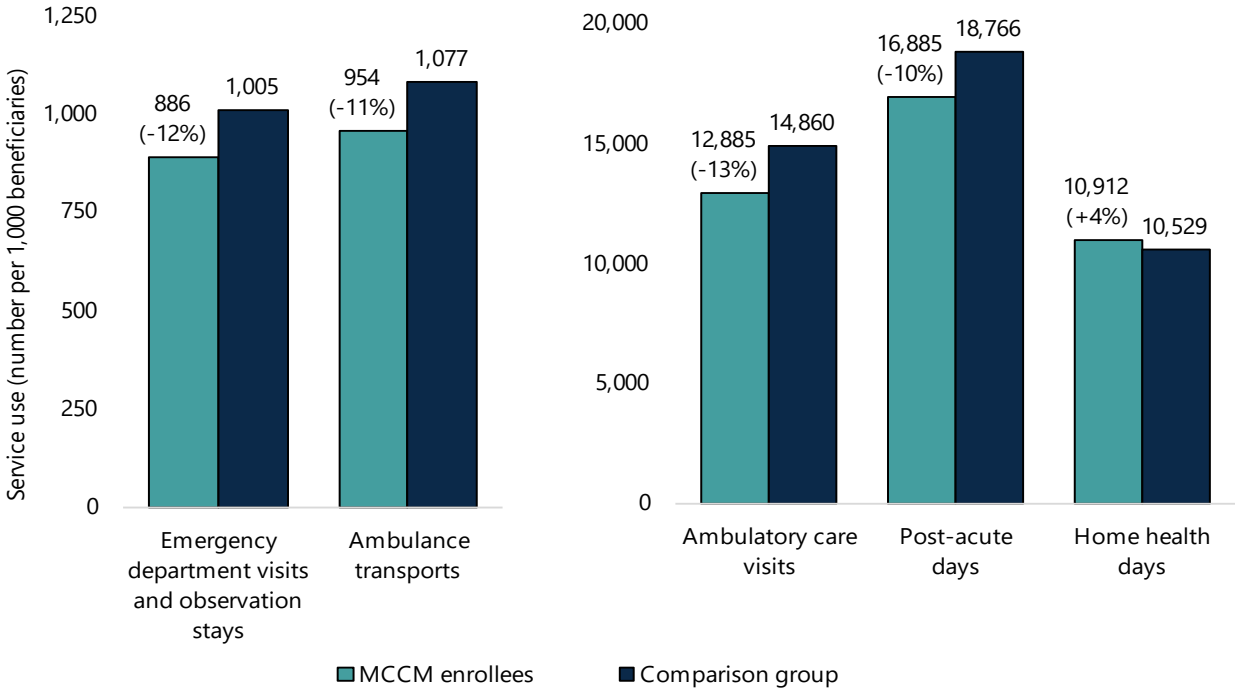
[c] Admissions *with an aggressive life-prolonging procedure, surgery, or diagnostic test* are hospital admissions during which an event occurred that contributes to our quality-of-care measure discussed in Section 6.5.

MCCM = Medicare Care Choices Model.

We also estimated impacts on several other types of health care use (Figure 22). Beneficiaries enrolled in MCCM had 119 (12 percent) **fewer emergency department visits and observation stays** per 1,000 beneficiaries than comparison beneficiaries. Model enrollees also had an estimated 123 (11 percent) fewer ambulance uses for emergent conditions per 1,000 beneficiaries than matched comparison beneficiaries and 1,975 (13 percent) fewer ambulatory care visits with primary care physicians and specialist physicians per 1,000 beneficiaries. Finally, we estimated the model

reduced the number of post-acute days by 2 days per beneficiary (10 percent).[48] The average number of home health days were similar for model enrollees and comparison group beneficiaries.

Figure 22. Average outpatient care service use for deceased MCCM enrollees and matched comparison beneficiaries: *MCCM enrollees had fewer emergency department stays and observation visits, ambulance transports, ambulatory care visits, and post-acute days than comparison beneficiaries.*



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting). Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. Impacts estimates for Medicare expenditures were statistically significant at the $p < 0.01$ level, except for home health days ($p = 0.27$). See Appendix E, Table E.2, for full impact analysis results for these outcome measures.

MCCM = Medicare Care Choices Model.

In summary, we found enrollment in MCCM was associated with lower health care use for almost all categories of service use we measured. We observed the largest estimated reductions for inpatient care, but also estimated sizable reductions in outpatient services and other types of care. These reductions in health care service use among MCCM enrollees (relative to comparison beneficiaries) are consistent with and largely explain the reductions in Medicare expenditures discussed in Section 6.1.

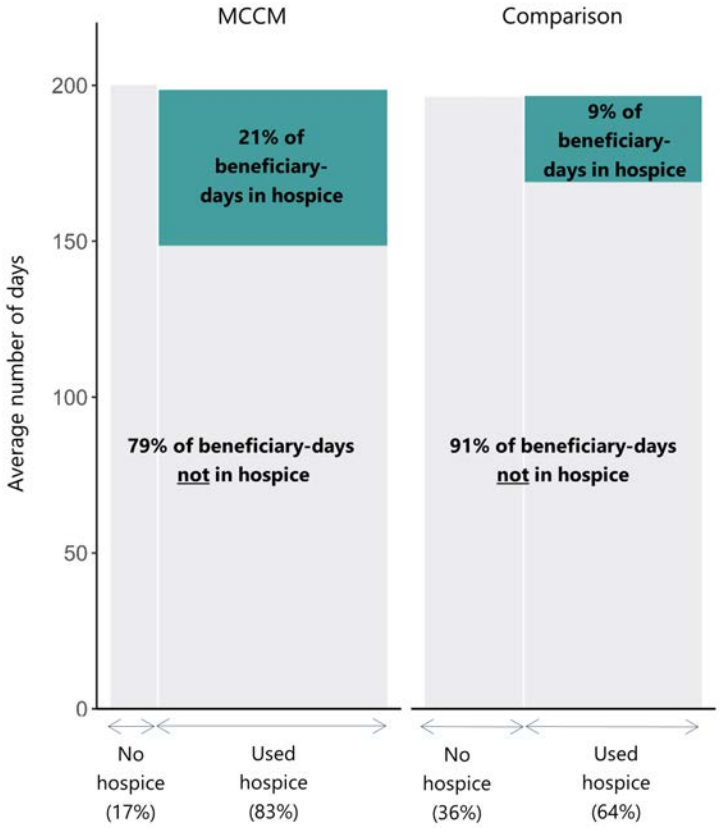
[48] Post-acute days include days spent in skilled nursing facilities, inpatient rehabilitation facilities, and long-term care hospitals and receiving home health care.

6.3. Effects on hospice use

One of the primary mechanisms by which MCCM can improve enrollees' outcomes and lower Medicare expenditures is by familiarizing terminally ill beneficiaries with hospice and providing a range of palliative care treatments while allowing enrollees to receive payment for treatment of their terminal conditions. By introducing MCCM enrollees to hospice providers earlier in their disease trajectory, MCCM could help ease the often-difficult transition to hospice. By increasing the use of the Medicare hospice benefit, MCCM could reduce Medicare expenditures and improve quality of life for MCCM enrollees who transition to hospice. This section evaluates impacts of the model on hospice use.

Descriptive analyses indicate MCCM enrollees were more likely to use hospice in the period between their MCCM enrollment date and death than beneficiaries in the comparison group, and when they did choose hospice, they did so earlier in their disease. We first used unadjusted analyses to compare MCCM enrollees and matched comparison beneficiaries on (1) the rate of hospice use, (2) the average number of days from enrollment to death, and (3) the average number of days in hospice among those who chose to switch from MCCM to hospice. The horizontal axis in Figure 23 shows a larger percentage of MCCM enrollees (83 percent) used hospice than the comparison group (64 percent). The vertical axis shows MCCM enrollees who transitioned to hospice spent more days in hospice, on average, than comparison beneficiaries who used hospice. The green area in this figure shows that, altogether, MCCM enrollees spent more than twice as much time in hospice, on average, as those in the comparison group (21 versus 9 percent of all beneficiary-days).

Figure 23. Unadjusted average number of days spent in hospice by deceased MCCM enrollees and matched comparison beneficiaries: ***In unadjusted analysis, MCCM enrollees used hospice at higher rates and spent more days in hospice than comparison beneficiaries.***



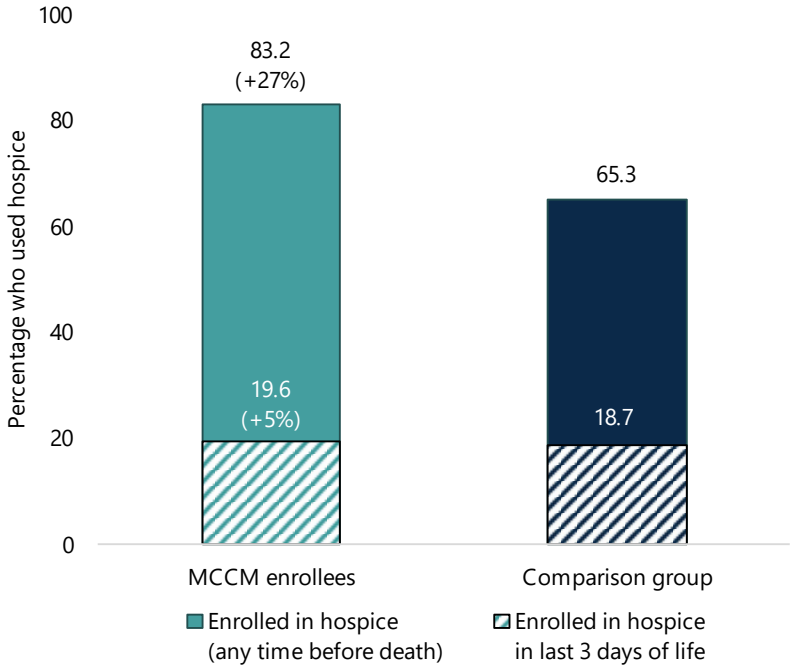
Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2016, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Note: This figure is based on unadjusted averages, not impact estimates, for MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting). Refer to the remainder of this chapter for regression-adjusted impact estimates.

MCCM = Medicare Care Choices Model.

MCCM enrollees were 18 percentage points more likely to use hospice than matched comparison beneficiaries in regression-adjusted impact analyses (Figure 24). About 83 percent of MCCM enrollees used hospice between MCCM enrollment and death, compared with 65 percent of comparison beneficiaries (over the same period of time before death). Despite an increase in hospice enrollment, there was not a significant increase in the rate of beneficiaries starting hospice in the last three days of life. This finding suggests the additional beneficiaries enrolling in hospice chose to enroll early enough to benefit from doing so. (Beneficiaries admitted to hospice less than three days before death will not receive the full array of benefits hospice care can provide [National Quality Forum measure 0216]).

Figure 24. Rates of hospice use for deceased MCCM enrollees and matched comparison beneficiaries: ***MCCM enrollees used hospice at higher rates than comparison beneficiaries, but the difference was not driven by those who started hospice in the last three days of life.***



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2016, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

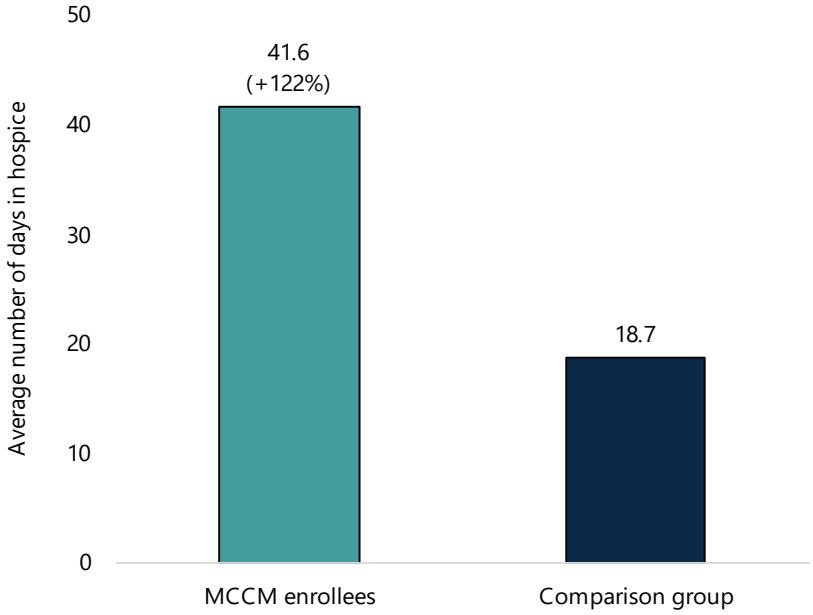
Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting). Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. Impact estimates for using hospice (solid shading) were statistically significant at the $p < 0.01$ level. However, estimates for MCCM's impact on starting hospice in the last three days of life (hatches) were not statistically significant ($p = 0.16$). See Appendix E, Table E.4, for full impact analysis results for these outcome measures.

MCCM = Medicare Care Choices Model.

MCCM enrollees entered hospice earlier than those in the matched comparison group, in addition to using hospice more often. The time from enrollment (or pseudo-enrollment) to starting hospice was shorter among MCCM enrollees than those in the comparison group, and therefore enrollees also spent more time in hospice (because enrollees and the comparison group are closely matched on survival time). We found MCCM enrollees spent an additional 23 days in hospice—more than double (122 percent more) the average number of days in hospice among the comparison group (Figure 25). Framed differently, MCCM enrollees spent 28 percent of the days from MCCM enrollment to death in hospice (and not in MCCM) compared with the 16 percent of days comparison beneficiaries spent in hospice (Appendix E, Table E.4). We used survival analysis methods (Cox proportional hazards regression models) to study how quickly MCCM enrollees switched to hospice compared with matched comparison beneficiaries and found enrollees were 41 percent

more likely than comparison beneficiaries to be receiving hospice care on any given day following their MCCM enrollment date.[49]

Figure 25. Average number of days in hospice for deceased MCCM enrollees and matched comparison beneficiaries: *MCCM enrollees spent more time in hospice between enrollment and death than comparison beneficiaries.*



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2016, to December 31, 2021. The estimates cover beneficiaries who enrolled through September 30, 2020, and who died on or before December 31, 2021, and their experiences in the model.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting). Numbers in parentheses above MCCM enrollees' bars show estimated percentage impacts. Impact estimates for time until starting hospice (solid shading) were statistically significant at the $p < 0.01$ level. See Appendix E, Table E.4, for full impact analysis results for this outcome measure.

MCCM = Medicare Care Choices Model.

6.4. Association between increased use of hospice and changes in Medicare expenditures and hospital service use

Section 6.3 shows MCCM beneficiaries used the Medicare hospice benefit more often and spent more time in hospice than beneficiaries in the comparison group. Meanwhile, in Sections 6.1 and 6.2, we report MCCM enrollees had lower Medicare expenditures and used fewer hospital and other health care services on average. Because Medicare does not pay for treatment of terminal conditions for beneficiaries receiving hospice benefits, Medicare expenditures (per day) and rates of service use

[49] The estimated hazard ratio was 1.41 with 90 percent confidence interval [1.36, 1.46] and $p < .001$. A hazard ratio of 1 would indicate no model effect on this outcome, while ratios greater than 1 indicate the propensity to enter hospice was higher for MCCM beneficiaries than matched comparison beneficiaries.

might be lower after beneficiaries' transitions to hospice.[50] By extension, MCCM's impacts on hospice use could have driven at least some of MCCM's overall impacts on Medicare expenditures and service use for beneficiaries in MCCM. To examine this pathway, we used a system of regression models that quantified how much of the overall decrease in Medicare Part A and B expenditures and service use was explained by the increased time that MCCM beneficiaries spent in hospice. That is, our analysis disaggregated the total effect on Medicare expenditures into two components: (1) the reduction in Medicare expenditures due to increased hospice use and (2) a residual impact capturing all the other ways MCCM affected Medicare expenditures (henceforth, MCCM's effects *through other channels*). As an example of the residual impact, MCCM might have reduced Medicare expenditures before enrollees entered hospice by preventing some emergency department visits and inpatient stays through symptom management and care coordination.

Using the approach described in Appendix C, Section 4.3, we estimated the following:

- The overall $9,470 reduction in Medicare Part A and B expenditures can be decomposed into (1) a $4,806 decrease in expenditures due to increased hospice use and (2) another $4,663 decrease due to effects of MCCM on Medicare Part A and B expenditures (Figure 26). This means MCCM enrollees' more frequent and earlier receipt of hospice care accounted for 51 percent of the overall impact on Medicare Part A and B expenditures.[51] The $4,806 decrease in expenditures due to increased hospice use captures the combination of two factors. First, MCCM beneficiaries spent about 28 percent of their time between enrollment and death in hospice, which is 12 percentage points higher than matched comparison beneficiaries (16 percent). Second, Medicare Part A and B expenditures are lower after MCCM beneficiaries transitioned to hospice compared with before they enrolled, on average.
- For inpatient expenditures, increased hospice use did not account for most of the overall estimated impact of MCCM. Increased hospice usage accounted for just $2,520, or 26 percent, of the overall reduction of $9,762. Other channels accounted for a reduction of inpatient expenditures of $7,242 (Figure 26).
- For inpatient admissions, we estimated an overall decrease due to MCCM of 432 admissions per 1,000 beneficiaries, which we decomposed into a decrease of 159 admissions associated with hospice enrollment and a residual decrease of 273 admissions (Figure 27). That is, changes in hospice use accounted for 37 percent of the estimated impact inpatient admissions. Similarly, hospice usage accounted for 29 percent of the decrease in number of days admitted to a hospital and 30 percent of the decrease in number of 30-day all-cause readmissions (Appendix E, Table E.6).

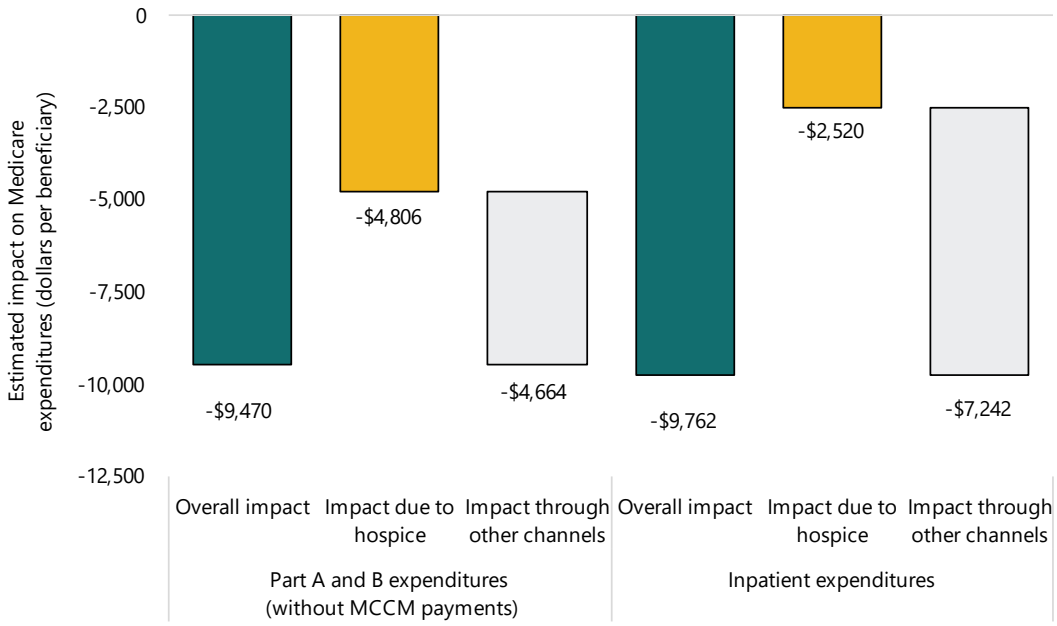
[50] Studies have been mixed on whether hospice saves Medicare money in the aggregate compared with conventional care (Medicare Payment Advisory Commission 2020). This is partly due to methodological difficulties. See, for example, Gomes et al. (2013), Smith et al. (2014), Hogan (2015), and Kaufman et al. (2021).

[51] If the calculations include MCCM payments, which accrue before beneficiaries entered hospice, the effects are similar: the overall estimated effect of MCCM on total Medicare expenditures ($7,505) can be broken down into (1) a $4,785 reduction due to increased hospice use and (2) a residual impact of $2,719 that nets out direct model payments. That is, hospice enrollment accounted for 64 percent of the estimated impact on net Medicare expenditures.

- We estimated an overall decrease of 121 emergency department visits and observations stays per 1,000 beneficiaries. This reduction is mostly due to hospice usage (a decrease of 89 per 1,000 beneficiaries) with the remainder due to other factors.
- Further, we estimated that hospice enrollment accounted for 94 percent of the impact on post-acute care days, 76 percent of the impact on the number of ambulance transports, and 68 percent of the impact on the number of ambulatory care visits (Appendix E, Table E.6).

In summary, we found **about half of MCCM's estimated impacts on Medicare Part A and B expenditures (excluding model payments) operates through MCCM enrollees choosing the Medicare hospice benefit earlier and more often**, as well as 74 percent of its estimated impacts on emergency department visits and observation stays. However, only 37 percent of the model's estimated impact on inpatient admissions operates through increased use of the Medicare hospice benefit.

Figure 26. Impacts of MCCM on Medicare Part A and B expenditures operating through increased hospice use versus other factors: *MCCM enrollees' higher hospice use explains most of the estimated reduction in Medicare Part A and B expenditures (but less than half the reduction in inpatient expenditures).*

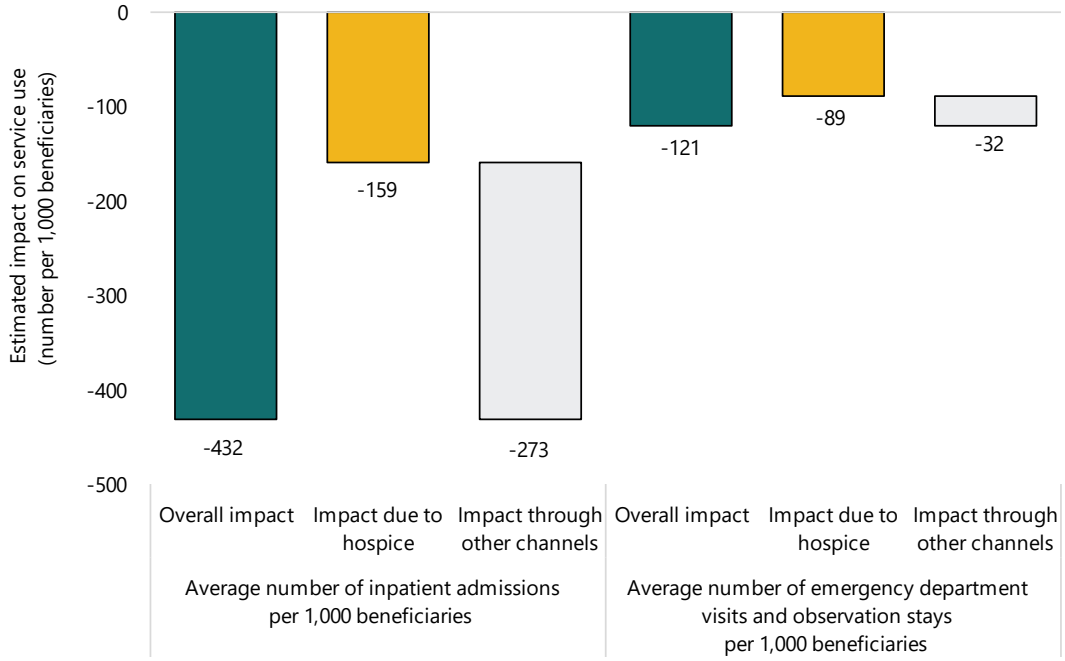


Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,136) and matched comparison beneficiaries (N = 15,147 before weighting). We used a system of regressions to estimate overall impacts, and impacts operating through hospice enrollment and other factors; see Appendix C, Section 4.3, for details. All estimated impacts are statistically significant at the $p < 0.01$ level. See Appendix E, Table E.6, for full results. The estimated overall impacts differ slightly from those reported in Section 6.1 because of different sample restrictions (this analysis excludes a small number of beneficiaries who died more than 30 days after disenrolling from the hospice benefit).

MCCM = Medicare Care Choices Model.

Figure 27. Impacts of MCCM on inpatient care use operating through increased hospice use versus other factors: *MCCM enrollees' higher hospice use explains most of the estimated reduction in their emergency department visits and observations stays (but less than half the reduction in inpatient admissions).*



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Note: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,136) and matched comparison beneficiaries (N = 15,147 before weighting). We used a system of regressions to estimate overall impacts, and impacts operating through hospice enrollment and other factors; see Appendix C, Section 4.3, for details. All estimated impacts are statistically significant at the $p < 0.01$ level. See Appendix E, Table E.6, for full results. The estimated overall impacts differ slightly from those reported in Section 6.2 because of different sample restrictions (this analysis excludes a small number of beneficiaries who died more than 30 days after disenrolling from the hospice benefit).

MCCM = Medicare Care Choices Model.

6.5. Effects on the quality of end-of-life care

CMS designed MCCM to maintain or improve the quality of end-of-life care for Medicare beneficiaries. We analyzed Medicare claims data for MCCM and comparison beneficiaries to see whether MCCM improved various measures of end-of-life care, such as decreasing the percentage of beneficiaries receiving an inappropriate procedure, surgery, or diagnostic test in the last 30 days of life; increasing beneficiaries' days at home; and decreasing the percentage of beneficiaries dying in an inpatient facility (Breslow 2015; Grunfeld et al. 2008; Earle et al. 2004, 2005; Emanuel and Emanuel 1998). We also investigated impacts on the percentage of beneficiaries who received, in the last 30 days of life, care likely to cause distress, discomfort, pain, and time away from home—more than one

outpatient emergency department visit, more than one hospitalization, or an intensive care unit admission (adapted from National Quality Forum measures 0211, 0212, and 0213).

We hypothesized that MCCM could improve, or at least not diminish, the quality of end-of-life care, especially during the crucial last 30 days of life. At this stage, it becomes clearer to beneficiaries, caregivers, and clinicians that death is approaching, and it becomes increasingly inappropriate to pursue heroic life-prolonging procedures such as CPR, or intubation and mechanical ventilation, or aggressive treatments such as hemodialysis or major surgeries. It also becomes inappropriate to conduct diagnostic testing to uncover abnormalities that will likely lead to painful and ultimately futile hospitalizations, treatments, and procedures. The focus of care in the last few weeks of life should therefore be maximizing comfort and time at home with loved ones and family. Because peer-reviewed studies that have analyzed potentially inappropriate aggressive life-prolonging treatments as measures of the quality of end-of-life care (and the related National Quality Forum-endorsed measures) have focused on specific diseases or conditions, we created a composite outcome for having any aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life (details are in Appendix D).

By these measures, MCCM enrollees received better quality of end-of-life care. Impact estimates showed that in the last 30 days of life, MCCM enrollees were 23 percent less likely to undergo aggressive life-prolonging procedure or surgery, and 23 percentage points less likely to receive any sort of (presumedly inappropriate) diagnostic testing (Table 9).[52] MCCM enrollees were considerably less likely to have multiple acute fewer hospitalizations and intensive care unit stays in the last 30 days of life (15 to 16 percentage points). They also were 11 percentage points (52 percent) less likely to die in an inpatient facility.

We also found MCCM enrollees spent 5.5 more days at home (183.5 versus 178.0 days at home, a 3 percent increase). Spending more days at home has been identified as a quality metric that is intuitively easy to understand and meaningful for beneficiaries (for example, Lee et al. 2019; Medicare Payment Advisory Commission 2015).[53] Days at home are days during which a beneficiary is not in a medical care facility observable in Medicare claims—that is, a hospital, an inpatient

[52] Note that the quality of end-of-life care outcomes discussed in this report are somewhat different than those discussed in the Fourth Annual Report (Kranker et al. 2022). The outcomes here include a broader range of surgeries and diagnostic tests. The current results are nonetheless consistent with the results in the Fourth Annual Report, and our conclusions on the direction of effects of MCCM on quality measures are substantively unchanged.

[53] Shen et al. (2022), Freed et al. (2022), and Ankuda and Grabowski (2022) discuss limitations with claims-based days at home measures, noting that such measures do not incorporate such factors as pain and other symptoms that affect the *quality* of the time at home, and could even mask problems with access to care or lead to skimping on and disparities in provision of appropriate inpatient care. These articles, however, focused solely on claims-based days at home measure, whereas this evaluation also includes measures of aggressive life-prolonging treatments generally felt to be inappropriate. Claims-based measures will always be limited by the lack of information on symptoms and patient preferences. (We have no data, for example, on patient and family perceptions of the claims-based aggressive care measures or patient symptoms experienced when undergoing such treatments.) However, we note that the direction of the days at home measure agrees with all of our other claims-based measures of the quality of end-of-life care.

rehabilitation hospital, a long-term care hospital, inpatient hospice, or a skilled nursing facility. In the last 30 days of life, MCCM enrollees were also 24 percent less likely to have multiple emergency department visits, 47 percent less likely to have multiple hospital admissions, 45 percent less likely to have an intensive care unit admission, and 52 percent less likely to die in an inpatient facility. These estimates align with the goals of MCCM of improving the quality of end-of-life care.

Table 9. Differences in quality of end-of-life care between deceased MCCM enrollees and matched comparison beneficiaries: *MCCM enrollees were more likely to receive better-quality of end-of-life care.*

Outcome	MCCM mean	Percentage impact[a]
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life[b]	61.2	-20
Percentage with an aggressive life-prolonging procedure or surgery	55.2	-23
Percentage with a diagnostic test	55.9	-22
Number of days at home[c]	183.5	+3
Percentage with more than one emergency department visit or hospitalization or at least one intensive care unit admission in the last 30 days of life	21.0	-43
Percentage with more than one outpatient emergency department visit	2.5	-24
Percentage with more than one hospitalization	5.1	-47
Percentage with an intensive care unit admission	17.5	-45
Percentage who died in an inpatient facility	10.4	-52

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting). All impact estimates in this table were statistically significant at the $p < 0.05$ level. See Appendix E, Table E.7, for full results and results for exploratory outcome measures.

[a] MCCM mean minus the comparison mean divided by the comparison mean (regression adjusted).

[b] Aggressive life-prolonging procedures are defined in Appendix D, Section 3.4.

[c] Days at home counts the number of days a beneficiary is alive and not admitted to a hospital, inpatient rehabilitation facility, long term care hospital, a skilled nursing facility, or inpatient hospice.

MCCM = Medicare Care Choices Model.

These impact estimates on the quality of end-of-life care agree with the qualitative findings presented earlier in this report. As described in Chapter 4, the qualitative evidence suggested that the range of educational, symptom management, assessment, supportive listening, and advance care planning services received by MCCM enrollees reduced the likelihood of seeking emergency care or needing hospitalization. Furthermore, enrollee caregiver satisfaction was highest among enrollees who transitioned to hospice. Chapter 5 showed how MCCM functioned as a stepping stone to hospice. Finally, Section 6.3 of this chapter described the substantial impact MCCM had on the likelihood of hospice enrollment and the amount of time spent in hospice. As described in Chapter 1,

hospice focuses on providing comfort and quality of life for beneficiaries with terminal conditions over aggressive care aimed at prolonging life.

6.6. Sensitivity analyses

Sensitivity analyses suggest that impacts are robust to alternative specifications and outliers. Unobserved differences between MCCM enrollees and the comparison group would have to be very large to fully negate the estimated impacts.

6.6.1. Robustness checks

To assess the robustness of the estimated differences in Medicare expenditures, health care service use, hospice use, and the quality of end-of-life care between beneficiaries enrolled in MCCM and the comparison group to alternative specifications, we conducted several sensitivity checks, such as trimming outcomes for outliers or using alternative functional forms. Appendix E, Section 4, provides details about these checks. Overall, we obtained qualitatively similar impact estimates with these alternative modeling approaches and the main approach (that is, the results presented in this chapter), increasing our confidence in the main findings.

6.6.2. *E*-Values

One remaining concern about our impact estimates is the possibility that factors we cannot measure influenced the outcomes and are more prevalent among MCCM enrollees or beneficiaries in the comparison group. For example, we might estimate reductions in Medicare expenditures and inpatient service use among MCCM enrollees if beneficiaries in the comparison group had doctors who practiced a style of medicine with relatively less hospice care and more hospital care.[54] In other words, we are concerned we might be overstating (or understating) our impact results but cannot directly assess the influence of unobserved differences in beneficiaries' characteristics between MCCM enrollees and comparison group beneficiaries. To better understand this, we used the *E*-value method developed by Ding and VanderWeele (2016) and VanderWeele and Ding (2017) to estimate how large and important differences in unmeasured factors would have to be to negate our estimated impacts. (See Appendix E, Section 2 for details about the methods and supplemental results.) Larger *E*-values indicate larger unobserved differences between the intervention and comparison groups, on variables strongly related to outcomes, would be needed to produce the observed impact estimate if the true impact of the model is 0; meanwhile, *E*-values close to 1 (the minimum) indicate that very small (or negligible) unobserved differences between the intervention and comparison groups could explain the observed differences in outcomes.

[54] Examples of other unmeasured, potentially confounding beneficiary characteristics include (1) whether a clinician would have certified a comparison beneficiary as having a prognosis of less than six months (although we matched on beneficiaries *actual* survival times), (2) health-related social needs (although we matched on several proxies), (3) functional status at time of enrollment (although we matched on recently reported limitations with activities of daily living, when available, and other proxies such as use of durable medical equipment), and (4) the presence of a caregiver (which was only available for the intervention group beneficiaries).

Overall, we found that nearly all our main impact estimates were robust to possible unobserved factors. That is, unobserved factors in the aggregate would have to be more influential than the most important factors we can measure in our data or that are reported in the literature, and these unobserved factors would also need to be highly imbalanced between MCCM enrollees and the comparison group after matching. **Although MCCM's true impact could be larger or smaller than what we estimated due to unmeasured factors, we believe these factors are unlikely to fully explain the estimated impacts of MCCM on Medicare expenditures, inpatient admission rates, hospice use, the number of days at home, or the likelihood of receiving an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life.**

For our estimated impact of MCCM on total Medicare expenditures (including MCCM payments) to be fully negated (*E*-value = 1.47), the unmeasured factors would have to account for a difference in expenditures equivalent to increasing an average enrollee's hierarchical condition category score from 5.2 (the median value) to 10.8 (about the 98th percentile) and be imbalanced (between MCCM and comparison groups) to the same degree.[55,56] To fully negate the estimated impact on inpatient admissions (*E*-value = 1.73), unmeasured factors would have to account for a difference in inpatient admissions in period between enrollment and death equivalent to increasing the number of inpatient stays in the last quarter of the baseline period from 1.0 (the median) to 3.6 (about the 98th percentile).

For emergency department visits and observation stays (*E*-value = 1.30), more modest confounding could fully explain the estimated impact of the model. For example, an unmeasured factor on par with an increase from 0 (the median) to just 0.3 (less than the 57th percentile) emergency department visits or observation stays in the last quarter of the baseline period could fully negate MCCM's estimated impact on the outcome. Unlike the estimated impacts for Medicare expenditures and inpatient stays, only a small degree of confounding could negate the estimated impact of MCCM on emergency department visits. We therefore have less confidence that MCCM affected emergency department visits and observation stays, even though the estimated impacts are qualitatively large, precisely estimated, and highly statistically significant.

We found *E*-values of 2.79 and 1.85 for our estimated impacts on the proportion of beneficiaries enrolling in hospice and time to hospice entry, respectively. When we compared these *E*-values with other established benchmarks in the literature, such as doctors' likelihood of referring beneficiaries to hospice, we concluded that unobserved factors are unlikely to fully explain the estimated impacts, even if we cannot rule out that these factors might have partly affected our estimates. Obermeyer

[55] A similarly sized unmeasured factor would be needed to negate the estimated impact of MCCM on Medicare Part A and B expenditures excluding MCCM payments (*E*-value = 1.55).

[56] We chose variables with strong and intuitive relationships with the outcomes as benchmarks for whether unobserved factors could plausibly relate more strongly to Medicare expenditures and inpatient admissions than MCCM enrollment. We chose the hierarchical condition category score as a benchmark for expenditures because it is a robust predictor for Medicare expenditures after enrollment, and it is commonly used in risk adjustment (a higher score predicts higher expenditures). Likewise, we used baseline inpatient admissions as a benchmark for inpatient admissions in the study period, because it is one of the strongest predictors of that outcome in our data.

and coauthors (2015) found a physician's practice style was the strongest predictor (among all covariates observed in their data) for whether a terminally ill beneficiary with cancer would use hospice. Our *E*-values suggest, to fully negate MCCM's estimated impact on using hospice, unmeasured factors would have to account for a difference in the rate of hospice enrollment larger than switching from a doctor in the bottom decile for referring terminally ill beneficiaries to hospice to one in the top decile. Therefore, unobserved factors in our evaluation, such as having a physician who is likely to encourage hospice to beneficiaries, would have to be much more likely among MCCM-enrolled beneficiaries than the comparison groups and be strongly related to the outcome variables to fully explain the estimated impacts of MCCM. MCCM's impact on the time until starting hospice was similarly robust; to fully negate the estimated impact of MCCM on the time until starting hospice, the unmeasured factors would need to have a stronger relationship with both the outcome variable and with enrollment than we observed for all of the *E*-values calculated for any of the expenditures and service use outcomes.

To fully negate MCCM's estimated impact on days at home (*E*-value = 1.17), unmeasured factors would have to have a stronger effect on outcomes than increasing the number of inpatient stays in the last quarter of the baseline period from 1.0 (the median) to 10.3 (about the 97th percentile).[57] The *E*-value for receiving an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life was 2.29, which is a larger *E*-value than we calculated for all the expenditures and service use outcomes.

6.7. Differences in outcomes between MCCM enrollees and comparison beneficiaries who entered in hospice at the start of the study period

Increased hospice use accounted for substantial portion of overall savings, but savings were not as large as might have been expected if MCCM enrollees started to receive hospice from their first day of enrollment. Because MCCM is an alternative to the Medicare hospice benefit, we wanted to explicitly compare the MCCM and hospice options. We did so by comparing MCCM enrollees with beneficiaries who entered hospice on their enrollment date to provide an alternative reference point for examining the experience of MCCM enrollees and supplement the main impact analysis. We hypothesized that comparison beneficiaries who entered hospice from the start would have lower Medicare expenditures and lower acute care utilization than MCCM enrollees; but it was unknown how different the estimates would be.[58] To conduct this analysis, we constructed a separate

[57] We chose inpatient admissions in the baseline period as the benchmark because it was strongly associated with inpatient and post-acute care days in the study period, which represent a large proportion of the days not spent at home. For receiving an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life, we could not find an appropriate benchmark because there are no obvious predictors for this outcome. As an alternative, we compare the *E*-value for an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life to *E*-values for other measures.

[58] Those who enrolled directly in hospice chose to forgo Medicare payment for their curative treatment at an earlier stage of their terminal disease. However, hospice payments are generally higher than MCCM payments

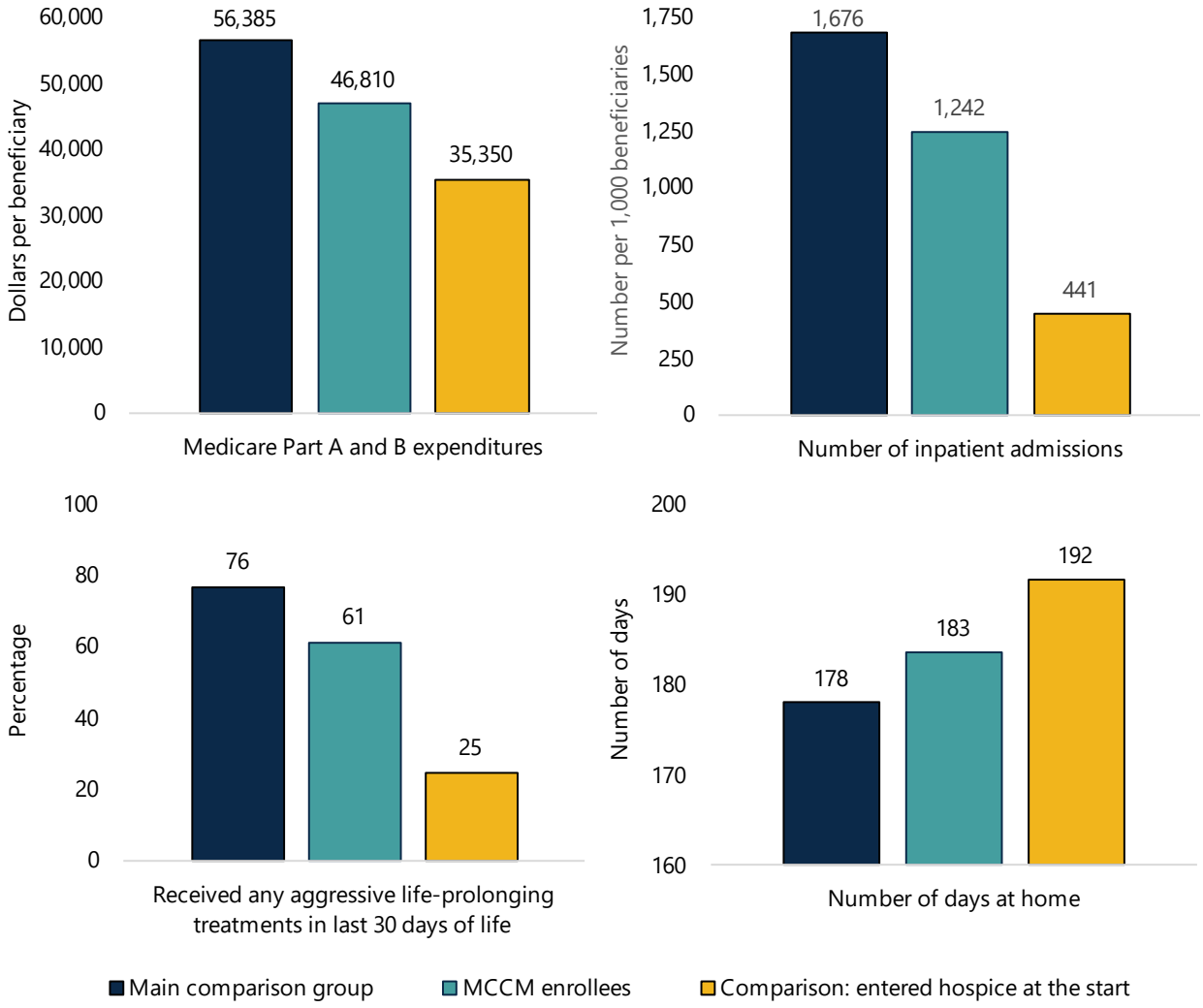
comparison group that consists of beneficiaries who did not enroll in MCCM but did enter hospice on the first day of the study period.[59] More details about these methods and how they differed from the main approach are available in Appendix C, Section 6.

Overall, we found that comparison beneficiaries who entered hospice from the start had lower Medicare expenditures; lower hospital service use; lower rates of aggressive, life-prolonging procedures, surgeries, or diagnostic tests in the last 30 days of life; and more days at home than MCCM enrollees. As Figure 28 shows, the MCCM enrollees' average outcomes fell between those for (1) the main comparison group and (2) those who directly entered hospice at the start of the study period. One way to interpret this finding is that MCCM moved beneficiary outcomes partway toward the outcomes that might have been achieved if they had entered hospice rather than MCCM on their MCCM enrollment date. We stress, however, that hospice is not necessarily a valid counterfactual for MCCM enrollees, because MCCM was principally designed as an alternative option for beneficiaries with a terminal diagnosis who were initially reluctant to enter hospice. Through this lens, **MCCM served as a stepping stone to hospice and achieved some benefits of hospice by providing a limited set of palliative care services to enrollees who often continued to pursue curative treatments for their terminal illness**.

(see Chapter 5). We did not have a hypothesis on how quality-of-care outcomes might differ, because both MCCM and hospice aim to improve quality of care and it was unclear which of the two might have larger impacts on these outcome measures.

[59] The comparison group who enrolled directly in hospice might be less affected by unobserved selection bias than our main analysis because (1) MCCM enrollees and beneficiaries who chose hospice may have shared more unobserved characteristics (preferences for end-of-life care, for example) with the enrolled group and (2) both groups were known to have a prognosis of less than six months to live as of their MCCM or hospice enrollment date.

Figure 28. Selected outcomes for deceased MCCM enrollees, main matched comparison beneficiaries, and alternative matched comparison beneficiaries who entered hospice at the start of the study period: ***MCCM enrollee outcomes fell in between that of the two comparison groups.***



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Note: Regression-adjusted means reported for MCCM enrollees (N = 5,153), main matched comparison beneficiaries (N = 15,269 before weighting), and the alternative matched comparison group that enrolled directly in hospice (N = 179,168 before weighting). See Appendix E, Section 1, for full results with the main comparison group (blue) and Appendix E, Section 6, for full results with the alternative comparison group (yellow). We constructed both comparison groups to resemble the MCCM enrollees at enrollment.

MCCM = Medicare Care Choices Model.

7. Variation in MCCM's Effects across Beneficiary Subgroups

Key takeaways

MCCM had widespread impacts on enrollee outcomes, although these impacts were larger for certain beneficiary subgroups:

- MCCM's impacts on Medicare expenditures and service use varied by the length of time enrollees lived after enrolling in MCCM. The largest Medicare savings occurred among those who lived 3 to 12 months after enrolling in MCCM. Impacts on hospice use were somewhat larger for those who lived less than one month.
- MCCM's effects were remarkably similar for the subgroups of beneficiaries with cancer, congestive heart failure, and chronic obstructive pulmonary disease.
- MCCM improved outcomes for enrollees from underserved communities, such as non-White or Hispanic, dually eligible, or rural beneficiaries, although not always as much as it improved outcomes for non-Hispanic White, non-dually eligible, or non-rural enrollees, respectively (depending on the outcome).
  - Most notably, MCCM reduced, but did not eliminate, disparities in the rates of hospice use among non-White or Hispanic (versus non-Hispanic White) enrollees and dually eligible (versus non-dually eligible) enrollees.
- Although there was meaningful variation in hospice-specific impacts, virtually all MCCM hospices with at least one enrolled beneficiary had the intended effects on beneficiaries' outcomes.

In Chapter 6, we reported that, on average, MCCM enrollees had lower Medicare Part A and B expenditures, used fewer resource-intensive services (such as being admitted to an inpatient hospital), used the Medicare hospice benefit earlier and more often, and received better-quality end-of-life care than beneficiaries in the matched comparison group. However, the model's benefits might not have been uniform among subpopulations, including those who survived for a short versus long period of time or those who had certain qualifying conditions. In addition, the model could have had differential impacts for model enrollees from historically underserved communities, given existing disparities in care and outcomes among these groups. Finally, some MCCM hospices might have had larger or smaller impacts because of differences in organizational characteristics, contextual factors, approaches to model implementation, or other factors.

To explore these issues, this chapter focuses on estimating the impacts of the model for subgroups of MCCM enrollees defined by the following characteristics:

1. Survival time
2. Qualifying condition (cancer, congestive heart failure, and chronic obstructive pulmonary disease)
3. Race and ethnicity
4. Dual eligibility for Medicare and Medicaid

5. Residing in a rural area
6. The hospice where the beneficiary enrolled

Throughout the chapter, we estimate impacts for subgroups using Bayesian hierarchical models described in Appendix C, Section 5.2, which provide increased efficiency (statistical power) and better protection against spurious findings than more traditional regression modeling approaches. With Bayesian models, we can interpret impact estimates, and comparisons of impact estimates, probabilistically. For example, we can compute the probability that impacts are larger for one subgroup than for another (such as the probably that impacts were larger for beneficiaries with cancer versus those without). We use these probability statements to supplement impact estimates and uncertainty intervals. Appendix E reports results for additional subgroups.

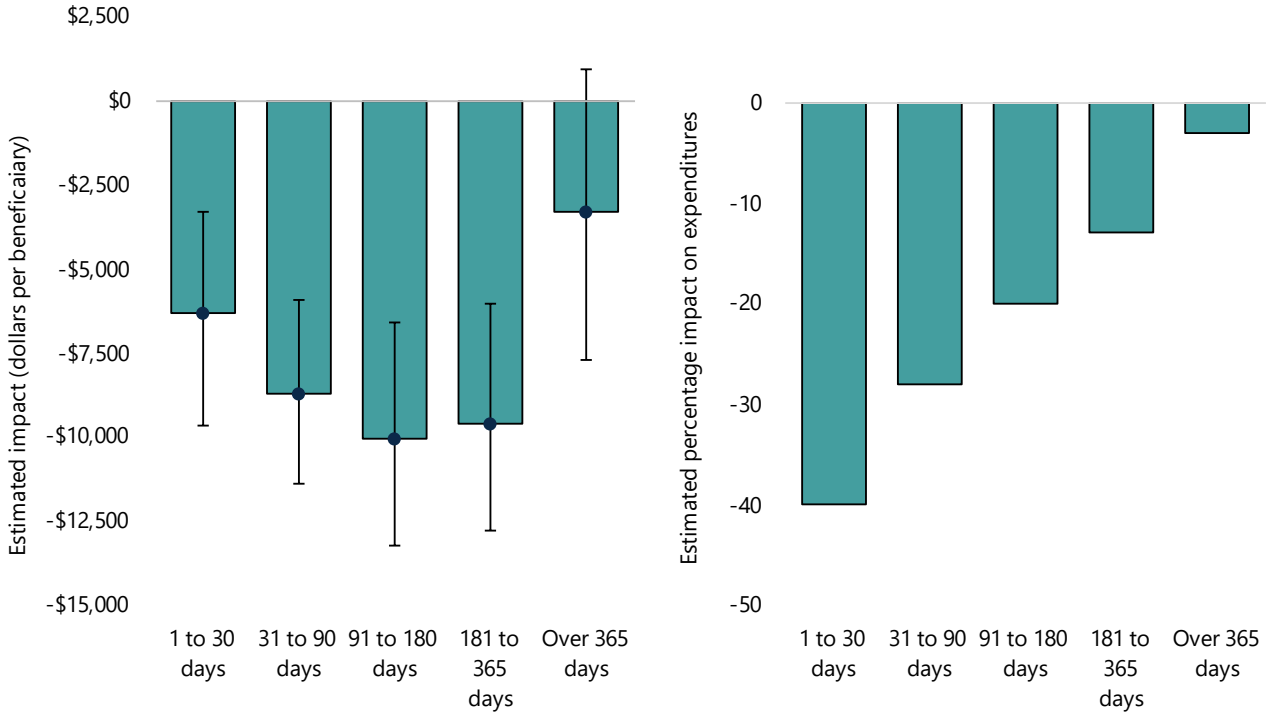
7.1. Variation in model effects by enrollee's survival time

Enrollment in MCCM is intended for Medicare beneficiaries with a prognosis of six months or less, but as noted in Chapter 3, survival times varied substantially across enrollees. To understand and account for potential variation in the model's effects, we assessed how MCCM's estimated impacts on Medicare expenditures, service use, hospice use, and quality of care varied by enrollees' survival time.

The estimated reduction in total Medicare expenditures (including model payments) per beneficiary was largest for enrollees who survived 3 to 12 months (left side of Figure 29). MCCM had smaller impacts on reducing net Medicare expenditures for the 17 percent of beneficiaries who survived at least one year, because they were enrolled in MCCM for longer (generating additional payments for MCCM or hospice) and had smaller reductions in Medicare Part A and B expenditures than enrollees with shorter survival times. We did, however, estimate that enrollees with longer survival times had the largest reductions in rates of inpatient admissions and emergency department visits and observation stays, and the largest increases in the number of days at home (Appendix E, Table E.9).

Reductions in net Medicare expenditures were largest in *percentage* terms among beneficiaries who survived the shortest amount of time (less than 30 days), and percentage impacts decreased with survival time (right side of Figure 29). MCCM had similarly large percentage reductions in hospital service use and days at home for enrollees with shorter survival times (Appendix E, Table E.9). One explanation compatible with our findings is that all MCCM enrollees experienced sizable reductions in expenditures and service use in the last 30 days of life (Appendix E, Table E.16). But longer-surviving enrollees had time to accrue further reductions in Medicare expenditures and hospital service use, particularly when they made earlier transitions from MCCM to hospice. In other words, **MCCM generated the largest savings toward the end of life but also generated additional savings earlier in an enrollee's disease trajectory if they enrolled early enough.**

Figure 29. Estimated impacts of MCCM on Medicare expenditures (including model payments) by survival time: ***MCCM generated the largest savings in absolute dollar terms for enrollees who survived 3 to 12 months, but savings in percentage terms decreased with survival time.***



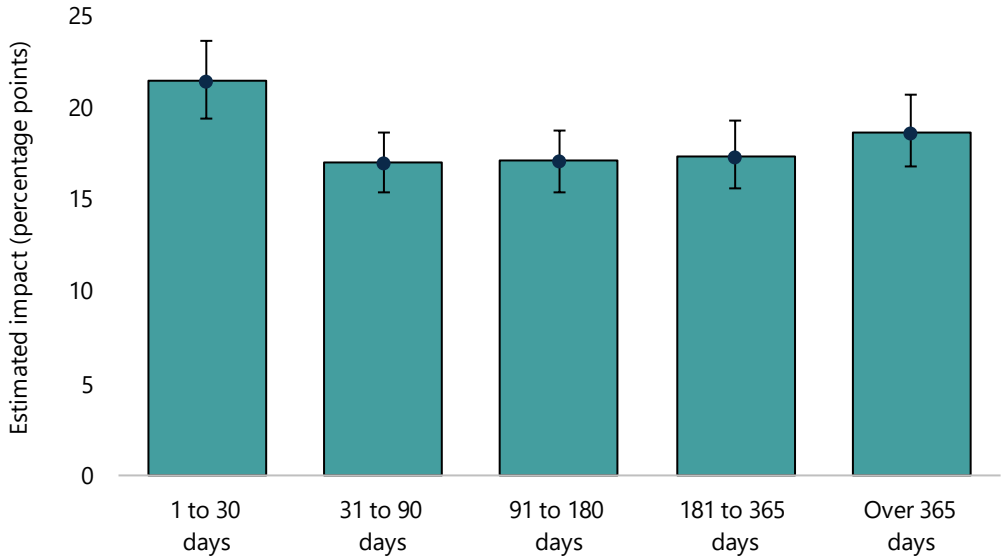
Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. The figure's left side shows 90 percent credible intervals. See Appendix E, Table E.9, for full impact analysis results for these subgroups and outcome measures.

MCCM = Medicare Care Choices Model.

Impacts on hospice use were somewhat larger for the those who survived less than one month compared with other enrollees with longer survival times (Figure 30). These enrollees with shorter survival times used the Medicare hospice benefit 77 percent of the time, as compared with 56 percent in the comparison group (a 22-percentage point increase). MCCM's impacts on hospice use were modestly smaller (17 to 19 percentage point increases) for beneficiaries who survived at least one month after enrolling in MCCM. MCCM's modestly larger impact on hospice use among beneficiaries who survived less than one month could be partly due to there being more opportunity for improvement among this subgroup: in the absence of MCCM, comparison beneficiaries who survived for less than one month had the lower rates of hospice use than comparison beneficiaries with longer survival times (Appendix E, Table E.9).

Figure 30. Estimated impacts of MCCM on Medicare hospice benefit use by survival time: *MCCM generated the biggest increase in hospice use for enrollees who survived less than one month.*



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. The figure shows 90 percent credible intervals. See Appendix E, Table E.9, for full impact analysis results for these subgroups and outcome measures.

MCCM = Medicare Care Choices Model.

MCCM's impact on receiving an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life was similar for all enrollees, regardless of the length of time between MCCM enrollment and death (Appendix E, Table E.9).

7.2. Variation in model effects across qualifying conditions

As noted in Chapter 1, beneficiaries had to have one of four qualifying conditions—cancer, congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS—to qualify for enrollment in MCCM. We investigated whether MCCM had similar impacts for beneficiaries with these different qualifying conditions.[60] The results help us understand whether the model benefited all enrollees and have implications for clinical care and the development of future policies.

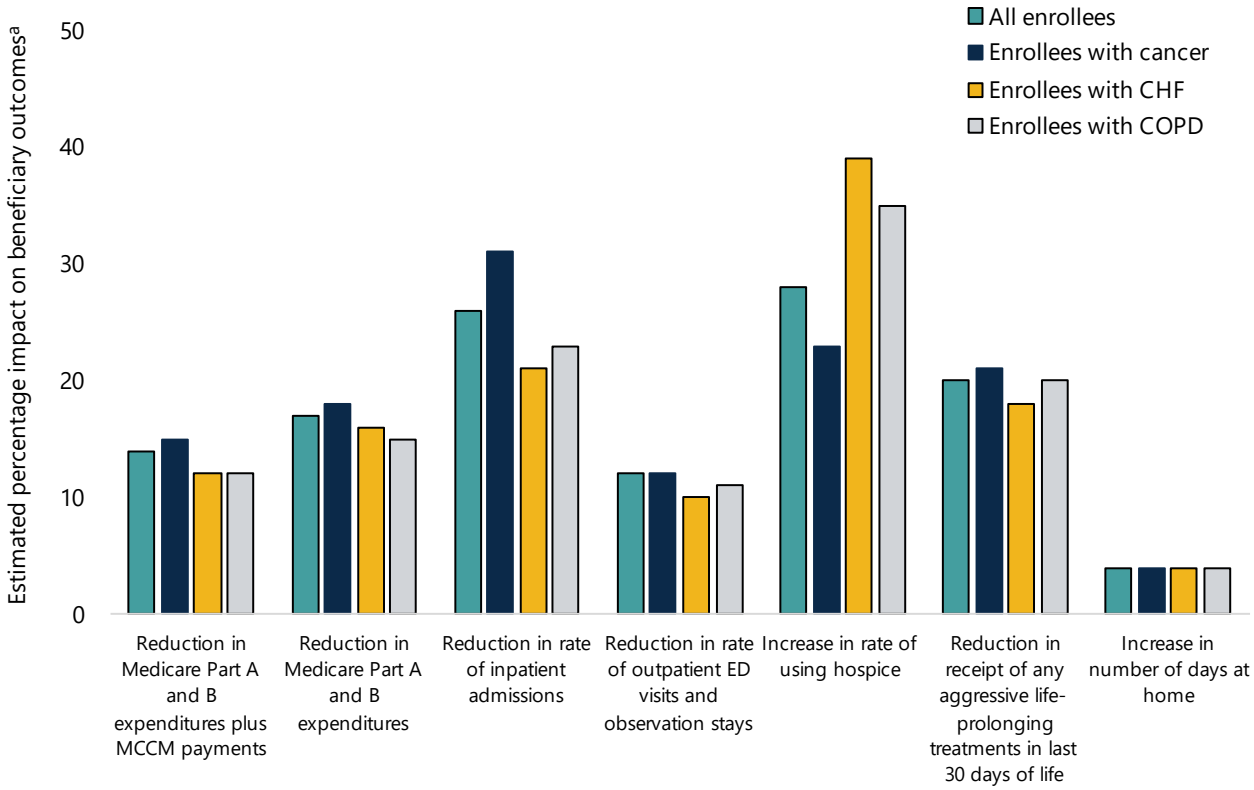
MCCM's impacts were remarkably similar for enrollees with cancer, congestive heart failure, and chronic obstructive pulmonary disease across all four outcome domains: Medicare expenditures, service use, hospice use, and quality of end-of-life care (Figure 31).

[60] This report does not present impacts for the 20 MCCM enrollees (less than 1 percent) with HIV/AIDS, because the sample size was too small.

- Medicare expenditures (including model payments) were reduced by 12 to 15 percent for enrollees with each of the three diagnoses. These subgroup analyses have high statistical precision, so there was a moderately high probability (76 percent) that net reductions in Medicare expenditures were larger for enrollees with cancer than other enrollees, despite the estimated impacts being relatively similar (approximately $7,300 to $7,900, depending on the condition).
- Likewise, there was little variation in impacts of MCCM on rates of inpatient admissions across beneficiaries with cancer, congestive heart failure, or chronic obstructive pulmonary disease. Estimated reductions in admission rates were similar across the three qualifying condition subgroups (442 to 454 fewer admissions per 1,000 beneficiaries). However, the subgroups had different underlying admission rates, so the impact estimates varied more when expressed in percentage terms (from 21 to 31 percent). Estimated impacts on rates of emergency department visits and observation stays were similar across the three qualifying condition subgroups.
- Similarly, impacts on the probabilities that enrollees used the hospice benefit were roughly equivalent across qualifying conditions (16 to 21 percentage points). However, MCCM enrollees and comparison beneficiaries with cancer used hospice at higher rates than other beneficiaries, so this finding represents a somewhat smaller *percentage* impact for enrollees with cancer.
- Finally, MCCM had approximately the same (4 percent) impacts on the number of days at home for enrollees with cancer, congestive heart failure, or chronic obstructive pulmonary disease. All three groups also saw similarly sized reductions in the likelihood of undergoing aggressive life-prolonging treatments in the last 30 days of life.

Thus, MCCM had similar estimated impacts on Medicare expenditures, acute care service use, hospice use, and quality of care across beneficiaries with the three qualifying conditions. The large, favorable estimated impacts across all three qualifying conditions suggest improvements depend less on beneficiaries' conditions or on model features specific to a particular illness. It may be that beneficiaries with different conditions experience the same types of potentially distressing symptoms with similar frequency towards the end of life, that, in the absence of MCCM, would have prompted an emergency department visit and subsequent hospital admission, but were avoided with MCCM and hospice care, leading to similarly sized reductions in expenditures and service use or increases in the number of days at home. The greater use of the hospice benefit among beneficiaries with cancer compared to beneficiaries with non-cancer conditions has been observed before (Seow et al. 2018 and 2020; Quereshi et al. 2019). Perhaps beneficiaries with cancer, their caregivers, and their clinicians are more accepting that cancer can be terminal than beneficiaries with non-cancer conditions.

Figure 31. Estimated impacts of MCCM on expenditures, service use, hospice use, and quality of end-of-life care, overall and by qualifying condition: *Impacts of MCCM did not vary substantially across beneficiaries with different qualifying conditions.*



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. See Appendix E, Table E.10, for full impact analysis results for these subgroups and outcome measures.

We did not present impacts for the 20 MCCM enrollees (less than 1 percent) with HIV/AIDS, because the sample size was too small.

[a] Estimated impacts were all in the hypothesized (intended) direction for all outcome measures in this figure. Therefore, we present the absolute values of impact estimates, in percentage terms, for ease of presentation. For example, the impact estimate for Medicare expenditures is shown as a *positive* amount, even though we estimated that MCCM *reduced* (not increased) Medicare expenditures.

CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; MCCM = Medicare Care Choices Model.

7.3. Model effects for enrollees from underserved communities

The CMS Innovation Center's 2021 Strategy Refresh and the CMS Framework for Health Equity underscore the center's commitment to advancing health equity (Brooks-LaSure et al. 2021; Seshamani et al. 2022; CMS 2021, 2022b).[61] One priority is to better understand the impact of CMS models for all beneficiaries, including those from underserved communities. For this reason, we investigated how

[61] The launch of MCCM predates this strategy; advancing health equity was not an explicit goal of the model.

beneficiary outcomes differed for MCCM enrollees (1) who were non-White or Hispanic versus those who were non-Hispanic White, (2) who were dually eligible for Medicare and Medicaid versus those who were eligible only for Medicare, and (3) who did versus did not live in rural areas. This analysis also aligns with a broader desire to understand whether impacts differ by subgroup; even if impacts were comparable or larger for enrollees from underserved communities, variation in impacts is of interest in its own right and can inform the design of other CMS models. Subgroup analyses can also help to assess whether the model reduced or increased health disparities, even if impacts were in the same direction for all subgroups. We conducted these analyses for all primary evaluation outcome measures and secondary quality of end-of-life care measures, but we focused particularly on quality-of-care measures and hospice use. It was unclear whether higher or lower levels of expenditures and acute care service use might represent better care for beneficiaries from underserved communities considering the health care access and other challenges these communities may face.

MCCM provided additional choices to beneficiaries—offering them services that Medicare does not typically fund. Therefore, we would not expect this model to have had negative consequences for beneficiaries who chose to enroll. However, the model did pay for services on a fixed-price basis, which suggests that, if it is more expensive for hospices to provide services to a particular subgroup—because they may live farther from the hospice than other subgroups, for example—this subgroup might receive a lower level of service and not benefit equally from the model. MCCM presents the following concerns:

- **Non-White or Hispanic beneficiaries** might not receive the services that best meet their needs, compared with non-Hispanic White beneficiaries, because of differences in health and health-related social needs, language and communication needs, and differences in access to and service use of health care resulting from systemic racism and having fewer resources.
- **Dually eligible beneficiaries** might have more challenges than non-dually eligible beneficiaries coordinating care across multiple payment sources and in-home service providers or have additional health-related social needs associated with having fewer resources.
- **Beneficiaries living in rural areas** might not receive the same set or intensity of in-home services from MCCM hospices because of higher travel costs, or they might have differential impacts because of lower availability of (fewer choices in) clinicians, home and community-based service providers, and hospice care.

To assess whether MCCM made progress in *reducing* disparities, we first determined the extent of *existing* disparities. To that end, we compared outcomes between enrollment and death for the underserved community and the reference group in the comparison group. This comparison grounds our understanding of existing disparities, absent the effects of MCCM. In the sections that follow, we focus our discussion on outcomes where we observed disparities in the comparison group. (Appendix E includes results for all the outcome measures. We also present the characteristics of MCCM enrollees belonging to these subgroups in Appendix A, Section 5.2.)

In general, outcomes were disparate for beneficiaries from underserved communities who did not enroll in MCCM (that is, in the comparison group between enrollment and death). MCCM generally affected enrollees' outcomes in the direction hypothesized (intended) for the model at large for beneficiaries from all subgroups. Further, MCCM partly reduced disparities in the use of hospice care, by increasing the use of the Medicare hospice benefit more for non-White or Hispanic enrollees and for dually eligible

enrollees compared with the estimated increases for non-Hispanic White and non-dually eligible enrollees, respectively. For other outcomes, however, impacts were typically similar or smaller for beneficiaries who were non-White or Hispanic, dually eligible for Medicare and Medicaid, or lived in rural areas. Therefore, many disparities persisted even with the effects of MCCM. The following sections discuss these results in more detail.

7.3.1. Non-White or Hispanic beneficiaries

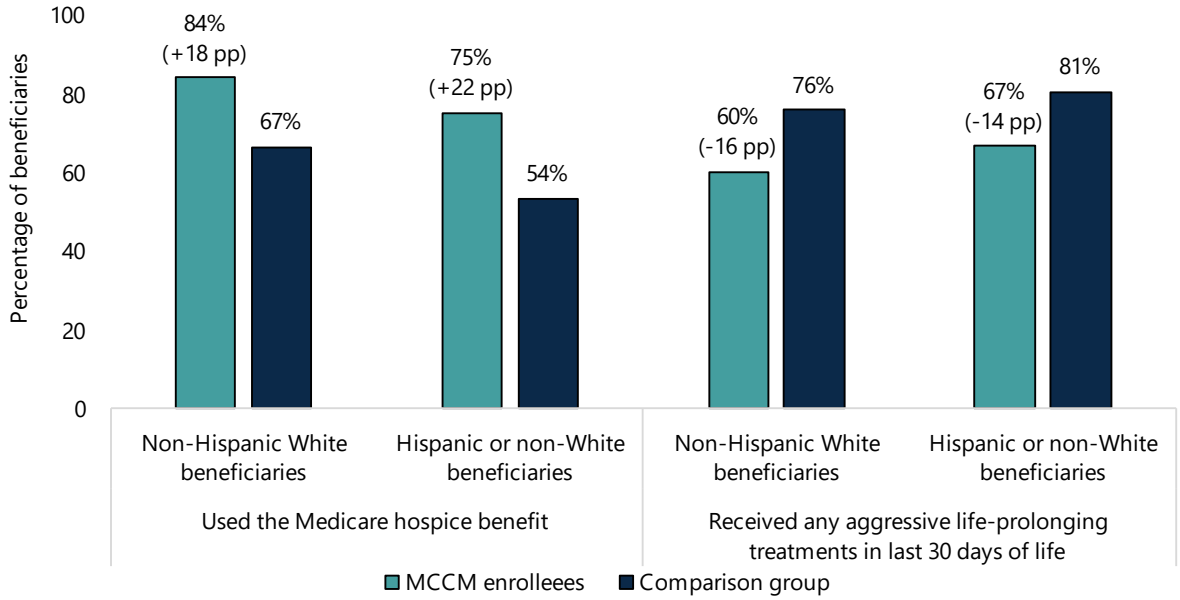
In the absence of MCCM, non-White or Hispanic beneficiaries tended to have different outcomes than non-Hispanic White beneficiaries. In the comparison group, non-White or Hispanic beneficiaries had higher levels of Medicare expenditures and service use than non-Hispanic White beneficiaries between enrollment and death. They used the Medicare hospice benefit at lower rates, in line with patterns that are well documented in the literature (Ornstein et al. 2020; LoPresti et al. 2016; MedPAC 2022; National Hospice and Palliative Care Organization 2022), and were more likely to die in an inpatient facility. Our analysis examines whether MCCM affected these disparities.

MCCM made progress toward addressing these disparities in rates of hospice use. Specifically, MCCM increased rates of hospice use by 22 percentage points for non-White or Hispanic enrollees (from 54 to 75 percent), which is larger than the 18 percentage point increase in hospice use attributed to MCCM among non-Hispanic White enrollees (from 67 to 84 percent; left side of Figure 32). Thus, our estimates suggest that MCCM reduced disparities in rates of hospice use—increasing the rate for non-White or Hispanic MCCM enrollees so that it exceeded the rate observed for non-Hispanic White beneficiaries in the comparison group.

The pattern was reversed for one outcome: receipt of aggressive treatments in the last 30 days of life. MCCM reduced the probability of receiving an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life for both subgroups, but it had a larger impact for non-Hispanic White enrollees (right side of Figure 32). MCCM reduced the probability of receiving an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life by 21 percent for non-Hispanic White enrollees and 17 percent for non-White or Hispanic beneficiaries, thereby increasing the disparity for this outcome. Even with MCCM, non-White or Hispanic enrollees remained more likely to receive this type of treatment in the last 30 days of life than non-Hispanic White enrollees. However, this relationship is not straight-forward to interpret; at least some literature suggests that, compared to non-Hispanic White populations, non-White or Hispanic populations may prefer more aggressive treatment with the goal of prolonging life as much as possible (LoPresti et al. 2016). Thus, it is unclear whether MCCM in this case failed to reduce a disparity or provided treatment in line with the beneficiaries' preferences.

For the remaining outcomes we examined, MCCM had similar estimated impacts for non-Hispanic White enrollees and enrollees with a different race or ethnicity (Appendix E, Table E.11).

Figure 32. Estimated impacts of MCCM on rates of hospice use and receipt of aggressive life-prolonging treatments, by race and ethnicity: ***MCCM increased the rate of using hospice more, and decreased the receipt of aggressive life-prolonging treatments less, for non-White or Hispanic MCCM enrollees (compared with the impacts for non-Hispanic White enrollees).***



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. The numbers in parentheses above MCCM enrollees' bars show estimated impacts in percentage points. See Appendix E, Table E.11, for full impact analysis results for these subgroups, including other outcome measures.

MCCM = Medicare Care Choices Model; pp = percentage points.

7.3.2. Dually eligible beneficiaries

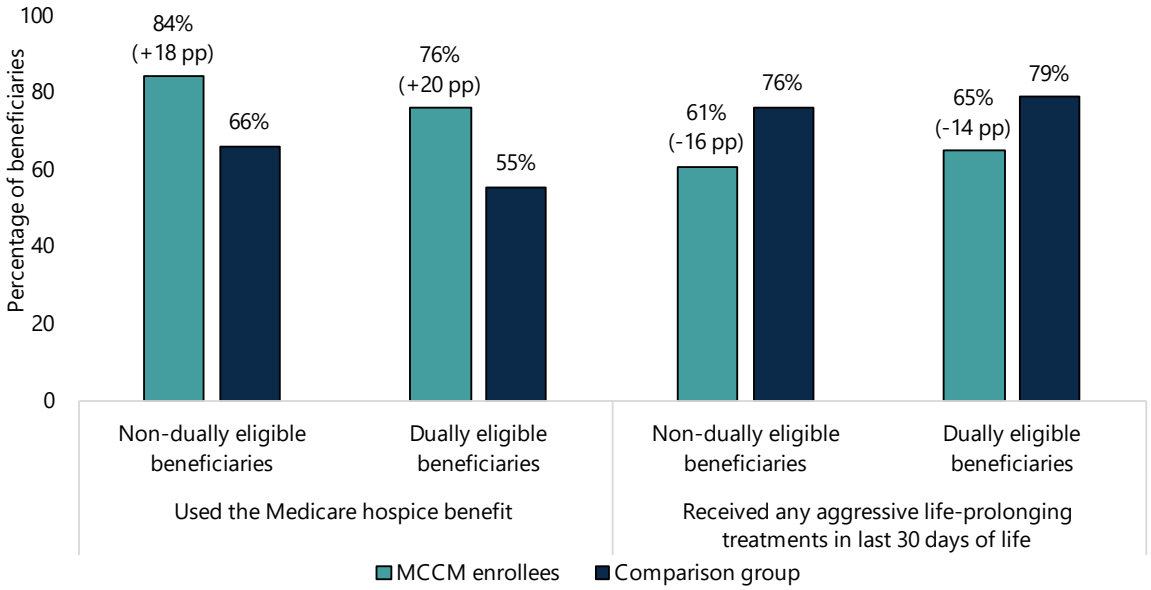
Without MCCM, dually eligible beneficiaries tended to have different outcomes than non-dually eligible beneficiaries. Namely, dually eligible beneficiaries in the comparison group had higher Medicare expenditures and health care service use and were less likely to use the Medicare hospice benefit between enrollment and death than those who were only enrolled in Medicare. They also experienced lower-quality care, particularly higher rates of aggressive life-prolonging treatments and multiple emergency department visits and hospitalizations in the last 30 days of life. Our analysis examines whether MCCM reduced these disparities.

We estimate MCCM increased hospice use more among dually eligible enrollees than it increased hospice use for non-dually eligible enrollees (left side of Figure 33). MCCM increased rates of hospice use by 20 percentage points for dually eligible enrollees (from 55 to 76 percent), more than the 18 percentage point increase in hospice use for non-dually eligible enrollees (from 66 to 84 percent). Conversely, MCCM reduced the probability of receiving an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life less for dually eligible beneficiaries (a 14 percentage

point reduction) compared with the 16 percentage point reduction estimated for non-dually eligible beneficiaries (right side of Figure 33). However, the differences in impact estimates for these two outcomes appear to be mostly because of observable differences between the two groups in beneficiary characteristics associated with model impacts. For example, dually eligible beneficiaries tended to be younger, and were more likely to be non-White or Hispanic, than non-dually eligible beneficiaries. Dually eligible beneficiaries were also more likely to have diabetes or heart failure and had slightly higher hierarchical condition category risk scores. (Appendix Table A.9 presents a full comparison of the baseline characteristics of dually eligible and non-dually eligible MCCM beneficiaries.) After holding the characteristics of dually eligible and non-dually eligible beneficiaries constant, little difference in impact estimates remained.[62]

For all the other outcomes examined, MCCM had similar impacts on dually eligible and non-dually eligible enrollees. That is, differences in impact estimates between the two subgroups were generally small, and could not be statistically distinguished from zero, before or after controlling for differences in beneficiary characteristics between the two groups (Appendix E, Table E.12).

Figure 33. Estimated impacts of MCCM on rates of hospice use and receipt of aggressive life-prolonging treatments, by dual eligibility status: *MCCM increased the rate of hospice use more, and decreased the receipt of aggressive life-prolonging treatments less, for dually eligible MCCM enrollees (compared with the impacts for non-dually eligible enrollees).*



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

[62] This result can be found in the last column of Appendix E, Table E.12. The main analysis (in Figure 33) controls for residual differences in beneficiary characteristics between the intervention and matched comparison groups but allows beneficiary characteristics to vary between the two subgroups (dually eligible and non-dually eligible beneficiaries). In the appendix, we also estimated differences in impact estimates holding beneficiary characteristics constant across subgroups. This analysis enables us to focus on how impact estimates between dually eligible and non-dually eligible beneficiaries, holding everything else constant.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. The numbers in parentheses above MCCM enrollees' bars show estimated impacts in percentage points. See Appendix E, Table E.12, for full impact analysis results for these subgroups, including other outcome measures.

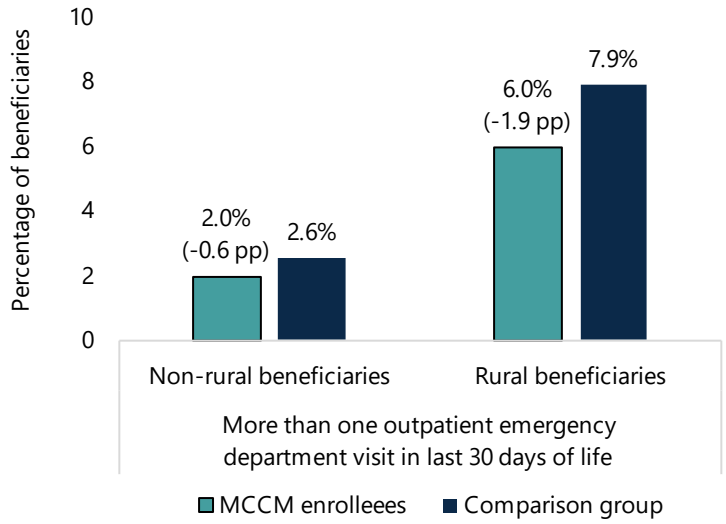
MCCM = Medicare Care Choices Model; pp = percentage points.

7.3.3. Beneficiaries living in rural areas

Without MCCM, there is little evidence of substantial disparities between rural and non-rural beneficiaries. Comparison beneficiaries living in rural and non-rural areas had similar levels of Medicare Part A and B expenditures, inpatient admissions, and quality of end-of-life care between enrollment and death. However, rural beneficiaries tended to visit the emergency department more than non-rural beneficiaries. Although it is not a primary outcome for our analyses of underserved communities, we investigated the effects of MCCM on this outcome for rural beneficiaries because it represents a disparity that the model could alleviate.

Our analysis of outcome differences in the comparison group suggests that there are few disparities to address for rural beneficiaries, and our results follow the same pattern. For the quality of care and hospice use outcomes of primary interest in this analysis, MCCM had similar impacts on beneficiaries living in rural and non-rural areas (Appendix E, Table E.13). Differences in impact estimates between the two subgroups were generally small and could not be statistically distinguished from zero. However, MCCM was most likely to have a larger impact on having multiple outpatient emergency department visits for rural enrollees. As noted, rural comparison beneficiaries tended to visit the emergency department more frequently than non-rural comparison beneficiaries, so this reduction represents a partial decrease in the disparity. We estimated a 94 percent probability that MCCM led to greater reductions in the percentage of beneficiaries with more than one outpatient emergency department visit in the last 30 days of life for rural enrollees, compared with its impact on non-rural beneficiaries.

Figure 34. Estimated impacts of MCCM on rates of more than one emergency department visit in the last 30 days of life, by rural status: ***MCCM decreased the rate of emergency department visits more for rural enrollees than non-rural enrollees.***



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. The numbers in parentheses above MCCM enrollees' bars show estimated impacts in percentage points. See Appendix E, Table E.13, for full impact analysis results for these subgroups, including other outcome measures.

MCCM = Medicare Care Choices Model; pp = percentage points.

7.4. Variation in model effects across participating hospices

So far, we have shown that MCCM produced the intended effects on a variety of outcome measures, both overall and within beneficiary subgroups. In this section, we present results of model effects *separately for each participating hospice*.[63] This analysis quantifies the extent to which impacts varied across hospices, which has implications for the generalizability of the evaluation findings to other hospices. (For example, the findings could inform decisions about whether or how to limit hospice eligibility for future models like MCCM.). Further, we use the hospice-specific impacts as inputs into analyses in Chapter 8, which explores the role of hospice-specific factors, such as implementation approaches, in explaining variation in model impacts.

Although there was meaningful variation in estimated hospice-specific impacts, virtually all MCCM hospices with at least one enrolled beneficiary had the intended effects on beneficiary outcomes. To begin, consider the hospice-specific impacts on total Medicare Part A and B expenditures plus MCCM payments in Figure 35. The dots are estimated impacts of MCCM on total Medicare expenditures (including model payments) for each hospice. The hospices are sorted by the size of the impact, with the hospices on the right (highest number rank) having the largest reductions in Medicare expenditures. The lines above or below each dot are 90 percent credible intervals. We have several important observations based on this figure:

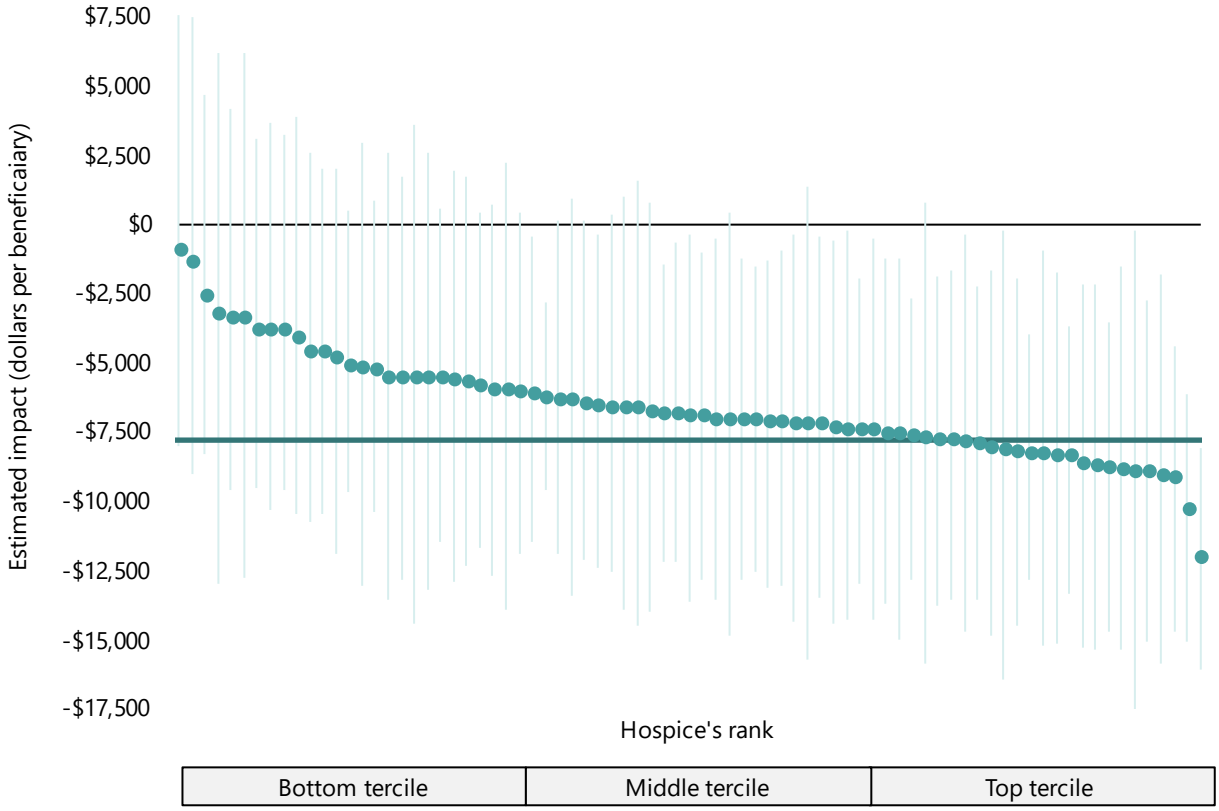
1. Our point estimates indicate *all* hospices reduced net Medicare expenditures for their enrollees. This is evidenced by the point estimates (dots) being negative for all hospices. The point estimate is the best estimate of the model's effect at a given hospice. Point estimates below zero indicate a greater than 50 percent chance that the hospice *reduced* net Medicare expenditures for its enrollees on average.
2. The figure exhibits substantial variation in impact estimates across hospices. The hospice with the smallest point estimate (at the far left) reduced Medicare expenditures by an estimated $912, the hospice in the middle (median) reduced Medicare expenditures by $6,914, and the hospice with the largest impact (far right) reduced Medicare expenditures by $11,988.
3. The 90 percent credible intervals for some hospices' impact estimates include $0. In a Bayesian analysis, the 90 percent credible interval is the region in which there is a 90 percent chance of finding the true impact. If the interval includes $0, this means that there is at least a 5 percent chance that MCCM *increased* net Medicare expenditures. For example, we estimate a 61 percent

[63] We calculated hospice-specific impact estimates for 79 hospices that had at least one MCCM enrollee in our analytic sample for impact analyses (defined in Appendix C, Section 2.2).

probability that the hospice on the far left of the figure decreased net Medicare expenditures for its MCCM enrollees (first row in Table 10).

4. We can statistically distinguish—or, say there was a high probability of differences in impacts—between the top and bottom hospices. In this case, there's an estimated 99 percent probability that the top 10 percent reduced Medicare expenditures more than average, and a 98 percent probability that bottom 10 percent reduced Medicare expenditures less than average (first row in Table 10).
5. The width of the credible intervals vary across hospices, reflecting varying degrees of certainty for each hospice's estimate. Generally, hospices with more enrollees will have smaller credible intervals.

Figure 35. Estimated impacts of MCCM on Medicare expenditures (including model payments) for each participating hospice: *Although there was meaningful variation in hospice-specific impact estimates, all MCCM hospices reduced Medicare expenditures.*



Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: Each dot is the impact estimate for a single MCCM hospice. The hospices are sorted by their impact estimate, from smallest to largest. The lines above and below each dot indicate the corresponding 90 percent credible intervals. We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. This figure includes 79 hospices that had at least one MCCM enrollee in our analytic sample for impact analyses (defined in Appendix C, Section 2.2). The horizontal green line indicates the overall impact estimate across all hospices.

MCCM = Medicare Care Choices Model.

Rather than present seven of these complex figures—one for each outcome—we summarize the hospice-specific impact estimates for all the main outcome measures in Table 10. The same general patterns emerge for these other outcomes as for Part A and B expenditures: **Although there was meaningful variation in hospice-specific impacts, virtually all MCCM hospices improved all the beneficiary outcomes we examined.** Each outcome exhibited variation in impacts across hospices. In the columns on the left of the table, there are wide distributions of hospice-specific impact estimates. We observe the largest hospice-specific variation for the percentage of beneficiaries with more than one outpatient ED visit in the last 30 days of life, the number of days at home, and the number of inpatient admissions. Further, we estimate high probabilities that the mean impacts among the 10 percent of hospices with the highest and lowest impact estimates are different from the average impact for all outcomes (columns on the right). That is, there is a high probability that the 10 percent of hospices with the greatest reduction in Medicare expenditures succeeded in reducing Medicare expenditures more than the average hospice, and vice versa for the 10 percent of hospices with the smallest reductions in Medicare expenditures. Although these probabilities are high for all outcomes, impacts varied more across some outcomes than others, as measured by a heterogeneity metric.[64] Despite this heterogeneity in impacts across hospices, we found that for virtually all hospices—even those with smaller impacts—MCCM led to decreases in Medicare expenditures and hospital service use, increases in hospice use, and improved quality of care.[65] That is, the generally positive impacts of MCCM were widespread.

[64] This metric is calculated using the distribution of point estimates across hospices for each outcome. For a given outcome, we define the magnitude of the heterogeneity as the interquartile range of the impacts (75th percentile minus the 25th percentile) divided by the median.

[65] We say *virtually all hospices* because all hospices' point estimates were in the hypothesized direction, except for one hospice for one outcome (inpatient admissions).

Table 10. Distribution of hospice-specific impact estimates on expenditures, service use, hospice use, and quality of end-of-life care: ***Although there was meaningful variation in hospice-specific impact estimates, virtually all MCCM hospices improved all the beneficiary outcomes.***

Outcome	Distribution of hospice-specific impact estimates[a]						Probabilities		
	Minimum	25th percentile	Median	75th percentile	Maximum	Magnitude of variation (IQR/median)	Top 10% of hospices more favorable than the average[b]	Bottom 10% of hospices less favorable than average[c]	Least favorable hospice-specific impact is favorable[d]
Expenditures (dollars per beneficiary)									
Medicare Part A and B expenditures plus MCCM payments	-912	-5,548	-6,914	-7,739	-11,988	32%	99	98	61
Medicare Part A and B expenditures	-4,672	-8,069	-8,753	-9,529	-13,599	17%	96	97	85
Service use (number per 1,000 beneficiaries)									
Number of inpatient admissions	+466	-362	-451	-529	-1,033	37%	99	>99	10
Number of outpatient emergency department visits and observation stays	-72	-104	-124	-138	-237	28%	83	82	83
Hospice use (percentage of beneficiaries)									
Used the Medicare hospice benefit	+9.9	+15.8	+17.8	+20.1	+25.4	24%	>99	>99	>99
Quality of end-of-life care									
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	-9.2	-13.4	-14.2	-15.4	-19.0	14%	>99	>99	>99
Number of days at home	+0.8	+5.1	+6.7	+8.1	+22.2	45%	>99	>99	>99

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. This table includes 79 hospices that had at least one MCCM enrollee in our analytic sample for impact analyses (defined in Appendix C, Section 2.2).

[a] These columns summarize the impact estimates (corresponding to dots in Figure 35) across hospices for each outcome.

[b] Probabilities in this column compare the posterior distribution of the average impact across the 10 percent of hospices with the most favorable impacts—that is, impacts of the greatest magnitude in the hypothesized direction—on each outcome to the posterior distribution of the average impact on that outcome.

[c] Probabilities in this column compare the posterior distribution of the average impact across the 10 percent of hospices with the least favorable impacts—that is, impacts of the greatest magnitude in the opposite of the hypothesized direction—on each outcome to the posterior distribution of the average impact on that outcome.

[d] Probabilities in this column compare the posterior distribution of the impact of the hospice with the least favorable—that is, the largest magnitude in the opposite of the hypothesized direction—impact to zero.

IQR = interquartile range (75th percentile minus the 25th percentile); MCCM = Medicare Care Choices Model.

8. Synthesis of Implementation and Impact Results

Key takeaways

In exploratory analyses, some organizational characteristics and implementation metrics for hospices participating in MCCM were associated with larger reductions in Medicare expenditures, larger increases in use of the Medicare hospice benefit, and larger reductions in aggressive treatment toward the end of life. Notable associations we discovered include the following:

- Participation in an accountable care organization was associated with larger reductions in expenditures and aggressive treatments, and larger increases in hospice use.
- Training hospice staff in delivering MCCM services and ensuring quality was associated with larger reductions in expenditures and aggressive treatments.
- How participating hospices delivered services to their enrollees was associated with impacts on beneficiary outcomes. For example, conducting a larger percentage of encounters in person or having a registered nurse care coordinator provide most of the MCCM services was associated with larger reductions in Medicare expenditures.
- Enrolling more beneficiaries in MCCM was associated with larger reductions in expenditures and aggressive treatments, and larger increases in use of the hospice benefit.

The goal of our synthesis analysis was to assess which hospice-level factors were associated with MCCM-participating hospices' model performance. The literature has shown individual, organizational, and market factors are associated with hospices' strategic conduct and performance delivering services (He et al. 2020); we wanted to explore whether these types of factors could be also associated with hospices' performance improving outcomes for MCCM enrollees. To measure model performance, we used hospice-specific, regression-adjusted impacts on three outcomes for beneficiaries enrolled at each hospice: (1) reductions in total Medicare expenditures; (2) increases in rates of using the Medicare hospice benefit; and (3) reductions in the likelihood of receiving aggressive life-prolonging procedures, surgeries, or diagnostic tests in the last 30 days of life.[66] Together, the three outcomes capture MCCM's intended effects on health service use, hospice enrollment, and quality of care.

In our exploratory analysis, we included hospice-level factors grouped into five categories:

1. *Hospice organizational characteristics and context,* such as size, ownership status, and participation in alternative payment models, were measured at the beginning of the model.[67] An association between these hospice characteristics and performance would indicate that MCCM hospice participants with certain organizational characteristics were better suited to improve their enrollees' outcomes.

[66] We presented these hospice-specific impact estimates in Chapter 7, Section 7.4. We normalized the hospice-specific impact estimates such that a *positive* number indicates impacts in the hypothesized direction.

[67] We discussed hospice organizational characteristics and context in Chapter 2.

2. *MCCM implementation metrics* describe how hospices changed their internal organization when participating in the model. These factors include changes in business or clinical operations and staff training that could contribute to better hospice performance if they enabled hospices to implement MCCM more effectively.[68]
3. *Service delivery factors* summarize how participating hospices delivered services to their enrollees. Specifically, this category includes the frequency of MCCM services, whether services tended to be delivered in person or via telehealth, and what disciplines of staff provided services (for example, nurses or social workers).[69] An association between service delivery factors and performance would suggest that some MCCM services were important for achieving model outcomes.[70]
4. *Quality metrics* measure the quality of care participating hospices delivered to their enrollees through MCCM. These metrics include screening and symptom management, advance care planning, and spiritual counseling measures we constructed from encounter-level MCCM program data.[70] An association between quality of care and performance would highlight the importance of achieving high levels of quality of care for attaining model outcomes.
5. *Enrollee characteristics* consisted of hospice-level averages of the characteristics of beneficiaries enrolled in MCCM by each hospice.[71] We also included the total number of MCCM enrollees the hospice served during its participation in the model. An association between enrollees' characteristics and performance would highlight opportunities for directing MCCM-like services to certain populations in the future.

The five categories include a total of 113 hospice-level factors that we then narrowed to 20 to 25 factors that were most strongly associated with hospice performance on each of the three primary outcomes.[72] Table 11 summarizes our findings by listing factors that were positively (+) or negatively (–) associated with each outcome. The table supports the following findings from our synthesis analysis:

[68] Chapter 3 of the second annual evaluation report (Abt Associates 2020a) discussed the implementation metrics.

[69] When calculating the percentage of encounters that were in person or telephone-based, we counted only encounters before March 2020, because the COVID-19 pandemic led to most encounters being telephone-based.

[70] We discussed service delivery measures and quality metrics in Chapter 4.

[71] We described enrollee characteristics in Chapter 3.

[72] We used a combination of lasso regression models, a comparison of hospices in the top and bottom terciles of hospice-specific impacts, and insights from our implementation analyses to identify the factors to include when analyzing variation in hospices' impacts on each of the three key outcomes. See Appendix F, Section 1, for details. Hospice factors excluded from Table 11 were not clearly associated with hospice-specific impacts—for example, hospice size and ownership (for profit versus nonprofit) status.

Table 11. Hospice-level factors most strongly associated with impacts on key beneficiary outcomes: *Some organizational characteristics and implementation metrics for hospices participating in MCCM were associated with larger impacts on key beneficiary outcomes*.

Hospice-level factor	Decreased Medicare expenditures	Increased hospice use	Decreased aggressive treatments
Hospice organizational characteristics and context			
Freestanding facility	✚	○	✚
Affiliation or contracts with personal care home	—	✚	—
Affiliation or contracts with continuing care retirement community	✚	✚	—
Affiliation or contracts with medical home	—	▬	—
Participation in accountable care organization	✚	✚	✚
Participation in preferred provider network	—	▬	✚
Percentage of Medicare beneficiaries in the hospital referral region who enrolled in hospice in their last year of life	✚	▬	—
Operates or is affiliated with a hospital-based palliative care program	▬	✚	▬
Experience with pre-hospice or bridge programs	○	✚	✚
Rural location	▬	—	—
MCCM implementation metrics			
Changes in data collection or reporting to accommodate MCCM	—	✚	—
Changes in coordination of durable medical equipment to accommodate MCCM	—	—	▬
Changes in MCCM leadership	▬	—	—
Has an MCCM-dedicated coordinator or manager	▬	○	○
Hospice notified when MCCM enrollee seeks care in an emergency department	—	—	✚
Hospice staff receipt of MCCM-focused training: delivery of clinical services in the home	✚		
Hospice staff receipt of MCCM-focused training: quality assurance/performance improvement (known as QAPI)	✚	—	✚
Service delivery factors			
Social worker providing the greatest proportion of services to MCCM beneficiaries	—	✚	—
Nurse aide providing the greatest proportion of services to MCCM beneficiaries	—	—	▬
MCCM registered nurse care coordinator providing the greatest proportion of services to MCCM beneficiaries	✚	▬	—
Percentage of MCCM encounters delivered in person before March 2020 (that is, before the COVID-19 pandemic)	✚	—	—

Hospice-level factor	Decreased Medicare expenditures	Increased hospice use	Decreased aggressive treatments
Quality metrics			
Percentage of enrolled beneficiaries who had a gap in services of between 31 and 60 days	—	✚	—
Percentage of enrolled beneficiaries who had a gap in services of 60 or more days	▬	—	—
Percentage of eligible encounters where the treatment improved the beneficiary's breathing	—	—	▬
Enrollee characteristics			
Total number of beneficiaries enrolled in MCCM	✚	✚	✚
Percentage of enrolled beneficiaries who live alone	✚	—	—

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021; MCCM portal data; MCCM program data, January 1, 2016 to December 31, 2021, merged with a data set constructed by Abt Associates for previous MCCM evaluation reports (Abt Associates 2020a, 2020b); survey data collected from an organizational survey conducted by Abt Associates; and Dartmouth Atlas.

Notes: The table visualizes the association scores between hospice-level factors and hospice-specific impacts for three outcomes: (1) Medicare Part A and B expenditures plus MCCM payments; (2) use of the Medicare hospice benefit; and (3) receipt of an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life. We selected hospice characteristics by considering the difference between top and low performers and estimating lasso regressions separately for each of five categories of hospice-level factors.

We included all factors in the table that had association scores of 0.1 and higher or –0.1 and lower for at least one outcome. An association score is a standardized coefficient from a multivariate regression of hospice-specific impacts on the hospice-level factors. It indicates the change in hospice-specific impacts (measured in standard deviations) expected when the corresponding hospice characteristics changes by one standard deviation, holding other factors constant. In the last three columns, ✚ indicates a positive association (association score above 0.03), ▬ indicates a negative association score (score below –0.03), ○ indicates a weak association (score between –0.03 and 0.03), and — indicates factors that we did not include for a particular outcome. See Appendix F for methodological details, exact associations scores, and supplemental results.

Affiliation or contracts with personal care home, continuing care retirement community, or medical home indicates that the participating hospice was either directly affiliated with one of these types of medical facilities or had contracts to cooperate with such an institution when they applied to participate in MCCM. Participation in accountable care organization or preferred provider network means that the hospice participated in this type of CMS Innovation Center model or belonged to these types of insurance network, respectively. The MCCM implementation metrics indicate which of the listed changes or other operational decisions participating hospices reported (in a survey conducted by Abt Associates). Other hospice characteristics, service delivery factors, quality metrics, and enrollee characteristics are described in Chapters 2 through 4 and Appendix A.

MCCM = Medicare Care Choices Model.

- **Hospices that participated in an accountable care organization had larger impacts on all three outcomes.** Hospices that participated in an accountable care organization in addition to MCCM might have faced additional incentives to reduce Medicare expenditures and been more accustomed to advanced payment models, integrated partnerships, and care coordination with other providers. Overall, hospice agencies participating in MCCM and an accountable care organization might have had better infrastructure and resources, been more integrated into the system, had more established ways to identify MCCM-eligible beneficiaries, or otherwise been more

sophisticated than their peers that did not participate in an accountable care organization (Colla et al. 2016, Driessen and West 2018, Lewis et al. 2013, Medicare Payment Advisory Commission 2009 and 2018, and Ouayogodé et al. 2020). The association between accountable care organization participation and beneficiary outcomes was consistent with Kim et al.'s finding (2019) that cancer patients attributed to an accountable care organization had fewer repeated hospitalizations. However, Lam et al. (2019) did not find an effect of accountable care organizations on end-of-life Medicare expenditures for cancer patients. Gilstrap et al. (2018) found ACOs in the Medicare Shared Savings Program had small and somewhat inconsistent effects on aggressive care among deceased beneficiaries and beneficiaries at high risk of death.

- **Hospices experienced with pre-hospice or bridge programs tended to generate larger increases in hospice use and larger decreases in aggressive treatments.** Based on interviews (see Chapter 4), we hypothesized that hospices experienced with pre-hospice or bridge programs would use this experience to implement MCCM more effectively. We did not see this relationship in impacts on total Medicare expenditures, but these hospices were more successful reducing aggressive treatments in the last 30 days of life and increasing hospice use among their MCCM enrollees. This might be because hospices with these programs have staff familiar with providing care to beneficiaries who are also receiving treatment for their terminal illness. These staff might be better equipped to help beneficiaries navigate transitions in care, including when to transition to the hospice benefit.
- **Hospices that operated a hospital-based palliative care program had larger increases in hospice use** (but smaller decreases in total Medicare expenditures and aggressive treatments). Reductions in Medicare expenditures were smaller among MCCM participants with hospital-based palliative care programs compared with participants without these programs. This finding could mean hospices that operate a hospital-based program have an inpatient resource that allows enrollees to access palliative care services while hospitalized, then transition back to the community. This resource could improve the quality of care for enrollees but add to total Medicare expenditures. At the same time, affiliation with a hospital-based palliative care program was associated with particularly large increases in beneficiaries' hospice use. (Operating or being affiliated with a *community-based* palliative care program was not associated with participating hospices' impacts on any of the three outcomes.)
- **Freestanding hospices had larger impacts on Medicare expenditures and aggressive treatment than facility-based hospices, and rural hospices had smaller impacts on total Medicare expenditures than non-rural hospices**.[73] Most hospices that participated in MCCM were freestanding and located in non-rural areas. These findings imply that facility-based and rural hospice participants might have faced unique challenges implementing the model and improving beneficiaries' outcomes. Rich and Gruber-Baldini (2009) showed that freestanding hospices provided a broader mix of services, which would partly explain our findings.

[73] Chapter 7 compared impacts on beneficiary outcomes for rural and non-rural beneficiaries, and we did not find meaningful differences in impacts between rural and non-rural beneficiaries. The analyses in this chapter weighted hospices equally, rather than implicitly giving more weight to hospices with more enrollees. Further, non-rural hospices might serve beneficiaries living in rural areas (or vice versa). The differences in the analytic approaches between Chapters 7 and 8 could explain the somewhat incongruous results.

- **Hospices that implemented changes in their data collection and reporting processes to accommodate MCCM participation had larger increases in use of the hospice benefit, and training hospice staff in quality assurance/performance improvement was associated with larger reductions in total Medicare expenditures and aggressive treatments**. This finding implies that aspects of how hospices implemented MCCM mattered for their performance. Kirby et al. (2007) also noted that hospices with innovative care and business practices tend to deliver higher quality of care to their patients.
- **Participating hospices that were notified when an MCCM enrollee sought care in an emergency department had larger impacts on aggressive treatments than their peers without this notification.** These notifications could have enabled hospices to coordinate more appropriate and less aggressive care after an acute incident. This finding suggests an important pattern in how MCCM participants used communication strategies to coordinate the care of their enrollees.
- **Hospices with changes in MCCM leadership or an MCCM-dedicated coordinator or manager had smaller impacts on total Medicare expenditures.** Changes in leadership could indicate issues in model implementation that were associated with lower performance. Even if new leadership made a hospice more effective implementing MCCM, the changes might have come too late to result in higher impacts when averaged over the duration of the model. Having a coordinator or manager dedicated to MCCM had mixed implications for hospice performance. It was associated with smaller reductions in Medicare expenditures but slightly larger impacts on hospice use.[74]
- **How participating hospices delivered services to their enrollees was associated with performance.** Specifically, hospices where the MCCM registered nurse care coordinator provided most of the services to MCCM enrollees tended to have larger impacts on total Medicare expenditures but smaller impacts on enrollment in the hospice benefit. Consistent with this finding, Artico et al. (2022) showed the beneficial impact of additional nurse and physician staffing on hospice patients' symptoms. In addition, the percentage of in-person encounters was associated with larger expenditure impacts, indicating an additional value of in-person over telephone-based encounters. Differences between in-person and telehealth visits in palliative and hospice care have received more attention since the COVID-19 pandemic; for example, Chua et al. (2022) noted technical challenges related to telehealth visits.
- **We did not find a strong association between hospice-level quality metrics and impacts on total Medicare expenditures.** This finding was not surprising given our implementation analysis showed little variation in quality of care across types of hospices (Chapter 4, Section 4.4). Most quality indicators were larger than 90 percent, indicating that hospices provided appropriate service to almost all enrollees, and there was not much room for improving hospice performance as measured by hospice-specific impacts.
- **Having more enrollees was associated with better hospice performance.** As noted in Chapter 2, relatively few of the MCCM hospices participated in the model robustly, and enrollment was highly

[74] Information on changes in MCCM leadership, MCCM-dedicated coordinators or managers, and whether hospices were notified when an MCCM enrollee sought care in an emergency department came from organizational surveys that another evaluator fielded in 2017 and 2018. Therefore, this information reflects participants' early implementation experience. In addition, not all hospices included in the synthesis analysis responded to the surveys (see Appendix F, Section 1 for details).

concentrated. Those hospices that enrolled a larger number of beneficiaries in MCCM tended to be more successful reducing total Medicare expenditures, reducing aggressive treatments, and increasing enrollment in the Medicare hospice benefit in the last 30 days of life. Hospices might have learned how to implement MCCM more effectively as they enrolled more beneficiaries, or hospices with larger enrollment might have had additional resources to provide performance-enhancing services. Conversely, hospices that were less successful implementing MCCM might have dropped out of the model before they had enrolled many beneficiaries.

To summarize, we found plausible associations between hospice-level factors and hospice-specific impacts on three key beneficiary outcomes. However, the same factors did not matter equally for all three outcomes, so it is difficult to draw general conclusions about what type of hospices were better performers overall. Table 11 also highlights that we identified only a few factors associated with better performance across multiple outcomes. Some factors, such as operation of or affiliation with a hospital-based palliative care program, were associated with larger impacts on some outcomes and smaller impacts on other outcomes (compared with participating hospices that did not have these factors). Some hospice factors were associated with only one or two outcomes. Notably, participation in an accountable care organization and the number of beneficiaries enrolled throughout the model duration were associated with larger reductions in total Medicare expenditures and aggressive treatments in the last 30 days of life, and a larger increase in use of the Medicare hospice benefits. This finding implies that hospices with the capacity to enroll many beneficiaries performed better than those that ultimately enrolled few beneficiaries (whatever the reason). Moreover, hospices that were integrated into an accountable care organization also saw larger impacts on all three outcomes. These takeaways could be useful for designing and implementing future models aimed at seriously or terminally ill Medicare beneficiaries. For example, larger, urban hospices could be expected to perform better in similar models, and our findings imply that an MCCM-like model might be implemented successfully through an accountable care organization model.

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9. Conclusions from the MCCM Evaluation

Key takeaways

- Based on a review of primary and secondary data, the model was successful for a limited and nonrepresentative group of hospice participants and enrollees.
  - MCCM provided a new alternative to hospice care, offering enrollees high-quality end-of-life supportive and palliative care services they would not have otherwise received through fee-for-service Medicare, concurrent with receiving treatments for terminal illnesses.
  - For many beneficiaries, MCCM was a stepping stone to the Medicare hospice benefit, not a long-term alternative to hospice. After receiving MCCM services for some time, about two-thirds of enrollees voluntarily transitioned from MCCM to hospice.
  - Model enrollees were (1) more likely to enroll in the Medicare hospice benefit, (2) less likely to use resource-intensive services (such as seeking care in an emergency department or being admitted to an inpatient hospital), and (3) more likely to receive better-quality end-of-life care than matched comparison beneficiaries.
  - The model reduced net Medicare expenditures (including MCCM payments) by an estimated $7,604 per beneficiary, or 13 percent.
  - The model improved outcomes for all subgroups, including MCCM beneficiaries from underserved communities (non-White or Hispanic beneficiaries, dually eligible beneficiaries, and beneficiaries living in rural areas). Estimated effects of the model varied by enrollees' survival time, but effects were remarkably similar across qualifying conditions.
- Evaluation results might not generalize from MCCM to other hospice providers or beneficiaries. Caution should be taken when extrapolating these findings to other settings.
- This evaluation offers several important lessons:
  - Among terminally ill beneficiaries, there exists a demand for palliative care services that do not require forgoing payment for ongoing treatments.
  - Receiving access to supportive and palliative care services earlier in a beneficiary's disease trajectory can lead to improvements in their and their caregivers' experiences and reduce acute hospital care use and Medicare expenditures (compared with usual care). An important mechanism for achieving these results was facilitating earlier and more frequent transitions to hospice.

This independent evaluation of MCCM explored whether the model improved outcomes for terminally ill Medicare beneficiaries by providing the option to receive supportive and palliative care services without forgoing payment for treatment of their terminal conditions, which is required to enroll in the Medicare hospice benefit. Specifically, we assessed whether MCCM improved the quality of end-of-life care, increased use of the Medicare hospice benefit, decreased the use of acute hospital care, and

decreased Medicare expenditures. We further examined how changes in hospice use explain the model's impacts and quantified the variation in impacts across beneficiary subgroups and hospices. We also evaluated MCCM's implementation by describing the hospices that participated and the beneficiaries who enrolled in the model and by quantifying the services provided to beneficiaries through the model.

9.1. Key findings

Based on this review of primary and secondary data, the model was successful for a limited and nonrepresentative group of hospice participants and enrollees. We highlight four key findings from the evaluation in this section.

The model was tested with a limited and nonrepresentative group of hospice participants and enrollees. CMS selected 141 hospices that had voluntarily applied to be in MCCM to participate in the model, a small share (about 3 percent) of all hospices nationwide. These hospices were not representative: MCCM participants tended to be larger than other hospices and more often were nonprofit organizations. Further, there was significant hospice attrition over time, partly because of negative financial impacts of the model (that is, receiving MCCM payments insufficient to cover costs) as well as the challenges identifying and enrolling eligible beneficiaries. Ultimately, relatively few hospices participated in MCCM robustly. Less than one-third of the hospices (N = 44) participated in the model through its end in December 2021, and even fewer (N = 32) enrolled 50 or more beneficiaries. Because enrollment was highly concentrated—just five hospices enrolled about half of the beneficiaries—the evaluation largely focuses on and reflects the experience of a few organizations implementing the model.

In addition, CMS' eligibility criteria limited the population of hospice-eligible Medicare beneficiaries allowed to enroll in MCCM. For example, the model excluded beneficiaries from Medicare Advantage, and required that enrollees have one of four specific terminal illnesses—cancer, congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS. By our estimates, the 7,263 beneficiaries who enrolled in MCCM represent less than 1 percent of all beneficiaries in the population of interest who lived in the market area of a participating hospice. Many hospices struggled to obtain referrals and enroll beneficiaries. Some hospices improved over time as they identified and implemented more effective referral and enrollment strategies, but others withdrew from the model when fewer than the anticipated number of beneficiaries enrolled. Beneficiaries referred to and enrolled in MCCM tended to use more health care services and have higher Medicare expenditures before enrollment than other eligible beneficiaries and were more likely to have cancer. However, beneficiaries from underserved communities (for example, those dually eligible for Medicaid) were less likely to be referred or enrolled in MCCM.

The model provided additional choices to fee-for-service Medicare beneficiaries, offering them high-quality care through MCCM that Medicare does not typically pay for. Over a median length of enrollment of about two months, the model enrollees received an average of 2.6 MCCM encounters per week, often delivered by nurses or nurse aides in-person and in the beneficiary's home. Participating hospices provided a variety of services during these encounters, including initial and subsequent comprehensive assessments, beneficiary and caregiver education, symptom management, case

management, care coordination, supportive and active listening, and advance care planning. Through these activities, hospice staff gained the trust of enrollees and their caregivers, identified early warning signs of potential health risk, and provided someone to call when medical concerns arose. Hospice staff believed these activities kept beneficiaries from seeking care in emergency departments and prevented hospitalizations.

CMS established several measures for tracking the quality of MCCM service delivery—such as screening and symptom management rates—and MCCM hospices almost universally performed well on these metrics according to self-reported data. Further, enrollees and their caregivers, particularly those who subsequently entered hospice, reported high levels of satisfaction with the services they received under MCCM.

CMS gave hospices flexibility in determining the quantity and types of MCCM services they provided to enrollees. However, MCCM payments were fixed at $400 per beneficiary per month. Based on average enrollees' MCCM service use, participating hospices received $13 per day or $77 per encounter, which is less than average Medicare payments for either home health care services or hospice services in recent years. Some hospices believed the MCCM reimbursement levels were inadequate to cover the cost of serving this population, including some that withdrew from the model (as noted above).

For many enrollees, MCCM served as a stepping stone to the Medicare hospice benefit, not a long-term alternative to hospice. The model was principally designed for beneficiaries who qualified to receive hospice care but were initially unwilling to enter hospice and forgo payment for treatment of their terminal illness. However, after spending time in MCCM, about two-thirds of enrollees voluntarily transitioned directly from MCCM to hospice according to MCCM program data, and many of those who transitioned were enrolled in MCCM for only a short time. (Only 13 percent of MCCM enrollees remained in MCCM until their death.) A combination of factors likely drove the high rate of transitions from MCCM to hospice. First, caregivers of MCCM enrollees indicated that MCCM enrollees typically decided to transition to the Medicare hospice benefit when their care needs changed or increased. Second, at least some of the MCCM participants made a concerted effort to help enrollees transition from MCCM to hospice, including having intentional ongoing discussions with enrollees and their caregivers about evolving care goals and using strategies to make the transition to hospice easier (such as maintaining the same care team or facilitating warm handoffs between teams). In addition, MCCM did not cover the same services as the Medicare hospice benefit, and quantitative analyses suggest that beneficiaries who transitioned to hospice received considerably higher service intensity (minutes per week), on average, while in hospice than they previously received through MCCM.

Overall, our impact estimates align with the expectations of the model. That is, we see patterns of outcomes that CMS intended to produce through MCCM. Using a rigorous evaluation design, our results consistently show that model enrollees were more likely to enter hospice than matched comparison beneficiaries, less likely to use resource-intensive services (such as being admitted to an inpatient hospital), and more likely to receive better-quality end-of-life care in the period between enrollment and death. For example, we estimated model beneficiaries were 18 percentage points more likely to use the Medicare hospice benefit (83 versus 65 percent); had 26 percent fewer inpatient hospital admissions and 12 percent fewer outpatient emergency department visits and observation stays; were 15 percentage points less likely to receive an aggressive life-prolonging procedure, surgery,

or diagnostic test in the last 30 days of life (61 versus 76 percent); and spent about 3 more days at home compared with beneficiaries in the comparison group. These shifts in outcomes are consistent with improved end-of-life care.

The differences in health care service use resulted in $9,576 (17 percent) lower Medicare Part A and B expenditures per beneficiary for MCCM enrollees than comparison group beneficiaries in our analytic sample during the period between their MCCM enrollment date and death. Payments to participating hospices for providing MCCM services to enrollees were $1,971 on average per enrollee, so total (net) Medicare expenditures decreased by $7,604 or 13 percent. In other words, Medicare expenditures decreased substantially. About half (51 percent) of the reduction in Medicare Part A and B expenditures and about one-quarter (26 percent) of the reduction in inpatient admissions were associated with increased hospice use among MCCM enrollees, who entered hospice earlier and more often.

As noted above, relatively few beneficiaries enrolled in MCCM over the six-year model implementation period, ultimately limiting the extent to which MCCM generated *aggregate* Medicare savings (and other benefits to eligible beneficiaries). Our estimates suggest that the model generated $39.2 million net savings for Medicare among beneficiaries in our analytic sample.

Our subgroup analyses indicate that MCCM not only had the intended effects on beneficiary outcomes *on average*, but **these benefits were also widespread across all beneficiary subgroups we examined** and virtually all participating hospices. For example, the model also achieved remarkably similar levels of Medicare savings and quality of care improvements across beneficiaries diagnosed with cancer, congestive heart failure, and chronic obstructive pulmonary disease, suggesting improvements in beneficiary outcomes depend less on beneficiaries' conditions or on model features specific to illnesses.[75]

Nonetheless, the subgroup analysis revealed *some* meaningful variation in MCCM's impacts—that is, **the model did have larger impacts on some beneficiary outcomes for certain subgroups**. First, MCCM was associated with the largest reductions in net Medicare expenditures per enrollee among the subgroup of enrollees who lived 3 to 12 months after enrolling in MCCM.[76] MCCM generated the largest savings toward the end of life but also generated additional savings earlier in an enrollee's disease trajectory. Since a substantial number of beneficiaries were enrolled in MCCM less than a month before they died, and impacts on Medicare expenditures were larger for beneficiaries who lived longer than a month (who had additional time to accrue Medicare savings), CMS might have realized even larger Medicare savings had beneficiaries with short lengths of stay been referred to participating hospices earlier. Second, MCCM partly reduced disparities in the use of hospice care, by increasing the use of the Medicare hospice benefit more for non-White or Hispanic enrollees and for dually eligible enrollees compared with the estimated increases for non-Hispanic White and non-dually eligible enrollees, respectively. For other outcomes, however, impacts were typically similar or smaller for beneficiaries who were non-White or Hispanic, dually eligible for Medicare and Medicaid, or lived in

[75] This report does not present impact estimates for model enrollees with HIV/AIDS. Only 20 model enrollees in our analytic sample had HIV/AIDS, which is too few to reliably estimate impacts.

[76] Medicare savings were relatively smaller among beneficiaries who died within one month of enrollment and those who unexpectedly lived more than a year. We also saw variation in impact estimates for other outcomes (in addition to Medicare expenditures) by the length of time beneficiaries lived after enrolling in MCCM.

rural areas (versus non-Hispanic White, non-dually eligible, and non-rural enrollees, respectively). Finally, in exploratory analyses we found some organizational characteristics and implementation metrics were associated with more favorable effects on beneficiary outcomes, including belonging to an accountable care organization, having experience with pre-hospice or bridge programs, using nurses to provide MCCM services, training staff on delivery of MCCM services, and having a more MCCM enrollees.

9.2. Strengths and limitations

Our evaluation has many strengths. We evaluated a real-world policy, implemented among a diverse set of hospice agencies, from many regions in the United States, that volunteered to implement the model. Using Medicare claims data for the impact analysis (Chapters 6 and 7), we observed outcomes for all enrolled beneficiaries, even after their discharge from the model. We also used claims to develop many baseline characteristics (including measures of health status and health trends to account as much as possible for beneficiaries' disease trajectories) for millions of potential comparison beneficiaries. We used matching to select a comparison group of beneficiaries who resembled enrollees on characteristics likely to be associated with outcomes. The implementation analyses (Chapters 2 through 5) largely relied on self-reported MCCM program data, but we were able to use this information to confirm the main findings and deepen our understanding of the results through our own interviews with hospice staff plus primary data collected by the previous evaluation contractor.

Nevertheless, our evaluation has limitations. We used observational causal inference methods to estimate the effects of MCCM and, absent a randomized controlled trial, it remains possible that unobserved differences between the model beneficiaries and the comparison group could have led to differences in outcomes, even if the model had no effect. However, we matched on a variety of observed characteristics to mitigate this risk. We aimed to select a comparison group that better resembled MCCM enrollees on many baseline characteristics, including patterns of service use in the period before enrollment, which could mitigate selection bias.

Further, our sensitivity analyses suggest such differences in beneficiaries' characteristics would have to be substantial to *fully* explain differences in their outcomes. Selection bias might have affected our estimates to some degree, but we would have estimated such large differences in outcomes without the model having a true effect only if the intervention and comparison groups substantially differed on unobserved variables strongly related to outcomes after matching. To us, this seems unlikely. In almost all cases, these hypothetical unobserved characteristics would have to relate more strongly to outcomes than any of the baseline characteristics included in our regression models. In all, the sensitivity analysis increases our confidence the model had *some* impact on these outcomes in the expected direction even if, perhaps, true impacts were not quite as large as we estimated.

A challenge to constructing the comparison group was narrowing the pool of potential comparison beneficiaries to those who met MCCM's beneficiary eligibility criterion of having a certifiable prognosis of six months or less to live. Because there was no certification of six-month prognoses for comparison beneficiaries in claims data, we used a decedent analysis approach, which limited the pool of comparison beneficiaries to those who died. Intuitively, we used actual dates of death to determine the period when each comparison beneficiary would have been certified as having a prognosis of less than six months to live (implicitly assuming health care providers can accurately judge such prognoses). A

unique advantage of the decedents approach was that we could ensure the distribution of the length of follow-up—the time from enrollment to death, or survival time—was similar between the model and comparison groups.[77] If the length of follow-up had different distributions between the intervention and comparison groups, we would expect average outcomes to also differ between the two groups, biasing impact estimates. A downside of the decedents approach is that it does not measure impacts among all enrollees; in our approach, we restricted the analysis sample to the 88 percent of model enrollees who had died by the time the model ended on December 31, 2021 and met other inclusion criteria for the impact analysis. We cannot know whether it is appropriate to extrapolate impact analysis findings to the beneficiaries who were excluded from the analysis.

Although our evaluation results are promising, they might not generalize from MCCM to other hospice providers or beneficiaries. As mentioned previously, MCCM had limited reach. A small percentage of all hospices nationwide volunteered to participate in MCCM, with only five hospices enrolling about half the beneficiaries. Further, the beneficiaries enrolled in MCCM represent a small percentage of the beneficiaries who, according to Medicare claims and enrollment data, lived near a participating hospice during model implementation and satisfied the model eligibility criteria but were neither referred to the model nor enrolled. The enrollees were also notably different from nonparticipating beneficiaries before matching, more often having cancer and high rates of Medicare expenditures and service use before enrollment. Voluntary selection into the model by hospices and beneficiaries limits the generalizability of the evaluation findings to a broader population of Medicare beneficiaries with less than six months to live (in addition to raising concerns about selection bias noted before).

KEY TAKEAWAY. Caution should be taken when extrapolating these evaluation findings to other hospice providers or beneficiaries.

In fact, CMS decided not to scale MCCM because of its low uptake, low market penetration, and lack of generalizability. Instead, CMS is using these evaluation results to enhance access to care, quality of care, and beneficiary and caregiver satisfaction, as well as to inform the design strategies for future models focused on beneficiaries with serious illness nearing the end of life.

9.3. Relevance beyond MCCM

Despite limited participation, the MCCM evaluation offers several important lessons:

1. **Among terminally ill beneficiaries, there exists a demand for palliative care services that do not require forgoing payment for ongoing treatments.** Among the eligible beneficiaries referred to the model, about two-thirds (64 percent) chose to enroll in MCCM over other available options.

[77] Because we know when each comparison beneficiary died, we could count backward to establish pseudo-enrollment dates for each comparison beneficiary and match in a way that ensured balance on survival times between model enrollees and comparison beneficiaries. After using sophisticated matching techniques to achieve tight balance on survival times, we could measure beneficiaries' outcomes from their enrollment dates (or pseudo-enrollment dates) until death for all beneficiaries and conduct impact analyses. In this way, we would measure outcomes over (virtually) the same length of time for model enrollees and their matched comparisons. Therefore, the decedents approach cannot estimate potential effects of the model on time until death or any indirect effects on other outcomes that operate through changes in survival.

The MCCM hospices provided access to palliative care services not typically covered through Medicare Part A or B. Although the participating hospices received relatively small $400 per beneficiary per month capitated payments—which could have potentially incentivized them to under-provide services—we found they provided enrollees with a high-touch intervention (2 to 3 encounters per week), performed well on CMS-defined quality metrics, and ultimately received positive feedback on beneficiary and caregiver satisfaction.

2. **Receiving access to supportive and palliative care services earlier in a beneficiary's disease trajectory can lead to improvements in their and their caregivers' experiences and reduce acute hospital care use and Medicare expenditures (compared with usual care).** The impact analyses indicate MCCM produced the improvements in end-of-life care, reductions in acute care service use, and Medicare savings for MCCM enrollees that CMS intended. Although their paths varied, MCCM enrollees ultimately received better quality end-of-life care according to established quality measures, such as spending more days at home. The model not only increased the quality of end-of-life care, but also benefited Medicare with large net savings (per beneficiary enrolled) by reducing acute hospital service use. The model benefitted a diverse group of beneficiaries, including those with three different qualifying conditions and those from underserved communities. Since we observed these impacts across virtually all of the hospice and beneficiary subgroups we examined, models that include interventions like MCCM could potentially achieve similar benefits.

3. **An important mechanism for achieving these results was facilitating earlier and more frequent transitions to hospice.** After spending time in MCCM, about two-thirds of enrollees (65 percent) made a voluntary decision to switch from the model into hospice before the end of life as intended. Enrollees also tended to make this decision to enter hospice earlier than those in the comparison group, thus potentially benefiting from more days in hospice. Gaining experience with palliative care through MCCM likely helped beneficiaries make the difficult decision to enter hospice. Because we found increased hospice use accounted for substantial savings, this evaluation suggests that efforts to increase exposure to palliative care options and to reduce barriers to the Medicare hospice benefit could be a promising approach for achieving Medicare savings and improving terminally ill Medicare beneficiaries' quality of life.[78] (The remainder of MCCM's impact on Medicare expenditures and rates of service use came through channels other than increased hospice use. That is, MCCM had more substantial effects than *solely* acting as a stepping stone to hospice.)

Questions remain about how to build on the model's success improving experience of care for seriously or terminally ill Medicare beneficiaries. MCCM implementation challenges included limited participation in MCCM by hospices, high levels of hospice attrition, low numbers of referred and

[78] Although this evaluation focused on the effects of MCCM, various results indicate the *Medicare hospice benefit* also generates savings for the Medicare program, reduces acute care (hospital) service use, and improves the quality of end-of-life care, at least among beneficiaries who met the MCCM eligibility criteria. As noted above, a significant share of the model's effects stem from earlier and increased use of hospice among MCCM enrollees—that is, by MCCM acting as a stepping stone to hospice. Although MCCM enrollees' outcomes compared favorably with outcomes observed in our main comparison group (that is, those who received usual care), we also found that outcomes were *even more favorable* for an alternative comparison group of beneficiaries who entered hospice at the beginning of the study period. That is, Medicare savings and impacts on other outcomes might have been even more substantial if MCCM enrollees had chosen to enter hospice rather than MCCM. Yet, MCCM was designed principally for beneficiaries who were initially uninterested in choosing hospice.

enrolled beneficiaries, and short lengths of enrollment before death (for some beneficiaries). There might be ways to design future models to increase their reach that are more attractive and sustainable for organizations, or that lead to higher rates of referrals and enrollment, lengthen the time over which MCCM can affect beneficiary outcomes, and broaden the use of best practices.[79] Replicating the model's success among a larger number of more representative organizations or beneficiary populations would help CMS better understand the generalizability of the evaluation findings. Our estimates indicate the model benefited MCCM enrollees from three underserved communities: non-White or Hispanic beneficiaries, dually eligible beneficiaries, and beneficiaries living in rural areas. However, the model included relatively few beneficiaries from these communities, likely because these groups are generally underrepresented among the beneficiaries served by participating hospices. (Beneficiaries from these communities were less likely to be referred to the model but similarly likely to enroll in MCCM upon being referred.) Recent CMS policy innovations to advance health equity (for example, Chong et al. 2022) might support organizations—including those serving underserved communities—to improve the provision of high-quality, end-of-life care that addresses beneficiaries' needs and improves the support received by beneficiaries.

In conclusion, by providing high-quality supportive and palliative care services and increasing use of Medicare's hospice benefit, participating hospices achieved the model's goals of improving enrollees' quality of life and care, achieving high satisfaction, and reducing Medicare expenditures and acute care service use for a limited group of enrolled beneficiaries. These findings point to the importance of transforming care delivery to improve terminally ill beneficiaries' and caregivers' experiences and reduce costly usage that might be inconsistent with beneficiaries' preferences. Although there are concerns about the generalizability of MCCM, the findings from this evaluation suggest the model provides a promising approach to increasing hospice use.

[79] For example, we conjecture that higher MCCM payments or expanded beneficiary eligibility criteria might have reduced hospice attrition (see Chapter 2, Section 2.1) or increased the number or diversity of hospices that initially decided to voluntarily participate in the model.

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Appendix A

Model Participation, Enrollment, Services, and Discharge: Data, Methods, and Supplemental Results

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This appendix provides an overview of the secondary data sources and methods we used to identify the number and characteristics of participating hospices (Chapter 2), the number and characteristics of beneficiaries who were referred to or enrolled in the model (Chapter 3), the number and type of encounters and services they received (Chapter 4), and model discharge status and lengths of enrollment (Chapter 5). We also highlight the differences in enrollment counts based on Medicare Care Choices Model (MCCM) program data versus Medicare claims and describe how we constructed the analytic files and created the variables used in the analysis. Finally, we provide a set of supplemental tables and figures to support the findings in Chapters 2 through 4.

1. Data

This section describes the secondary data sources we used in our descriptive analyses: (1) MCCM program data and (2) hospice-level data files drawn from several sources.

1.1. MCCM program data

The MCCM program data were collected through an online portal operated by CMS through its implementation and monitoring contractor. This portal was a secure web-based data entry tool and repository for hospice- and beneficiary-level enrollment and service information. Data collected through the portal included referral, enrollment, and discharge information; enrollees' demographic and health characteristics and living situation; MCCM encounters and service utilization; and quality of services delivered.

The MCCM program data (sometimes called the "portal data") were collected through four forms: (1) the patient baseline information form, (2) the service and activity log, (3) the hospice information form, and (4) the patient discharge form. The Lewin Group used the data in these forms to create three data sets:

1. **Beneficiary data set.** This data set included demographic and health characteristics, referral and enrollment information, and discharge data among other variables. These data combined the information from the patient baseline information form and patient discharge form for each beneficiary. This data set included 22,652 records, one for each unique combination of hospice, beneficiary, and enrollment date. A beneficiary who was referred multiple times, had multiple periods of enrollment, or was enrolled by more than one hospice appeared separately each time. It included MCCM enrollees plus beneficiaries who were referred but not enrolled to MCCM.
2. **Service log data set.** This service-level data set contained information from the service and activity log. There was one record for each service delivered to or on behalf of the beneficiary while they were enrolled in MCCM, as well as information from any post-discharge encounters. This data set included 217,156 records: one for each unique combination of hospice, beneficiary, service date, and service log identification number. Multiple services could be provided during the same encounter or visit, and each one was reported separately.
3. **Hospice data set.** This data set contained all the information entered into a hospice information form for each participating hospice. Hospices were asked to update their hospice information forms on a quarterly basis to ensure the information was accurate and up to date. This data set included

one record for each unique combination of hospice identification number and hospice record number.

Table A.1 lists the types of information available from these three data sets.

Table A.1. Types of information reported in the MCCM program data

Data set	Types of information reported
Beneficiary data set	Referral dates Eligibility status Reasons for declining enrollment Enrollment start and end dates Demographic and health characteristics Qualifying diagnosis at enrollment Presence of active caregiver Functional status Discharge disposition (including transition to hospice)
Service log data set	Date and type of encounter Mode and location of encounter Level of care Type of service Type of staff providing service Quality of services delivered
Hospice data set	Hospice name and ID Location (city and state) Ownership status MCCM staff name and role MCCM participation status and dates

MCCM = Medicare Care Choices Model.

1.2. Hospice-level data files

We used five hospice-level data sources:

1. *MCCM roster.* CMS provided a data file that identified each of the 141 hospices that participated in MCCM, including each hospice's name, cohort, participation status (including dates of withdrawal, if applicable), CMS Certification Number, and contact information (address, phone number, and other details).
2. *Hospice matching file.* The prior evaluation contractor, Abt Associates, constructed a data set that described all hospice agencies participating in the Medicare program (N = 4,362). Previous evaluation reports (Abt Associates 2018, 2020a, 2020b) described the process for creating this data set and its contents, and how they used the file to construct a matched comparison group of hospices that resembled the hospices participating in MCCM. Data sources included the CMS Provider of Services file, Medicare hospice claims, and the Consumer Assessment of Healthcare Providers and Systems (CAHPS) hospice survey.
3. *Organizational survey.* The previous evaluation contractor collected two waves of organizational survey data in 2017 and 2018 (Abt Associates 2020a).

4. *Dartmouth Atlas.* Using each hospice's location, as defined by Dartmouth Atlas hospital referral regions, we added the percentage of Medicare deaths occurring in hospital. We also calculated the percentage of Medicare beneficiaries with hospice in last year of life in the region (using Medicare's enrollment database).
5. *MCCM program data.* As described in Sections 1.1 and 3, we aggregated MCCM program data to the hospice level, including the number of beneficiaries enrolled by each hospice and total MCCM payments (based on Medicare claims).

2. Reconciliation of enrollment counts based on MCCM program data versus Medicare claims

MCCM program data and Medicare administrative data (enrollment and claims) provided different counts of the number of Medicare beneficiaries who were eligible for and enrolled in the model. As shown in Table A.2, the MCCM program data (described in section 1.1 of this appendix) identified 22,652 beneficiaries referred to or enrolled in MCCM between January 2016 and December 2021, of which 7,263 (32 percent) met the MCCM eligibility criteria and chose to enroll in the model. The program data showed that the remaining 15,389 referrals were either ineligible to participate (11,558) or were eligible but chose not to enroll in the model (3,831). In contrast, a review of Medicare claims and enrollment data showed that CMS paid a claim for at least one MCCM-covered service for 6,613 beneficiaries. Of these, 6,017 (91 percent) met the eligibility criteria based on Medicare administrative data (defined in Appendix C, Section 2.2) and 596 (9 percent) did not. Together, 5,835 (97.1 percent) of the 6,613 beneficiaries with an MCCM claim appear as eligible and enrolled based on the MCCM program data. However, the other 192 beneficiaries (2.9 percent) with an MCCM claim do not appear as enrolled in the MCCM program data (of these, 138 beneficiaries were not included in the MCCM program data at all). Conversely, 841 (11.6 percent) of the 7,263 beneficiaries who appear to have enrolled in MCCM based on the MCCM program data submitted by hospices do not have any Medicare claims for MCCM payments.

Table A.2. Number of enrollments and referrals in MCCM program data, compared with the beneficiary's eligibility and enrollment status in Medicare claims and enrollment data

Status in MCCM program data	Assessment of Medicare claims and enrollment data[a]					Total
	Not found (in Medicare data)	Not eligible; no MCCM claim	Not eligible; with MCCM claim(s)	Eligible; no MCCM claim	Eligible' with MCCM claim(s)	
Not included in MCCM program data	n/a	1	8	0	130	**139**
Referred and ineligible	1,276	7,931	2	2,305	38	**11,558**
Referred, eligible, not enrolled	60	1,647	0	2,108	14	**3,831**
Enrolled	0	357	586	484	5,835	**7,263**
Total	**1,336**	**9,936**	**596**	**4,897**	**6,017**	**22,791**

Note: The rows in this table count the number referrals and enrollments in the MCCM program data. In a few cases, a beneficiary is counted multiple times because they were referred or enrolled more than once (either by the same or a different participating hospice).

[a] Appendix C, Section 2.2 describes the model eligibility criteria we assessed using claims data. Beneficiaries with an MCCM claim had at least one paid hospice claim with the associated MCCM demonstration identification number (73).

MCCM = Medicare Care Choices Model; n/a = not applicable.

Differences in eligibility and enrollment status between MCCM program data and Medicare claims raised questions about which source should serve as the official record of enrollment and hence should be used for our analyses of the MCCM program data. For example, MCCM program data are self-reported by hospices without external verification and thus may overstate eligible enrollment if Medicare administrative contractors later determine a beneficiary did not meet the eligibility criteria.[80] The MCCM program data include 60 eligible referrals and one enrollee who we could not find in the Medicare enrollment database at all, plus others who did not appear eligible for the model based on claims data. Missing claims for MCCM services could have occurred if hospices did not submit a claim for an enrollee (for example, for those who enrolled but, after enrollment, withdrew from the model, as well as those who were later found to be ineligible, died, or transferred to hospice care). A review of MCCM program data confirmed that half of all enrollees without an MCCM claim were enrolled in the model for less than one week, and most received an initial assessment only. There were no MCCM claims for these beneficiaries. However, data submitted by the hospices indicate these beneficiaries were enrolled, and excluding them could bias the results (for example, reported average MCCM service use would be higher if these beneficiaries are excluded). There are also plausible scenarios where claims data would fail to capture information needed to make a positive eligibility determination. For example, claims data might not show an MCCM-qualifying diagnosis in the 12 months before enrollment, even though the referring physician provided the hospice with evidence of the condition.

Three other factors complicated the decision about which source of data to use for an analysis of enrollment:

1. First, the MCCM program data were the only source of information on referrals (including eligible referrals who chose not to enroll). Using claims data alone to identify enrollees would make it difficult to determine certain outcomes, such as the percentage of eligible referrals who actively chose to enroll in the model.
2. Second, in addition to eligibility and enrollment information, the MCCM program data provided a detailed record of MCCM service use—including date, mode, and type of service, and type of staff providing the service—for all beneficiaries that *hospices* considered enrolled in the model.

[80] Enrollees were screened for eligibility at the time of MCCM enrollment, and MCCM claims were later validated by the Medicare Administrative Contractor based on program eligibility standards. For the impact analysis, we initially considered using MCCM program data as a potential data source to identify MCCM enrollees. We ultimately decided on limiting the intervention group to those beneficiaries with positive paid MCCM claims to ensure that these beneficiaries were eligible and would continue receiving services. That is, we did not include beneficiaries who were enrolled in the model but did not receive any services according to MCCM claims data. Our understanding is that because the hospices did not have the ability to verify all the information needed for enrollment, beneficiaries could be enrolled in the model but not have claims paid because the Medicare Administrative Contractor subsequently deemed the beneficiary was ineligible, or the beneficiary died, transferred to hospice, or disenrolled before an MCCM-funded service could be provided.

Restricting enrollees to those with an MCCM claim would exclude service records for nearly 1,000 eligible beneficiaries who received an MCCM service (according to the MCCM program data) but for whom the hospice did not submit a claim.

3. Third, MCCM program data provided information on reasons eligible referrals chose not to enroll in the model and reasons enrollees were discharged from the model. Again, restricting to enrollees with an MCCM claim would exclude responses (from those without a claim) that were collected in MCCM program data and may be of interest to CMS.

Based on these factors, we decided to rely primarily on MCCM program data to define the population of beneficiaries for our analysis of referrals, eligibility, enrollment, and MCCM service use (that is, for Chapters 2 through 5). Using MCCM program data to define enrollment enabled us to:

- Avoid the missing data issues described earlier
- Align our counts with the enrollment trends previously reported by CMS
- Compare enrollments to referrals (both eligible and ineligible)
- Use a uniform list when reporting reasons for choosing not to enroll or reasons for disenrollment
- Use an internally consistent count of enrollees when analyzing their MCCM service use

3. Creating analytic files and conducting descriptive analyses

In this section, we describe the methods we used to construct hospice-, beneficiary-, and encounter-level files and conduct the descriptive analyses in Chapters 2 through 5. Section 4 of this appendix provides definitions for variables we created during this step.

3.1. Hospice-level analytic files

We created two hospice-level analytic files to conduct the descriptive analyses in Chapters 2, 4, and 8.

- First, to conduct the descriptive analysis on hospice participation in Chapter 2, we merged five hospice-level data files, described in Section 1.2, including information from the hospice roster file from CMS, as well as the survey data and national registry data created by the previous evaluation contractor.[81] We used this information to calculate the percentage of hospices with each facility characteristic for all MCCM participants, the hospices participating in MCCM 2021 extension, and all hospices nationwide, as well as for some supplemental analyses that appear later in this appendix. We were missing information for a few nonparticipating hospices on census region, chain affiliation, and hospice size. To create a complete file, we imputed missing values by chained equations and then averaged across the imputed values to obtain a final estimate.
- Second, to analyze MCCM quality of services and performance at the hospice level (Chapters 4 and 8), we created a separate hospice-level file by aggregating measures from the beneficiary and encounter files (see below) to the hospice ID level.

[81] This hospice-level analytic file was also used as an input to the synthesis analysis, described in Appendix F.

3.2. Beneficiary-level analytic files

We created two beneficiary-level analytic files to conduct the descriptive analyses in Chapters 3 through 5.

- First, we created a beneficiary-level file to analyze referrals and enrollments (Chapter 3). The file included all beneficiaries with an enrollment date on or before December 31, 2021, or a signature date (time stamp for data entry) on or before December 31, 2021 for those who did not enroll. We excluded inactivated records (record type = 2) and kept the most recent record only (for those with multiple referrals or enrollment).
- Second, to analyze MCCM encounter and service information (Chapter 4), we created a separate beneficiary-level file by aggregating the encounter and service information (see below) from the service log data set to the unique beneficiary ID and hospice ID level. We excluded 14 beneficiaries that appeared as enrolled in the enrollment file, but for whom there were no records in the service log file.

Our analyses of the beneficiary-level analytic data files consisted of calculating means of continuous variables and percentages of categorical or binary variables, overall and for subgroups of beneficiaries or hospices.

3.3. Encounter-level analytic files

To analyze the number and type of encounters and services delivered under MCCM (Chapter 4), we used the service log data set from MCCM program data. When preparing this file for analysis, we dropped:

- 1,307 encounters for 82 beneficiaries because the unique combination of beneficiary and hospice IDs reported in the encounter file was not reported in the enrollment file.
- 68 encounters for 4 beneficiaries because their enrollment status was ineligible or declined to enroll in enrollment file.
- 34 encounters because the service date occurred before the enrollment date or the service date was missing.

Our analyses of the beneficiary-level analytic data files consisted of calculating means of continuous variables and percentages of categorical or binary variables, overall and for subgroups of beneficiaries or hospices.

4. Creating variables and performance measures for descriptive analysis

In this section, we describe our methods for creating or modifying variables needed for the descriptive analyses presented in Chapter 2 through 5. We also describe our methods for creating several measures of the quality of services delivered using MCCM program data.

4.1. Creating or modifying variables

We created or modified four variables for our descriptive analysis of MCCM program data.

- **Discharge status.** We combined the reason for discharge field documented by participating hospices in MCCM program data and the date of death from the Medicare enrollment database to create a new discharge status variable for our analysis. The raw data for these variables are shown in Table A.3. The new variable can take one of four distinct values:
  - *Still alive when the model ended.* This value occurred when claims data showed the beneficiary was still alive and enrolled in the model on December 31, 2021. We analyzed this group separately because their discharge from the MCCM might not have been voluntary—that is they could have been discharged from MCCM simply because the model ended, rather than by choice. We do not have data on dates of death for beneficiaries who died after our analysis period ended on December 31, 2021.
  - *Transitioned to Medicare hospice benefit.* This value occurred when the MCCM program data recorded a discharge reason as "Elected the Hospice Benefit."[82]
  - *Remained in MCCM until death.* This value occurred when MCCM program data recorded a discharge reason as "Died."[82] If MCCM program data indicated someone was discharged on or after their date of death, we classified them as "remained in MCCM until death" regardless of the discharge reason in the MCCM program data.
  - *All other cases.* All remaining beneficiaries were classified into a residual category for "other discharge status."[82] This included beneficiaries who voluntarily requested to disenroll from MCCM, as well as those who moved out of hospice service area, transferred to another MCCM hospice, were discharged for cause, or lost eligibility because they lived outside their home for 90 days or more. This category also included three beneficiaries who died according to MCCM program data, but whose death we could not confirm in the Medicare enrollment database.

Table A.3. Number (and percentage) of MCCM enrollees with each discharge status, overall and by date of death

Discharge Reason (MCCM program data)	Died on or before December 31, 2021 (Medicare enrollment database)		Total
	Yes	No	
Entered hospice	4,751 (74%)	147 (18%)	4,898 (67%)
Died	932 (14%)	3 (<1%)	935 (13%)
Enrollee requested; voluntary disenrollment from MCCM	249 (4%)	274 (33%)	523 (7%)
Other	510 (8%)	397 (48%)	907 (12%)
Total	6,442 (100%)	821 (100%)	7,263 (100%)

Sources: MCCM program data, January 1, 2016 to December 31, 2021, and the Medicare enrollment database.

MCCM = Medicare Care Choices Model.

[82] This category is limited to beneficiaries who died on or before December 31, 2021, according to the Medicare enrollment database. As noted above, beneficiaries alive on January 1, 2022, were analyzed separately.

- **Length of enrollment.** We defined the number of days enrolled in MCCM as the minimum of either (1) the number of days from enrollment to last service date; or (2) the number of days from enrollment to discharge date.[83] If the discharge date was before the enrollment date, we set the length of enrollment to zero. If the discharge date was after their date of death, we set discharge date equal to the date of death. If the discharge date was after the model ended, we set discharge date equal to December 31, 2021. We applied these conditions because, for a few enrollees, their discharge date occurred before their enrollment date or implausibly late.
- **Functional status and caregiver status.** CMS made several changes in hospice reporting specifications starting in January 2018. To accommodate these changes and use data for all six model years, we made the following data edits:
  - Merged the functional status variable (as reported on the beneficiary-level enrollment file at the time of enrollment in 2016 and 2017) with the functional status variable (as reported on the encounter-level file the first time from 2018 to 2021).
  - Merged the caregiver status variable (as reported on the beneficiary-level enrollment file at the time of enrollment in 2016 to 2017) with the caregiver status variable (as reported on the encounter-level file the first time from 2018 to 2021). For example, "spouse" and "partner" were separate categories in the 2016 and 2017 data, but the data used "spouse/partner" from 2018 to 2021. Thus, we had to map two caregiver categories in 2016 and 2017 into a single "spouse/partner" category for the purpose of analyzing data across all years. Our "other" category includes "paid caregiver other than family member" and "unpaid caregiver other than family member; no caregiver" from the records through December 31, 2017 and includes "other" from the records on or after January 1, 2018.

4.2. Calculating measures of quality of MCCM services delivered

We also used MCCM program data to create several measures of the quality of services delivered, specifically those related to screening and symptom management and discussion on advance care planning and emotional well-being. We calculated these rates at the encounter level after applying the inclusion criteria defined by the data dictionary provided by The Lewin Group. See Table A.4 for details. We could calculate other measures of service quality (such as initial and comprehensive assessment rates) from MCCM program data without modification and thus we do not discuss them in this technical appendix.

[83] This sentence describes the process for analyzing enrollment-level data. For beneficiary-level analyses presented later in this appendix, we did not edit discharge dates using last service dates. In some cases, this led to longer measured lengths of enrollment in the beneficiary-level analyses (compared to the enrollment-level analyses); however, the correlation between lengths of enrollment in the two approaches was high (0.991).

Table A.4. Specifications for select measures related to quality of services delivered

Measure	Inclusion criteria	Specification
Pain screening and management		
Screening	All encounters for initial assessment, first comprehensive assessment, or subsequent comprehensive assessment **and** a provider type of MCCM registered nurse care coordinator, hospice registered nurse/licensed practical nurse, nurse practitioner, or hospice physician	Number of encounters with completed pain screening divided by the total number of included encounters
Management	All encounters with pain level reported as mild, moderate, or severe	Number of encounters with pain management reported as initiated or already on a pain management plan divided by the total number of included encounters
Management effective	All encounters with pain management reported as initiated or already on pain management plan	Number of encounters with pain management plan reported as achieving enrollee's comfort goal divided by the total number of included encounters
Shortness of breath screening and management		
Screening	All encounters for initial assessment, first comprehensive assessment, or subsequent comprehensive assessment **and** a provider type of MCCM registered nurse care coordinator, hospice registered nurse/licensed practical nurse, nurse practitioner, or hospice physician	Number of encounters with completed shortness of breath screening divided by the total number of included encounters
Management	All encounters with completed dyspnea treatment	Number of encounters with completed shortness of breath treatment divided by the total number of included encounters
Management effective	All encounters with completed shortness of breath treatment	Number of encounters with report of improved breathing treatment divided by the total number of included encounters
Psychological/emotional well-being screening and management		
Screening	All encounters for initial assessment, first comprehensive assessment, or subsequent comprehensive assessment) **and** provider type of MCCM registered nurse care coordinator, hospice registered nurse/licensed practical nurse, nurse practitioner, hospice physician, or social worker	Number of encounters with completed depression screening divided by the total number of included encounters
Management	All encounters with a positive depression screening	Number of encounters with completed depression follow-up appointment divided by the total number of included encounters
Management effective	All encounters with a completed depression follow-up encounter	Number of encounters with reported improvement in depression symptoms divided by the total number of included encounters

Measure	Inclusion criteria	Specification
Bowel regimen for opioid use		
Management	All encounters with reported opioid usage	Number of encounters with bowel regimen reported as initiated, already on bowel regimen, or not initiated and medical reason not needed divided by the total number of included encounters
Management effective	All encounters with a bowel treatment reported as initiated or already on bowel regimen	Number of encounters with bowel regimen reported as effective divided by the total number of included encounters
Other quality measures		
Spiritual or religious discussions	All encounters for initial assessment, first comprehensive assessment, or subsequent comprehensive assessment **and** provider type of MCCM registered nurse care coordinator, hospice registered nurse/licensed practical nurse, nurse practitioner, or hospice physician **or** encounters with the service type as counseling and the counseling type reported as spiritual	Number of encounters where spiritual concern is reported as yes and discussion occurred, yes but enrollee declined to discuss, or yes but enrollee was unable and caregiver declined to discuss divided by the total number of included encounters
Advance care planning	All encounters for initial assessment, first comprehensive assessment, or subsequent comprehensive assessment, **and** provider type of MCCM registered nurse care coordinator, hospice registered nurse/licensed practical nurse, nurse practitioner, or hospice physician	Number of encounters with advanced care plan reported as yes and discussion occurred, yes but enrollee refused to discuss, or yes but enrollee was unable and caregiver refused to discuss divided by the total number of included encounters

MCCM = Medicare Care Choices Model.

5. Supplemental results

This section contains additional results to support the findings presented in Chapters 2 through 4. These include full results for all the descriptive analyses on hospice participation (Chapter 2), referrals and enrollment (Chapter 3), and encounter and service use (Chapter 4). We also used many of the quality performance measures based on MCCM program data presented in this section in our synthesis analysis in Chapter 8.

5.1. Hospices' participation in MCCM

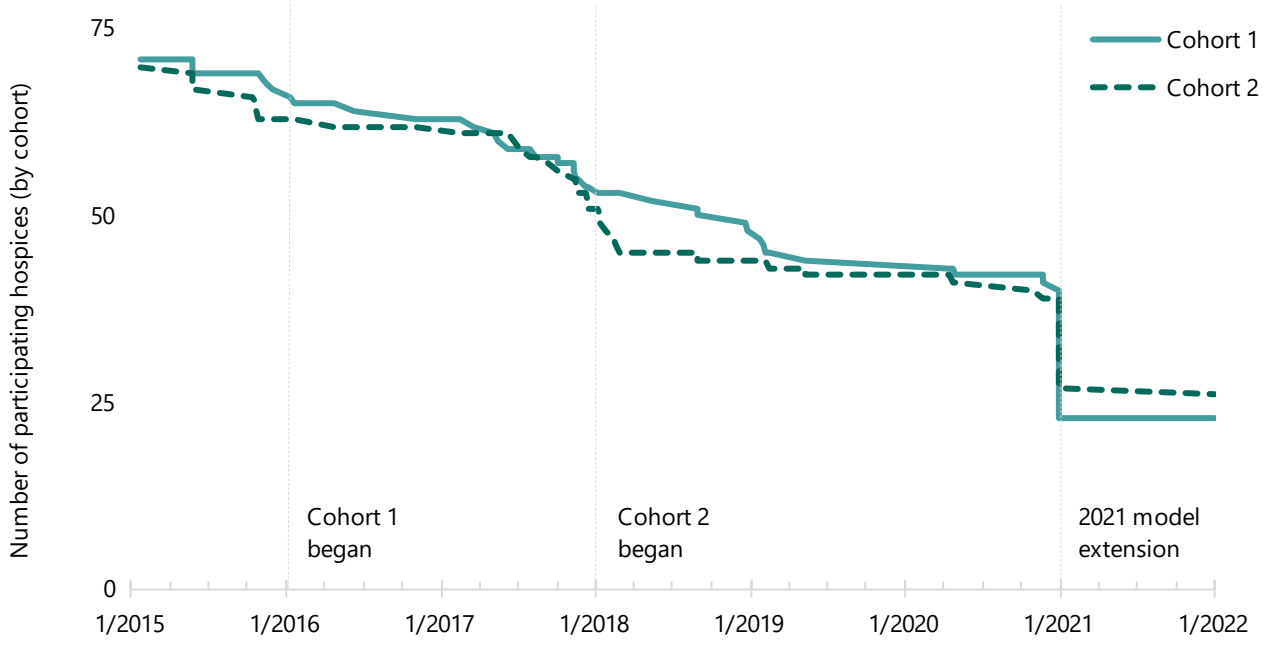
This section presents supplemental results for Chapter 2.

1. We present the number of hospices that officially participated in MCCM, separately for each cohort (Figure A.1). Many Cohort 2 hospices withdrew just before and after January 2018—the cohort's start date for model implementation. In Cohort 1, the dates of withdrawal were less concentrated than those for Cohort 2. In both cohorts, a significant number of hospices withdrew from the model in December 2020, the originally scheduled model end date, rather than participating in the one-year model extension (through December 2021).
2. We compare the characteristics of (1) all hospices nationwide, (2) the 141 hospices that participated in MCCM, and (3) the 49 hospices that formally participated in the 2021 model extension, and 17

hospices that did not withdraw before their cohort start date (Table A.5). Select results from this table appear in Chapter 2, Section 2.2.

3. We present hospice characteristics for subcategories of the 141 hospices that participated in the model (Table A.6). The first four columns show hospices based on their dates of withdrawal from the model. There were not large differences in the profiles of hospices that participated in the model through 2020 or 2021, compared with those that withdrew earlier. The last two columns are based on the number of enrollees (not hospices). All five hospices with the top-five largest numbers of enrollees were large, and none were located in rural areas or affiliated with a religious institution.
4. We focus on the subset of 117 hospices that did not withdraw before their cohort start date, comparing the characteristics of hospices that did and did not receive payments for providing MCCM services (Table A.7). There were not large differences between the profiles of hospices in these two groups, although nonprofit and large hospices were modestly more likely to enroll beneficiaries and receive positive payments for providing MCCM services than for-profit, medium sized, and small sized hospices.

Figure A.1. Number of hospices participating in MCCM over time, for Cohorts 1 and 2



Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: *Participating hospices* includes all hospices that had not formally withdrawn from MCCM as of a given date. It includes hospices who did not ever receive payments for providing MCCM services.

MCCM = Medicare Care Choices Model.

Table A.5. Characteristics of all MCCM hospices, hospices participating in the model extension, and all hospices nationwide

Hospice characteristic	All hospices nationwide (N = 4,361)	All MCCM hospices (N = 141)	Hospices in the 2021 model extension[a] (N = 49)
Ownership (percentage)			
Nonprofit	24	69	69
For profit	63	17	20
Government	3	1	0
Other	10	13	10
Size (percentage)			
Large (at least 20,000 days of routine home care in 2016)	32	77	82
Medium (3,500 to 19,999 days of routine home care in 2016)	48	20	16
Small (fewer than 3,500 days of routine home care in 2016)	20	3	2
Age (percentage)			
Founded in 1980s	13	52	55
Founded in 1990s	24	34	29
Founded in 2000s	30	10	12
Founded in 2010s	33	4	4
Census region (percentage)			
Northeast	10	20	18
Midwest	22	34	29
South	39	32	37
West	28	14	16
Location (percentage)			
Rural	21	16	10
Not rural	79	84	90
Facility type (percentage)			
Freestanding	81	68	78
Facility-based	19	32	22
Religious affiliation (percentage)			
Yes	2	3	4
No	98	97	96
Chain affiliation (percentage)			
Yes	43	46	49
No	57	54	51
Hospice level of care (mean percentage of days)			
Routine home care	98.2	97.0	96.8
General inpatient care	1.3	2.4	2.6
Continuous home care	0.1	0.2	0.2
Inpatient respite care	0.4	0.4	0.4
Duration of stay for hospice enrollees (mean percentage of stays)			
Fewer than 7 days	28.3	32.1	33.6
Seven to 180 days	56.0	55.4	54.4
More than 180 days	15.7	12.5	12.0
Quality of care ratings (mean)			
Overall rating[b]	80.2	80.9	80.3

Hospice characteristic	All hospices nationwide (N = 4,361)	All MCCM hospices (N = 141)	Hospices in the 2021 model extension[a] (N = 49)
Type of health records[c] (percentage)			
Electronic	n.a.	69	73
Mix of electronic and paper	n.a.	30	24
Paper	n.a.	1	2
Experience with palliative care and bridge programs[c] (percentage)			
Operates or is affiliated with a community-based palliative care program	n.a.	55	51
Operates or is affiliated with a hospital-based palliative care program	n.a.	65	68
Experience with pre-hospice or bridge programs	n.a.	45	44
Participation in alternative payment models[c] **(percentage)**			
Bundled payment programs	n.a.	3	2
Preferred provider network	n.a.	14	15
Shared savings program	n.a.	1	0
Accountable care organizations	n.a.	18	22
Medical home	n.a.	8	10
Other alternative payment models	n.a.	7	7
No alternative payment models other than MCCM	n.a.	69	71

Sources: MCCM program data, January 1, 2016 to December 31, 2021, merged with a data set constructed by Abt Associates for previous MCCM evaluation reports (Abt Associates 2020a, 2020b) and organizational survey data collected by Abt Associates.

Note: We imputed missing data for a small number of non-MCCM hospices; see Appendix A for more details about these methods. Percentages might not sum to 100 percent due to rounding.

[a] Includes five hospices that officially participated in the one-year extension but did not receive any payments for providing MCCM services during the six model years.

[b] Quality ratings were from the Consumer Assessment of Healthcare Providers and Systems (CAHPS) hospice survey.

[c] Percentage was calculated among 71 hospices that responded to the organizational survey.

MCCM = Medicare Care Choices Model; n.a. = not available.

Table A.6. Characteristics of MCCM hospices, by withdrawal status and by number of enrollees

Hospice characteristic	By date of withdrawal from MCCM				By number of enrollees	
	Withdrew before the cohort start date (N = 24)	Withdrew after the cohort start date and before December 2020 (N = 38)	Participated through December 2020[a] (N = 30)	Participated in the one-year (2021) model extension[b] (N = 49)	Not in the top five (N = 136)	Five hospices with most enrollees (N = 5)
Ownership (percentage)						
Nonprofit	96	58	60	69	69	60
For profit	0	24	17	20	17	20
Government	0	0	3	0	1	0
Other	4	18	20	10	13	20
Size (percentage)						
Large	75	82	67	82	76	100
Medium	21	18	27	16	21	0
Small	4	0	7	2	3	0
Age (percentage)						
Founded in 1980s	63	42	50	55	51	60
Founded in 1990s	33	39	37	29	34	40
Founded in 2000s	0	16	7	12	10	0
Founded in 2010s	4	3	7	4	4	0
Census region (percentage)						
Northeast	13	24	23	18	20	20
Midwest	33	37	40	29	35	20
South	38	26	27	37	32	40
West	17	13	10	16	14	20
Location (percentage)						
Rural	13	21	23	10	17	0
Not rural	87	79	77	90	83	100
Facility type (percentage)						
Freestanding	75	55	63	78	68	80
Facility-based	25	45	37	22	32	20
Religious affiliation (percentage)						
Yes	0	0	7	4	3	0
No	100	100	93	96	97	100
Chain affiliation (percentage)						
Yes	54	34	50	49	46	40
No	46	66	50	51	54	60
Hospice level of care (mean percentage of days)						
Routine home care	97.0	97.6	96.7	96.8	97.1	95.9
General inpatient care	2.4	1.8	2.9	2.6	2.4	3.7
Continuous home care	0.1	0.2	0.1	0.2	0.2	0.1
Inpatient respite care	0.4	0.4	0.3	0.4	0.4	0.2
Duration of stay for hospice enrollees (mean percentage of stays)						
Fewer than 7 days	30.9	29.6	33.6	33.6	31.8	39.2
Seven to 180 days	55.0	57.1	55.3	54.4	55.6	50.1
More than 180 days	14.1	13.3	11.1	12.0	12.6	10.6
Quality of care ratings (mean)						
Overall rating[c]	79.8	82.0	81.5	80.3	81.0	79.1

Sources: MCCM program data, January 1, 2016 to December 31, 2021, merged with a data set constructed by Abt Associates for previous MCCM evaluation reports (Abt Associates 2020a, 2020b).

Note: The *cohort start date* was January 2016 for Cohort 1 or January 2018 for Cohort 2. Percentages might not sum to 100 percent due to rounding.

[a] Includes 7 hospices that did not receive have any paid claims for MCCM services. Does not include hospices that participated in the one-year model extension.

[b] Includes 4 hospices that did not receive have any paid claims for MCCM services.

[c] Quality ratings were from the Consumer Assessment of Healthcare Providers and Systems (CAHPS) hospice survey.

MCCM = Medicare Care Choices Model.

Table A.7. Characteristics of MCCM hospices that did not withdraw after their cohort start date

Hospice characteristic	MCCM hospices that did not withdraw before their cohort start date		
	Received zero MCCM payments (N=36)	Received positive MCCM payments (N=81)	Total (N=117)
Ownership (percentage)			
Nonprofit	56	67	63
For profit	31	16	21
Government	0	1	1
Other	14	16	15
Size (percentage)			
Large	67	83	78
Medium	28	16	20
Small	6	1	3
Age (percentage)			
Founded in 1980s	42	53	50
Founded in 1990s	36	33	34
Founded in 2000s	19	9	12
Founded in 2010s	3	5	4
Census region (percentage)			
Northeast	25	20	21
Midwest	33	35	34
South	25	33	31
West	17	12	14
Location (percentage)			
Rural	28	12	17
Not rural	72	88	83
Facility type (percentage)			
Freestanding	56	72	67
Facility-based	44	28	33
Religious affiliation (percentage)			
Yes	0	5	3
No	100	95	97
Chain affiliation (percentage)			
Yes	44	44	44
No	56	56	56
Hospice level of care (mean percentage of days)			
Routine home care	98.3	96.5	97.0
General inpatient care	1.3	2.9	2.4
Continuous home care	0.2	0.2	0.2
Inpatient respite care	0.2	0.4	0.3
Duration of stay for hospice enrollees (mean percentage of stays)			
Fewer than 7 days	29.0	33.6	32.3
Seven to 180 days	57.6	54.6	55.5
More than 180 days	13.3	11.7	12.2
Quality of care ratings (mean)			
Overall rating[a]	82.0	80.8	81.1

Sources: MCCM program data, January 1, 2016 to December 31, 2021, merged with a data set constructed by Abt Associates for previous MCCM evaluation reports (Abt Associates 2020a, 2020b).

Note: This table excludes 24 hospices that withdrew before their cohort start date. The *cohort start date* was January 2016 for Cohort 1 or January 2018 for Cohort 2. Percentages might not sum to 100 percent due to rounding.

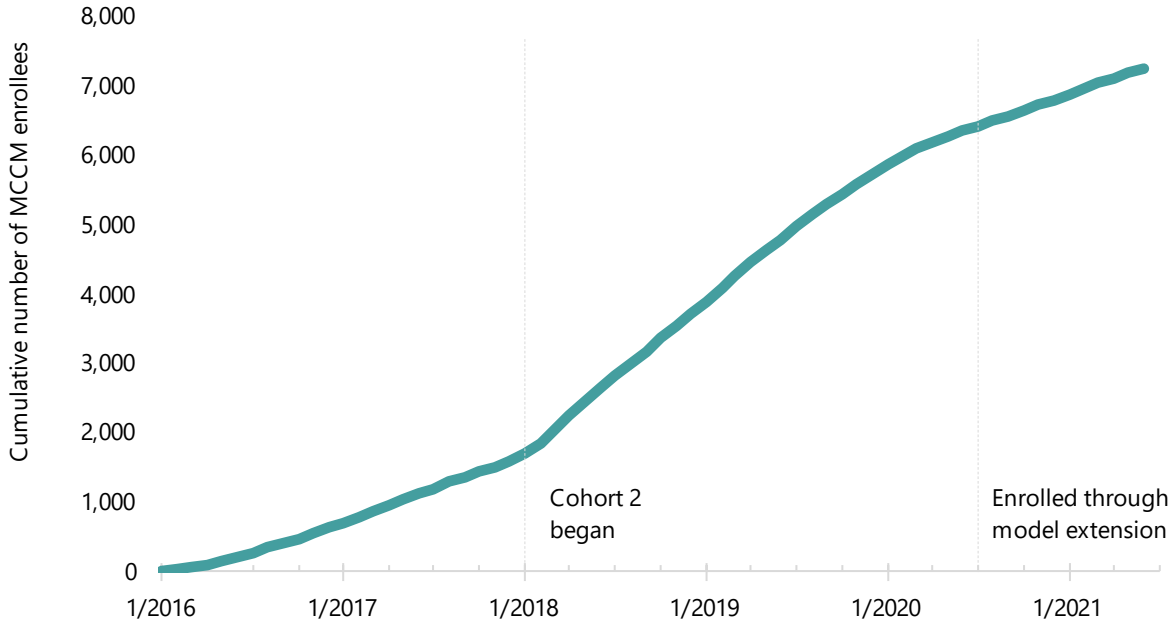
[a] Quality ratings were from the Consumer Assessment of Healthcare Providers and Systems (CAHPS) hospice survey.

MCCM = Medicare Care Choices Model.

5.2. Beneficiaries who Enrolled in MCCM

This section presents the referring provider specialty for MCCM enrollees, characteristics of beneficiaries who enrolled in MCCM; the results serve as the basis for or supplement the descriptive findings presented in Chapter 3. Figure A.2 and Figure A.3 show additional details on trends in enrollment over time. Table A.8 shows the number and percentage of MCCM enrollees by medical specialty of referring provider.

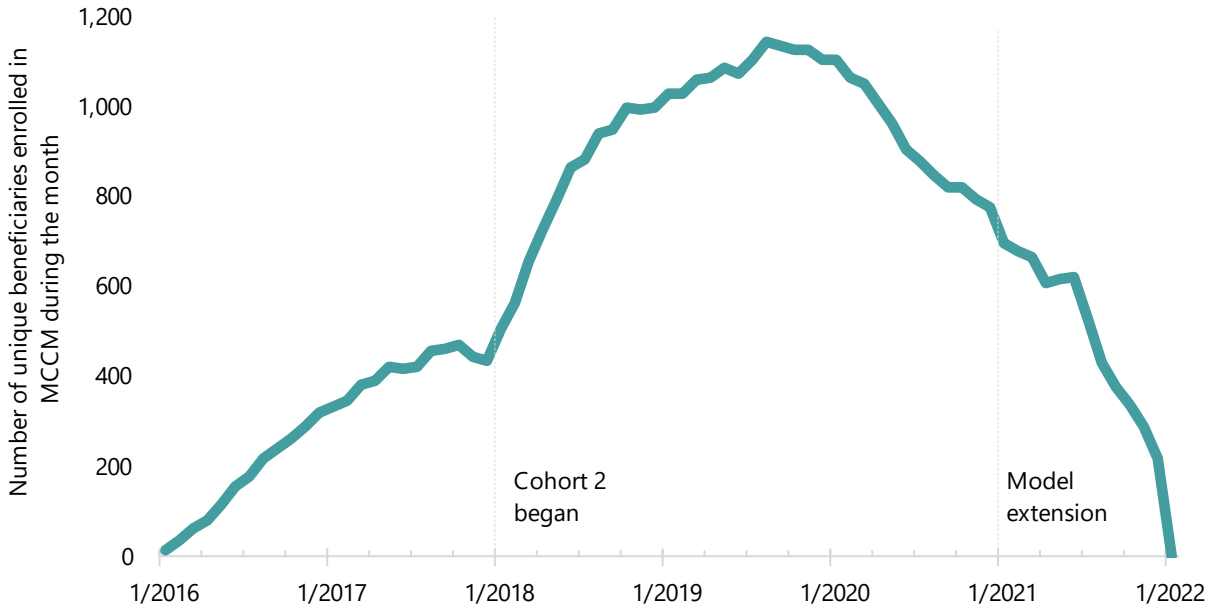
Figure A.2. Cumulative number of MCCM enrollees through the end of each month



Source: MCCM program data, January 1, 2016 to December 31, 2021.

MCCM = Medicare Care Choices Model.

Figure A.3. Number of unique beneficiaries enrolled in MCCM at any time in a month



Source: MCCM program data, January 1, 2016 to December 31, 2021.

MCCM = Medicare Care Choices Model.

Table A.8. Referral sources for beneficiaries enrolled in MCCM: Number and share of MCCM enrollees by referring provider specialty

Referring provider's specialty	MCCM enrollees	
	Number	Percentage
Family medicine	1,605	22
Internal medicine	1,535	21
Oncology	2,418	33
Cardiology	349	5
Pulmonary	206	3
Other specialists	278	4
Unknown	872	12
Total	7,263	100

Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: A total of 4,517 unique NPI referred 22,652 beneficiaries to MCCM. Of those referred, 11,094 were eligible and among those 7,263 enrolled. Among NPI with multiple referring specialty flags, the following hierarchy was implemented: (1) oncology, (2) cardiology, (3) pulmonology, (4) internal medicine, (5) hematology and (6) nephrology.

MCCM = Medicare Care Choices Model.

In Table A.9 through Table A.14, we present the characteristics of subgroups of MCCM enrollees by year of enrollment, discharge status, dual eligibly status, race and ethnicity, rural status, and primary diagnosis at enrollment. These tables include demographic characteristics, MCCM-qualifying conditions, health status at enrollment, use of Medicare services before enrollment, and the number of days enrolled in MCCM and between enrollment and death (for those who died while enrolled).[84]

Table A.9. Characteristics of MCCM enrollees, by year of enrollment

Beneficiaries' characteristics	Year of enrollment						All enrollees (N = 7,069)
	2016 (N = 607)	2017 (N = 917)	2018 (N = 2,069)	2019 (N = 1,961)	2020 (N = 1,060)	2021 (N = 455)	
Demographics							
Average age (years)	76	76	77	78	78	78	77
Age 80 or older (%)	37	38	45	45	43	44	43
Female (%)	52	54	52	53	48	51	52
Race and ethnicity (%)							
Non-Hispanic White	86	86	87	86	86	86	86
Black or African American	9	10	8	9	8	9	8
Other or unknown	4	5	6	5	7	5	5
Whether dually eligible for Medicaid (%)	17	16	13	12	9	11	13
Resides in rural area (%)	19	15	13	12	12	12	13
MCCM-qualifying diagnosis (%)							
Cancer	66	66	66	64	71	68	66
Congestive heart failure	37	37	38	41	36	35	38
Chronic obstructive pulmonary disease	33	37	35	34	30	31	34
HIV/AIDS	1	<1	1	<1	<1	0	<1
Health status							
Average hierarchical condition category score	5.1	5.2	5.4	5.5	5.4	5.5	5.4
Ischemic or unspecified stroke (%)	8	8	10	9	10	10	9
Kidney disease (%)	46	47	49	51	53	48	50
Diabetes with acute or chronic complications (%)	29	33	34	36	33	32	34
Dementia with or without complication (%)	13	13	18	18	14	15	16
Cardio-respiratory failure and shock (%)	35	36	38	39	35	42	37
Acute myocardial infarction (%)	10	12	12	12	11	11	12
Average Medicare service use in the 90 days before enrollment							
Total Medicare expenditures ($)	23,893	26,465	28,817	31,456	31,456	32,142	29,431
Part B drug expenditures ($)	3,740	3,840	3,945	4,298	5,420	5,106	4,308
Number of inpatient admissions	0.9	1.1	1.0	1.1	1.0	1.0	1.0

[84] The lengths of enrollment and survival times reported at the bottom of these six tables are different than those reported in Table 6 in Chapter 5 because (1) we used a de-duplicated sample, restricted to beneficiaries observable in claims for the 12 months before their enrollment or referral data and (2) calculated lengths of enrollment using discharge dates without accounting for last service date (see footnote 83).

Beneficiaries' characteristics	Year of enrollment						All enrollees (N = 7,069)
	2016 (N = 607)	2017 (N = 917)	2018 (N = 2,069)	2019 (N = 1,961)	2020 (N = 1,060)	2021 (N = 455)	
Days from most recent inpatient discharge and enrollment	81	72	71	68	70	67	70
Number of outpatient emergency department visits and observation stays	0.6	0.7	0.7	0.7	0.6	0.7	0.6
Number of ambulatory visits with primary care clinicians	3.7	3.7	3.9	4.4	4.9	5.5	4.3
Number of ambulatory visits with specialist physicians	4.2	4.4	4.8	4.6	4.8	4.6	4.6
Drugs for advanced stage cancer (%)	33	33	32	32	35	35	33
Advance care planning visit in previous two years (%)	5	9	20	27	27	32	21
Days observed							
Number of days enrolled in MCCM	215	202	180	188	154	103	179
Number of days alive not enrolled in MCCM through the end of the analysis period (12/31/2021)	162	135	111	97	69	42	104
Number of days alive from enrollment through the end of the analysis period (12/31/2021)	377	337	291	286	223	144	283
Number of days from enrollment until death (among those who died before the end of the analysis period, 12/31/2021)	283	256	223	202	140	85	209
MCCM discharge disposition							
Transitioned to the Medicare hospice benefit[a] (%)	69	67	70	65	60	54	66
Remained in MCCM until death (%)	12	14	14	13	12	9	13
Still alive when the model ended (%)	5	6	6	12	20	33	11
Other discharge status reasons[a, b] (%)	13	13	10	10	8	4	10
Hospice use after enrollment							
Used hospice after enrollment (among those observed in Medicare claims data, %)	78	78	79	77	71	65	76

Sources: MCCM program data, Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021.

Note: The analyses in this table were limited to the 7,069 enrollees (97 percent) who were observable in claims for the 12 months before their enrollment or referral.

[a] Does not include beneficiaries who were alive on January 1, 2022, after the model ended.

[b] The "other" category includes beneficiaries who (1) voluntarily withdrew from MCCM, (2) moved out of hospice service area, (3) lived outside the home for more than 90 days, (4) transferred to another MCCM hospice, or (4) were discharged for cause, and (6) unspecified reasons (besides enrolling in hospice or dying).

MCCM = Medicare Care Choices Model.

Table A.10. Characteristics of MCCM enrollees, by MCCM discharge status

Beneficiaries' characteristics	Discharge status				All enrollees defined in claims (N = 7,069)
	Transitioned to hospice[a] (N = 4,631)	Remained in MCCM until death (N = 913)	Alive when model ended (N = 805)	Other[a,b] (N = 720)	
Demographics					
Average age (years)	78	77	77	77	77
Age 80 or older (%)	43	44	43	43	43
Female (%)	51	48	60	53	52
Race and ethnicity (%)					
Non-Hispanic White	88	80	84	85	86
Black or African American	7	14	11	10	8
Other or unknown	5	6	6	5	5
Whether dually eligible for Medicaid (%)	10	16	17	18	13
Resides in rural area (%)	13	14	14	14	13
MCCM-qualifying diagnosis (%)					
Cancer	72	56	48	62	66
Congestive heart failure	33	53	44	41	38
Chronic obstructive pulmonary disease	31	39	44	35	34
HIV/AIDS	<1	1	<1	1	<1
Health status					
Average hierarchical condition category score	5.4	5.9	4.9	5.3	5.4
Ischemic or unspecified stroke (%)	9	9	9	12	9
Kidney disease (%)	48	54	53	48	50
Diabetes with acute or chronic complications (%)	32	41	36	36	34
Dementia with or without complication (%)	16	16	16	19	16
Cardio-respiratory failure and shock (%)	34	48	44	37	37
Acute myocardial infarction (%)	10	15	12	13	12
Average Medicare service use in the 90 days before enrollment					
Total Medicare expenditures ($)	29,266	32,734	26,806	29,237	29,431
Part B drug expenditures ($)	4,811	3,158	3,427	3,513	4,308
Number of inpatient admissions	1.0	1.3	1.0	1.0	1.0
Days from most recent inpatient discharge and enrollment	71	64	79	69	70
Number of outpatient emergency department visits and observation stays	0.6	0.6	0.7	0.7	0.6
Number of ambulatory visits with primary care clinicians	4.1	4.5	4.9	4.2	4.3
Number of ambulatory visits with specialist physicians	4.9	4.4	4.0	4.1	4.6

Beneficiaries' characteristics	Discharge status				All enrollees defined in claims (N = 7,069)
	Transitioned to hospice[a] (N = 4,631)	Remained in MCCM until death (N = 913)	Alive when model ended (N = 805)	Other[a,b] (N = 720)	
Drugs for advanced stage cancer (%)	37	24	20	30	33
Advance care planning visit in previous two years (%)	20	24	23	19	21
Days observed					
Number of days enrolled in MCCM	120	175	501	206	179
Number of days alive not enrolled in MCCM through the end of the analysis period (12/31/2021)	61	<1	351	232	104
Number of days alive from enrollment through the end of the analysis period (12/31/2021)	182	176	851	438	283
Number of days from enrollment until death (among those who died before the end of the analysis period, 12/31/2021)	181	174	n.a.	436	209
Hospice use after enrollment					
Used hospice after enrollment (among those observed in Medicare claims data, %)	98	12	25	74	76

Sources: MCCM program data, Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021.

Note: The analyses in this table were limited to the 7,069 enrollees (97 percent) who were observable in claims for the 12 months before their enrollment or referral.

[a] Does not include beneficiaries who were alive on January 1, 2022 after the model ended.

[b] The "other" category includes beneficiaries who (1) voluntarily withdrew from MCCM, (2) moved out of hospice service area, (3) lived outside the home for more than 90 days, (4) transferred to another MCCM hospice, or (4) were discharged for cause, and (6) unspecified reasons (besides enrolling in hospice or dying).

MCCM = Medicare Care Choices Model; n.a. = not applicable.

Table A.11. Characteristics of MCCM enrollees, by dual eligibility

Beneficiaries' characteristics	Dually eligible beneficiaries (N = 892)	Non-dually eligible beneficiaries (N = 6,177)
Demographics		
Average age (years)	71	78
Age 80 or older (%)	25	46
Female (%)	64	50
Race and ethnicity (%)		
Non-Hispanic White	65	89
Black or African American	23	6
Other or unknown	12	4
Resides in rural area (%)	21	12
MCCM-qualifying diagnosis (%)		
Cancer	57	68
Congestive heart failure	42	37
Chronic obstructive pulmonary disease	44	32
HIV/AIDS	2	<1
Health status		
Average hierarchical condition category score	5.7	5.3
Ischemic or unspecified stroke (%)	9	9
Kidney disease (%)	45	50
Diabetes with acute or chronic complications (%)	42	33
Dementia with or without complication (%)	13	16
Cardio-respiratory failure and shock (%)	45	36
Acute myocardial infarction (%)	13	11
Average Medicare service use in the 90 days before enrollment		
Total Medicare expenditures ($)	28,987	29,495
Part B drug expenditures ($)	3,432	4,434
Number of inpatient admissions	1.1	1.0
Days from most recent inpatient discharge and enrollment	71	70
Number of outpatient emergency department visits and observation stays	0.8	0.6
Number of ambulatory visits with primary care clinicians	4.2	4.3
Number of ambulatory visits with specialist physicians	3.6	4.8
Drugs for advanced stage cancer (%)	28	34
Advanced care planning visit in previous two years (%)	19	21
Days observed		
Number of days enrolled in MCCM	218	174
Number of days alive not enrolled in MCCM through the end of the analysis period (12/31/2021)	157	96
Number of days alive from enrollment through the end of the analysis period (12/31/2021)	375	270
Number of days from enrollment until death (among those who died before the end of the analysis period, 12/31/2021)	271	201

Sources: MCCM program data, Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021.

Note: The analyses in this table were limited to the 7,069 enrollees (97 percent) who were observable in claims for the 12 months before their enrollment or referral.

MCCM = Medicare Care Choices Model.

Table A.12. Characteristics of MCCM enrollees, by race and ethnicity

Beneficiaries' characteristics	Non-White or Hispanic beneficiaries (N = 974)	Non-Hispanic White beneficiaries (N = 6,095)
Demographics		
Average age (years)	74	78
Age 80 or older (%)	34	44
Female (%)	56	51
Race and ethnicity (%)		
Non-Hispanic White	0	100
Black or African American	61	0
Other or unknown	39	0
Whether dually eligible for Medicaid (%)	32	10
Resides in rural area (%)	7	14
MCCM-qualifying diagnosis (%)		
Cancer	68	66
Congestive heart failure	41	37
Chronic obstructive pulmonary disease	28	35
HIV/AIDS	2	<1
Health status		
Average hierarchical condition category score	5.7	5.3
Ischemic or unspecified stroke (%)	12	9
Kidney disease (%)	52	49
Diabetes with acute or chronic complications (%)	47	32
Dementia with or without complication (%)	18	16
Cardio-respiratory failure and shock (%)	34	38
Acute myocardial infarction (%)	14	11
Average Medicare service use in the 90 days before enrollment		
Total Medicare expenditures ($)	34,046	28,694
Part B drug expenditures ($)	3,771	4,393
Number of inpatient admissions	1.2	1.0
Days from most recent inpatient discharge and enrollment	63	72
Number of outpatient emergency department visits and observation stays	0.7	0.6
Number of ambulatory visits with primary care clinicians	4.3	4.3
Number of ambulatory visits with specialist physicians	4.2	4.7
Drugs for advanced stage cancer (%)	34	33
Advanced care planning visit in previous two years (%)	25	20
Days observed		
Number of days enrolled in MCCM	197	177
Number of days alive not enrolled in MCCM through the end of the analysis period (12/31/2021)	108	103
Number of days alive from enrollment through the end of the analysis period (12/31/2021)	305	280
Number of days from enrollment until death (among those who died before the end of the analysis period, 12/31/2021)	215	208

Sources: MCCM program data, Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021.

Note: The analyses in this table were limited to the 7,069 enrollees (97 percent) who were observable in claims for the 12 months before their enrollment or referral.

MCCM = Medicare Care Choices Model.

Table A.13. Characteristics of MCCM enrollees, by rural status

Beneficiaries' characteristics	Rural beneficiaries (N = 949)	Non-rural beneficiaries (N = 6,120)
Demographics		
Average age (years)	76	78
Age 80 or older (%)	35	44
Female (%)	52	52
Race and ethnicity (%)		
Non-Hispanic White	93	85
Black or African American	4	9
Other or unknown	3	6
Whether dually eligible for Medicaid (%)	20	12
MCCM-qualifying diagnosis (%)		
Cancer	62	67
Congestive heart failure	37	38
Chronic obstructive pulmonary disease	42	33
HIV/AIDS	<1	1
Health status		
Average hierarchical condition category score	5.2	5.4
Ischemic or unspecified stroke (%)	9	9
Kidney disease (%)	47	50
Diabetes with acute or chronic complications (%)	34	34
Dementia with or without complication (%)	14	16
Cardio-respiratory failure and shock (%)	42	37
Acute myocardial infarction (%)	10	12
Average Medicare service use in the 90 days before enrollment		
Total Medicare expenditures ($)	27,635	29,710
Part B drug expenditures ($)	4,434	4,288
Number of inpatient admissions	1.1	1.0
Days from most recent inpatient discharge and enrollment	68	71
Number of outpatient emergency department visits and observation stays	1.0	0.6
Number of ambulatory visits with primary care clinicians	4.0	4.3
Number of ambulatory visits with specialist physicians	3.7	4.8
Drugs for advanced stage cancer (%)	32	33
Advanced care planning visit in previous two years (%)	13	22
Days observed		
Number of days enrolled in MCCM	181	179
Number of days alive not enrolled in MCCM through the end of the analysis period (12/31/2021)	134	104
Number of days from enrollment until death or the end of the analysis period (12/31/2021)	315	283
Number of days from enrollment until death (among those who died before the end of the analysis period, 12/31/2021)	219	209

Sources: MCCM program data, Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021.

Note: The analyses in this table were limited to the 7,069 enrollees (97 percent) who were observable in claims for the 12 months before their enrollment or referral.

MCCM = Medicare Care Choices Model.

Table A.14. Characteristics of MCCM enrollees, by qualifying diagnosis

Beneficiaries' characteristics	Beneficiaries with cancer (N = 4,692)	Beneficiaries with congestive heart failure diagnosis (N = 2,687)	Beneficiaries with chronic obstructive pulmonary disease (N = 2,397)	Beneficiaries with HIV/AIDS (N = 33)
Demographics				
Average age (years)	76	80	77	56
Age 80 or older (%)	35	57	43	0
Female (%)	50	50	54	24
Race and ethnicity (%)				
Non-Hispanic White	86	85	89	39
Black or African American	8	10	7	52
Other or unknown	6	5	4	9
Whether dually eligible for Medicaid (%)	11	14	16	64
Resides in rural area (%)	13	13	16	3
MCCM-qualifying diagnosis (%)				
Cancer	100	39	49	67
Congestive heart failure	22	100	46	18
Chronic obstructive pulmonary disease	25	41	100	33
HIV/AIDS	<1	<1	<1	100
Health status				
Average hierarchical condition category score	5.7	5.8	5.7	6.1
Ischemic or unspecified stroke (%)	8	12	9	6
Kidney disease (%)	45	66	51	30
Diabetes with acute or chronic complications (%)	29	46	35	24
Dementia with or without complication (%)	12	21	17	12
Cardio-respiratory failure and shock (%)	26	55	64	30
Acute myocardial infarction (%)	8	20	12	9
Average Medicare service use in the 90 days before enrollment				
Total Medicare expenditures ($)	31,834	29,939	27,623	44,762
Part B drug expenditures ($)	6,215	1,928	3,230	2,568
Number of inpatient admissions	1.0	1.3	1.1	1.3
Days from most recent inpatient discharge and enrollment	73	64	70	80
Number of outpatient emergency department visits and observation stays	0.7	0.7	0.7	1.0
Number of ambulatory visits with primary care clinicians	4.0	5.0	4.6	3.9
Number of ambulatory visits with specialist physicians	5.5	4.0	4.1	3.7
Drugs for advanced stage cancer (%)	48	15	21	27
Advanced care planning visit in previous two years (%)	20	25	22	12
Days observed				
Number of days enrolled in MCCM	147	208	212	219
Number of days alive not enrolled in MCCM through the end of the analysis period (12/31/2021)	80	115	136	125
Number of days alive from enrollment through the end of the analysis period (12/31/2021)	226	323	348	345
Number of days from enrollment until death (among those who died before the end of the analysis period, 12/31/2021)	173	242	249	273

Sources: MCCM program data, Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021.

Note: The analyses in this table were limited to the 7,069 enrollees (97 percent) who were observable in claims for the 12 months before their enrollment or referral. Beneficiaries can have more than one primary diagnosis, so the total sample size across diagnoses sums to more than 7,069.

MCCM = Medicare Care Choices Model.

5.3. Services provided to MCCM enrollees

This section presents the number and characteristics of encounters and services delivered under MCCM. Table A.15, Table A.16, Figure A.4, Figure A.5, and Table A.17, show the prevalence and intensity of encounters by beneficiary characteristics, year, and enrollment month. Prevalence is measured as the percentage of enrollees with an encounter and the distribution of encounters across demographic subgroups. Intensity is measured as the average number of encounters per enrollee in total and per week. Table A.18 presents the same prevalence and intensity measures by type, mode, location, level of encounter, as well as by type of staff member delivering the service. Table A.19 examines how the prevalence of in-person visits during the COVID-19 pandemic compared to the prevalence before the pandemic, overall and for beneficiary subgroups.

Table A.20 presents the prevalence and intensity measures for each of the 20 main service categories, and Table A.21 shows similar results for the services commonly used as measures of quality of care (such as screening and treatment rates). Table A.22 reports on continuity of care. Table A.23 and Table A.24 show the quality of services delivery measures by type of hospice, based on location, ownership status, size, chain affiliation, facility-based versus freestanding, and pre-existing MCCM-like or palliative care program.

Finally, Table A.25 presents total and average Medicare payments for MCCM services, based on the hospice's number of MCCM enrollees.

Table A.15. Number of enrollees, average length of enrollment, and encounter intesity, overall and by beneficiary characteristic

MCCM enrollees	Number of enrollees with at least one encounter	Percentage of enrollees with at least one encounter	Average length of enrollment (in weeks)	Average number of encounters per enrollee per week
All MCCM enrollees with at least one encounter	7,237	100	24.0	2.6
Qualifying diagnosis[a]				
Cancer	4,466	62	18.3	2.8
Congestive heart failure	1,285	18	34.4	2.1
Chronic obstructive pulmonary disease	1,678	23	31.8	2.2
HIV/AIDS	17	<1	23.2	2.5
Discharge status				
Transitioned to hospice	4,731	65	16.2	2.8
Remained in MCCM until death	927	13	23.2	2.3
Model ended	820	11	67.5	1.4
Other	759	10	26.2	2.2
Functional status[b,d]				
Independent	1,301	18	30.5	2.3
Needs some assistance	3,485	48	26.3	2.3
Dependent	1,668	23	20.0	2.9
Disabled	237	3	16.2	3.3

MCCM enrollees	Number of enrollees with at least one encounter	Percentage of enrollees with at least one encounter	Average length of enrollment (in weeks)	Average number of encounters per enrollee per week
Caregiver[c,d]				
Spouse/partner	3,094	43	23.1	2.7
Immediate family member	1,919	27	26.3	2.5
Friend/neighbor	605	8	30.1	2.3
Other relative	163	2	28.2	2.5
Other	527	7	32.0	1.8
Marital status[d]				
Never married	420	6	25.8	2.2
Married	3,632	50	21.6	2.7
Partner	64	1	29.0	2.9
Widowed	2,042	28	27.4	2.5
Divorced	667	9	25.1	2.5
Race and ethnicity				
Non-Hispanic White	6,223	86	23.7	2.6
All other	1,013	14	25.5	2.4
Year of enrollment				
2016	636	9	29	2.3
2017	936	13	27	2.2
2018	2,120	29	24	2.7
2019	2,003	28	25	2.4
2020	1,081	15	20	2.8
2021	461	6	13	3.1

Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: The calculations in this table is among the 7,237 enrollees who had at least one encounter. Encounters represent a documented action between an individual provider and an enrolled beneficiary or caregiver. Most encounters included multiple services delivered by a member of the hospice staff. The number of encounters reported in this chapter excludes interdisciplinary group meetings, which did not involve beneficiaries. Enrollees can have multiple qualifying conditions. Mutually exclusive category column percentages might not sum to 100 percent due to rounding.

[a] Enrollees can have more than one qualifying condition.

[b] Due to the change in available variables starting January 1, 2018, functional status from the beneficiary level at enrollment file (only available through December 31, 2017) was merged with the first value of functional status for an enrollee from the encounter level file starting with January 1, 2018, data.

[c] Due to the change in available variables starting January 1, 2018, caregiver from the beneficiary level at enrollment file (available through only December 31, 2017) was merged with the first value of caregiver for an enrollee from the encounter level file starting with January 1, 2018, data.

[d] This panel does not show results for beneficiaries with missing data.

MCCM = Medicare Care Choices Model.

Table A.16. Distribution of the number of MCCM encounters for enrollees, overall and by beneficiary characteristic

MCCM enrollees	Number of encounters	Percentage of encounters	Average number of encounters per enrollee	Average number of encounters per enrollee per week
All MCCM enrollees and encounters	217,156	100	30.0	2.6
Qualifying condition[a]				
Cancer	100,577	46	22.5	2.8
Congestive heart failure	68,047	31	40.6	2.2
Chronic obstructive pulmonary disease	54,363	25	42.3	2.1
HIV/AIDS	418	<1	24.6	2.5
Length of time enrolled in MCCM				
0 to 30 days	13,854	6	5.6	4.7
31 to 90 days	23,828	11	14.2	1.9
91 to 180 days	27,930	13	26.0	1.4
181 to 365 days	44,338	20	45.3	1.2
365 or more days	107,206	49	103.1	1.1
Discharge status				
Remained in MCCM until death	27,430	13	29.6	2.3
Transitioned to hospice	109,776	51	23.2	2.8
Alive when model ended	56,744	26	69.2	1.4
Other	23,206	11	30.6	2.2
Functional status[b,d]				
Independent	47,517	22	36.5	2.3
Needs some assistance	111,775	51	32.1	2.3
Dependent	46,337	21	27.8	2.9
Disabled	5,878	3	24.8	3.3
Caregiver[c]				
Spouse/partner	86,499	40	28.0	2.7
Immediate family member	67,419	31	35.1	2.5
Friend/neighbor	23,334	11	38.6	2.3
Other relative	6,674	3	40.9	2.5
Other	19,142	9	36.3	1.8
Marital status[d]				
Never married	13,498	6	32.1	2.2
Married	92,702	43	25.5	2.7
Partner	2,382	1	37.2	2.9
Widowed	76,299	35	37.4	2.5
Divorced	20,530	9	30.8	2.5

Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: The calculations in this table were among the 7,237 enrollees who had at least one encounter. Mutually exclusive category column percentages might not sum to 100 percent due to rounding.

[a] Enrollees can have more than one qualifying condition.

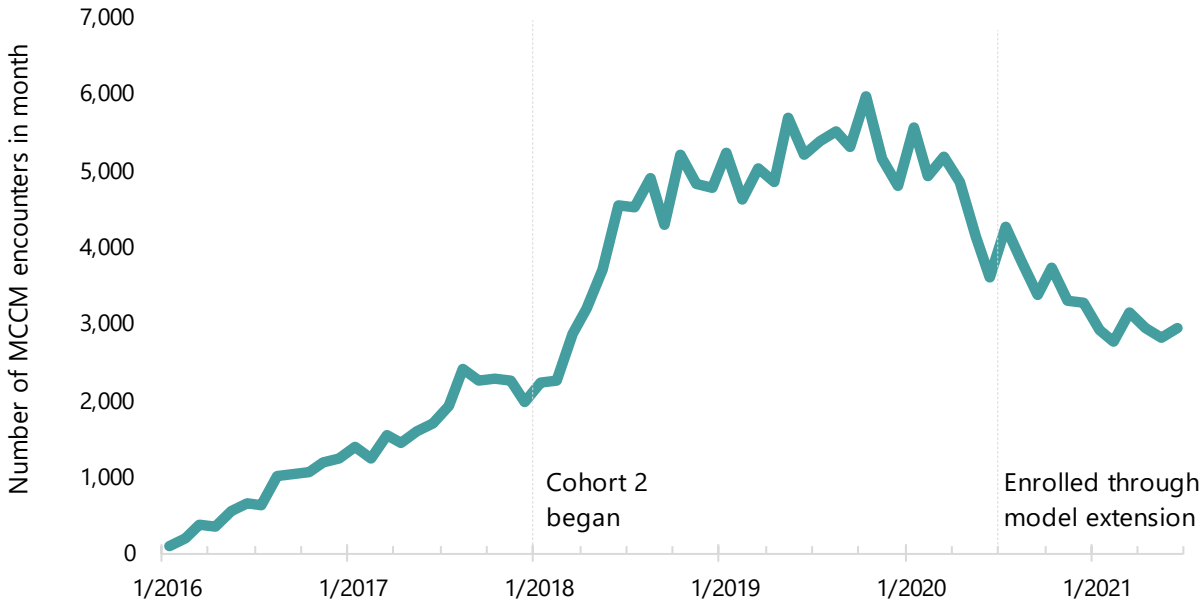
[b] Due to the change in available variables starting January 1, 2018, functional status from the beneficiary level at enrollment file (available through only December 31, 2017) was merged with the first value of functional status for an enrollee from the encounter level file starting with January 1, 2018, data.

[c] Due to the change in available variables starting January 1, 2018, caregiver from the beneficiary level at enrollment file (only available through December 31, 2017) was merged with the first value of caregiver for an enrollee from the encounter level file starting with January 1, 2018, data.

[d] This panel does not show results for beneficiaries with missing data.

MCCM = Medicare Care Choices Model.

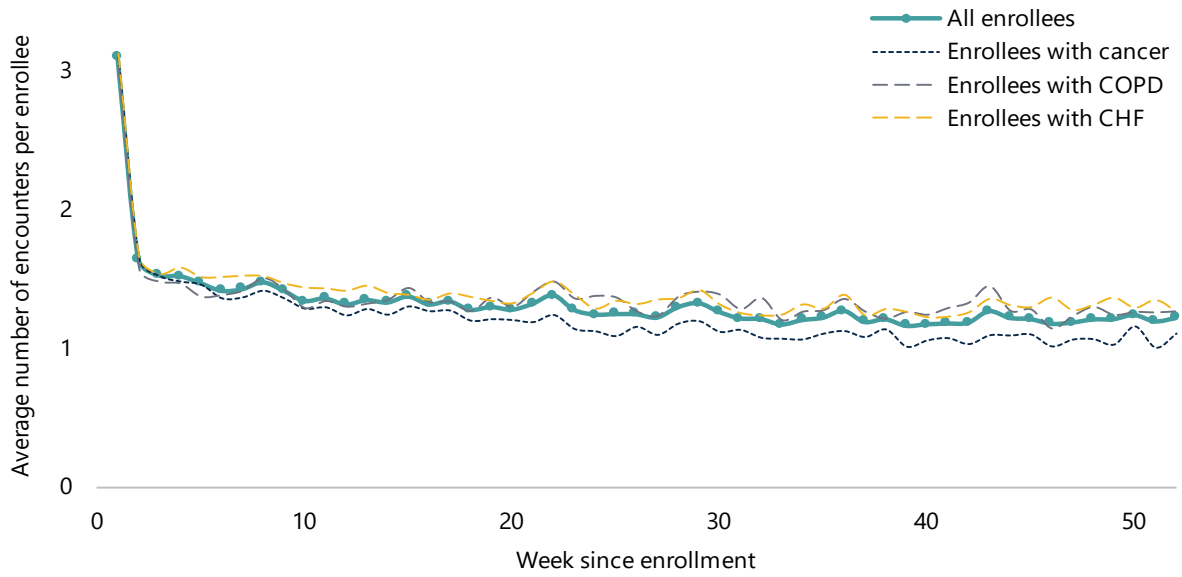
Figure A.4. Number of MCCM encounters provided in each month, 2016 to 2021



Source: MCCM program data, January 1, 2016 to December 31, 2021.

MCCM = Medicare Care Choices Model.

Figure A.5. Average number of encounters per week for each week after enrollment, overall and by qualifying diagnosis



Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: This analysis was limited to the first 12 months of enrollment for ease of presentation. Enrollees can have more than one qualifying condition. We did not include the 20 beneficiaries with HIV/AIDS in this analysis because the sample sizes were too small.

CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; MCCM = Medicare Care Choices Model.

Table A.17. Average number of encounters per month, by month of enrollment, overall and by beneficiary characteristic

MCCM enrollees	Months after enrollment											
	Month 1	Month 2	Month 3	Month 4	Month 5	Month 6	Month 7	Month 8	Month 9	Month 10	Month 11	Month 12
All MCCM enrollees	6.5	4.9	4.7	4.7	4.7	4.5	4.5	4.5	4.3	4.2	4.3	4.3
Qualifying diagnosis[a]												
Cancer	6.6	4.7	4.5	4.5	4.5	4.2	4.0	4.1	3.9	3.9	3.9	3.9
Congestive heart failure	6.7	5.0	4.8	4.9	4.9	4.9	4.9	4.9	4.7	4.5	4.7	4.8
Chronic obstructive pulmonary disease	7.0	5.4	5.1	5.1	5.0	4.9	4.9	4.9	4.6	4.6	4.6	4.7
HIV/AIDS	6.1	4.1	4.3	5.0	5.3	7.3	4.7	6.3	4.3	10.0	5.0	3.7
Discharge status												
Transitioned to hospice	6.8	5.1	4.9	5.0	5.1	4.8	4.8	4.9	4.7	4.6	4.8	4.9
Remained in MCCM until death	6.7	4.8	4.8	4.9	4.7	4.8	4.7	4.8	4.9	4.6	4.3	4.2
Model ended	6.6	4.7	4.3	4.3	4.3	4.2	4.1	4.2	3.9	4.0	4.1	4.0
Other	6.3	4.9	4.5	4.7	4.6	4.4	4.2	4.2	4.1	4.0	3.8	3.9
Functional status[b,d]												
Independent	6.9	4.9	4.7	4.8	4.4	4.5	4.4	4.4	4.0	4.3	4.4	4.4
Needs some assistance	6.7	4.9	4.7	4.7	4.8	4.6	4.5	4.7	4.4	4.2	4.3	4.3
Dependent	7.1	5.5	5.2	5.1	5.0	4.8	4.7	4.7	4.7	4.5	4.5	4.5
Disabled	6.9	5.4	5.3	5.2	6.0	5.6	5.0	4.9	5.1	4.8	4.5	5.0
Caregiver[c,d]												
Spouse/ partner	6.8	5.0	4.7	4.5	4.7	4.4	4.3	4.5	4.2	4.0	3.9	3.9
Immediate family member	7.3	5.2	5.1	5.2	5.0	4.8	4.8	4.8	4.7	4.5	4.6	4.7
Friend/ neighbor	6.7	5.2	4.9	5.2	5.1	5.0	4.8	5.0	4.7	5.0	5.2	5.0
Other relative	7.5	5.7	5.0	5.1	5.6	5.6	5.3	4.6	3.8	5.1	6.9	5.0
Other	6.3	4.9	4.5	4.7	4.5	4.6	4.5	4.5	4.1	4.3	4.0	4.4
Marital status[d]												
Never married	6.5	4.6	4.7	5.0	4.6	4.9	4.4	4.2	4.2	3.8	4.0	3.9
Married	6.6	4.8	4.5	4.4	4.5	4.2	4.1	4.2	4.0	3.9	3.9	3.8
Partner	7.5	5.7	5.8	4.8	5.3	5.0	4.0	4.3	4.8	4.8	4.2	2.6
Widowed	7.0	5.3	5.1	5.3	5.1	5.1	5.1	5.2	4.9	4.9	5.1	5.3
Divorced	6.8	4.9	4.9	4.9	4.7	4.6	4.4	4.7	4.4	4.4	4.3	4.4

Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: This table is limited to the first 12 months of enrollment for ease of presentation. Each month is defined as 30-day spans after an enrollment date. For example, Month 1 is 30 days after an enrollment date, and Month 2 is 60 days after an enrollment date, etc. Each rate is calculated as the number of encounters which occurred in the time span denoted divided by the total number of enrollees who are enrolled during that time span.

[a] Enrollees can have more than one qualifying condition.

[b] Due to the change in available variables starting January 1, 2018, functional status from the beneficiary level at enrollment file (available through only December 31, 2017) was merged with the first value of functional status for an enrollee from the encounter level file starting with January 1, 2018, data.

[c] Due to the change in available variables starting January 1, 2018, caregiver from the beneficiary level at enrollment file (available through only December 31, 2017) was merged with the first value of caregiver for an enrollee from the encounter level file starting with January 1, 2018, data.

[d] This panel does not show results for beneficiaries with missing data.

MCCM = Medicare Care Choices Model.

Table A.18. Number of MCCM encounters for enrollees, overall and by type of encounter (2018 through 2021)

MCCM encounters	Number of encounters	Percentage of encounters	Percentage of enrollees with at least one encounter	Average number of encounters per enrollee per week
All MCCM encounters	167,797	100	100	2.6
Provider type				
MCCM registered nurse care coordinator	44,902	27	64	0.6
Hospice registered nurse/licensed practical nurse	41,666	25	77	1.0
Nurse practitioner	572	<1	3	0.01
Nurse aide	41,058	24	28	0.3
Hospice physician	190	<1	2	<0.01
Social worker	28,726	17	82	0.5
Chaplain	6,799	4	33	0.1
Counselors[a]	372	<1	3	0.03
Therapists[b]	529	<1	1	<0.01
Other[c]	2,782	2	10	0.04
Encounter type				
First visit (by discipline)	14,686	9	98	0.9
Follow up	143,308	85	93	1.5
Post-inpatient discharge	539	<1	6	0.0
Inpatient coordination of care	5,077	3	21	0.1
After-hours triage	4,136	2	25	0.2
Assessment type				
Initial assessment	5,534	3	84	0.4
First comprehensive assessment	7,274	4	84	0.5
Second or more comprehensive assessment	45,232	27	70	0.4
Mode				
In person (home or community)	121,717	73	>99	1.9
Phone (clinical/support)	42,945	26	78	0.7
Mail	86	<1	1	<0.01
Video conferencing	341	<1	1	<0.01
Phone (administrative)	2,152	1	11	0.03
Email	503	<1	4	0.02
Location (regardless of mode)				
Enrollee's home or residence[d]	153,165	91	>99	2.3
Skilled nursing facility	1,245	<1	7	0.01
Inpatient rehabilitation facility	1,316	<1	8	0.01
Inpatient hospital	6,482	4	29	0.1
Inpatient psychiatric facility	33	<1	<1	<0.01
Place not otherwise specified	5,502	3	26	0.1
In-person visits by location				
Enrollee's home or residence[d]	114,957	69	>99	1.8
Skilled nursing facility	933	1	5	0.01
Inpatient rehabilitation facility	764	<1	5	0.01
Inpatient hospital	4,614	3	21	0.1
Inpatient psychiatric facility	17	<1	<1	<0.01
Place not otherwise specified	429	<1	4	0.01

MCCM encounters	Number of encounters	Percentage of encounters	Percentage of enrollees with at least one encounter	Average number of encounters per enrollee per week
Level				
Routine home care	167,021	>99	>99	2.6
In-home respite care	710	<1	6	0.01

Source: MCCM program data, January 1, 2018 to December 31, 2021.

Note: CMS updated the MCCM program data collection protocol on January 1, 2018, limiting the comparability of services delivered before and after that date. Therefore, the analyses in this table were restricted to encounters on or after January 1, 2018 for 5,685 MCCM enrollees who enrolled on or after January 1, 2018 who had at least one encounter.

[a] The provider category "Counselors" comprises nutritional counselors, bereavement counselors, and other spiritual counselors.

[b] The provider category "Therapists" comprises art therapists, music therapists, massage therapists, pet therapists, and additional therapists.

[c] The provider category "Other" comprises pharmacists, volunteers, and administrative or nonclinical staff.

[d] About three-quarters of encounters with a service location of enrollee's home/residence have the service delivery mode of "in person," and nearly a quarter have the service delivery mode as "phone (clinical/support). Just under 2 percent have the service delivery mode identified as one of the other modes.

MCCM = Medicare Care Choices Model.

Table A.19. The number and percentage of encounters that were in person before versus during the COVID-19 pandemic

MCCM enrollees	Before the COVID-19 pandemic (January 2016 to February 2020)			During the COVID-19 pandemic (March 2020 to December 2021)		
	Total number of encounters	Number in person	Percentage in person	Total number of encounters	Number in person	Percentage in person
All MCCM enrollees	150,939	114,560	76	66,217	43,299	65
Qualifying condition[a]						
Cancer	71,202	52,252	73	29,375	18,436	63
Congestive heart failure	46,615	35,834	77	21,432	14,258	67
Chronic obstructive pulmonary disease	38,078	29,937	79	16,285	11,222	69
HIV/AIDS	336	174	52	82	25	30
Length of time enrolled in MCCM						
0 to 30 days	10,979	7,944	72	2,875	1,958	68
31 to 90 days	19,430	14,147	73	4,398	2,804	64
91 to 180 days	21,215	15,640	74	6,715	4,414	66
181 to 365 days	30,313	23,027	76	14,025	9,400	67
365 or more days	69,002	53,802	78	38,204	24,723	65
Functional status[b,d]						
Independent	29,829	21,422	72	17,688	12,214	69
Needs some assistance	80,509	62,054	77	31,266	20,396	65
Dependent	30,922	23,816	77	15,415	9,667	63
Disabled	4,370	3,390	78	1,508	881	58
Caregiver[c,d]						
Spouse/partner	57,793	42,662	74	28,706	18,139	63
Immediate family member	40,962	32,535	79	26,457	18,113	68
Friend/neighbor	21,137	16,354	77	2,197	1,357	62
Other relative	4,170	3,097	74	2,504	1,754	70
Other	15,985	11,767	74	3,157	1,826	58
Marital status[a,d]						
Never married	9,050	6,735	74	4,448	2,983	67
Married	64,279	47,701	74	28,423	17,707	62
Partner	1,512	1,117	74	870	621	71
Widowed	53,670	42,042	78	22,629	15,205	67
Divorced	14,356	10,530	73	6,174	4,159	67

Source: MCCM program data, January 1, 2016 to December 31, 2020.

[a] Enrollees can have more than one qualifying condition.

[b] Due to the change in available variables starting January 1, 2018, functional status from the beneficiary level at enrollment file (available through only December 31, 2017) was merged with the first value of functional status for an enrollee from the encounter level file starting with January 1, 2018, data.

[c] Due to the change in available variables starting January 1, 2018, caregiver from the beneficiary level at enrollment file (available through only December 31, 2017) was merged with the first value of caregiver for an enrollee from the encounter level file starting with January 1, 2018, data.

[d] This panel does not show results for beneficiaries with missing data.

MCCM = Medicare Care Choices Model.

Table A.20. Types of services provided to MCCM enrollees (2018 through 2021)

MCCM services	Number of services	Percentage of services	Percentage of enrollees with at least one service	Average number of services per enrollee	Average number of services per enrollee per week	Average number of services per encounter
All MCCM services	509,859	100	100	90.0	8.7	3.0
Service type						
Family conference	6,027	1.2	42	1.1	0.3	0.04
Education	63,343	12	83	11.2	1.2	0.4
Transitional planning	4,086	<1	39	0.7	0.2	0.02
Medication administration	3,424	<1	16	0.6	0.1	0.02
Symptom management	43,519	9	71	7.7	0.8	0.3
48-hour initial assessment	5,534	1	84	1.0	0.4	0.03
Comprehensive assessment within five days of admission	7,274	1	84	1.3	0.5	0.04
Subsequent comprehensive assessment	45,232	9	70	8.0	0.4	0.3
Bereavement support	765	<1	6	0.1	0.0	<0.01
Care coordination	10,941	2	46	1.9	0.3	0.1
Case management	32,541	6	57	5.7	0.5	0.2
Counseling	16,998	3	57	3.0	0.3	0.1
Shared decision making	38,012	7	55	6.7	0.8	0.2
Supportive/active listening	101,334	20	89	17.9	1.5	0.6
Wound care	1,253	<1	8	0.2	0.0	0.01
Other	14,700	3	32	2.6	0.2	0.1
Homemaker services	11,507	2	12	2.0	0.1	0.1
Personal care assistance (such as bathing or eating)	27,315	5	20	4.8	0.2	0.2
Advanced care planning	37,151	7	83	6.6	0.4	0.2
Spiritual concerns	38,903	8	83	6.9	0.4	0.2

Source: MCCM program data, January 1, 2018 to December 31, 2021.

Note: CMS updated the MCCM program data collection protocol on January 1, 2018, limiting the comparability of services delivered before and after that date. Therefore, the analyses in this table were restricted to encounters on or after January 1, 2018, for 5,685 MCCM enrollees who enrolled on or after January 1, 2018. As noted in the data dictionary, each of these measures has a condition denoting which encounters are eligible. Each rate was calculated based on the eligible encounters.

MCCM = Medicare Care Choices Model.

Table A.21. MCCM quality measures, overall

Measure	MCCM encounters	
	Number of encounters eligible for the service	Percentage of eligible encounters that received the service
Pain screening and management encounters[a]		
Screening	48,574	99
Management	12,500	95
Management effective	10,018	80
Shortness of breath screening and management encounters[a]		
Screening	48,434	99
Management	6,699	74
Management effective	5,369	80
Psychological/emotional well-being screening and management encounters[a]		
Screening	49,783	92
Management	3,218	94
Management effective	903	27
Bowel regimen for opioid use encounters[a]		
Management	15,778	95
Management effective	13,697	91
Other quality measures		
Spiritual or religious discussions[a]	39,480	75
Advance care planning discussion[a]	38,070	78
Hospice registered nurse or licensed practical nurse provided encounters	41,666	25
Number/percentage of MCCM encounters delivered in person before March 1, 2020	114,560	76
Number/percentage of MCCM encounters delivered in the home before March 1, 2020	133,163	88

Source: MCCM program data, January 1, 2016 to December 31, 2021.

[a] CMS updated the MCCM program data collection protocol on January 1, 2018, limiting the comparability of services delivered before and after that date. Therefore, certain analyses in this table were restricted to encounters on or after January 1, 2018, for 5,685 MCCM enrollees who enrolled on or after January 1, 2018. As noted in the data dictionary, each of these measures has a condition denoting which encounters are eligible. Each rate was calculated based on the eligible encounters. See Appendix A, Section 4.2 for methodological details.

MCCM = Medicare Care Choices Model.

Table A.22. Continuity in care by beneficiary characteristics over the first 6 months of enrollment

MCCM enrollees	Total number of enrollees	At least one encounter every: 1 to 7 days – Number of enrollees	1 to 7 days – Percentage of enrollees	1 to 14 days – Number of enrollees	1 to 14 days – Percentage of enrollees	1 to 30 days – Number of enrollees	1 to 30 days – Percentage of enrollees	1 to 60 days – Number of enrollees	1 to 60 days – Percentage of enrollees
All MCCM enrollees with encounters	7,237	2,321	32	4,177	58	6,352	88	7,092	98
Qualifying condition[a]									
Cancer	4,466	1,627	36	2,743	61	3,980	89	4,394	98
Congestive heart failure	1,678	424	25	875	52	1,455	87	1,639	97
Chronic obstructive pulmonary disease	1,285	309	24	639	50	1,079	84	1,247	97
HIV/AIDS	17	<107	<60	11	65	15	88	16	94
Functional status[b]									
Independent	1,301	290	22	628	48	1,113	86	1,272	98
Needs some assistance	3,485	939	27	1,901	55	3,048	87	3,419	98
Dependent	1,668	654	39	1,068	64	1,481	89	1,639	98
Disabled	237	110	46	166	70	215	91	231	97
Missing	546	328	60	414	76	495	91	531	97
Caregiver[c]									
Spouse/partner	3,094	991	32	1,794	58	2,752	89	3,049	99
Immediate family member	1,919	537	28	1,052	55	1,663	87	1,882	98
Friend/neighbor	605	182	30	354	59	536	89	595	98
Other relative	163	45	28	83	51	137	84	154	94
Other	527	123	23	266	50	449	85	510	97
Missing	929	443	48	628	68	815	88	902	97

MCCM enrollees	Total number of enrollees	At least one encounter every							
		1 to 7 days		1 to 14 days		1 to 30 days		1 to 60 days	
		Number of enrollees	Percentage of enrollees	Number of enrollees	Percentage of enrollees	Number of enrollees	Percentage of enrollees	Number of enrollees	Percentage of enrollees
Marital status[d]									
Never married	420	126	30	229	55	342	81	405	96
Married	3,632	1,230	34	2,160	59	3,230	89	3,573	98
Partner	64	25	39	41	64	57	89	64	100
Widowed	2,042	592	29	1,131	55	1,787	88	1,999	98
Divorced	667	209	31	376	56	580	87	656	98
Declined to Rep	410	138	34	239	58	354	86	393	96

Source: MCCM program data, January 1, 2016 to December 31, 2021.

Note: This table includes services with enrollees in the first 6 months of enrollment. The analyses exclude interdisciplinary group meetings since those are not encounters between providers, and enrollees or caregivers, and also exclude any encounters that occurred after an enrollee's discharge date. Each column is showing the number of enrollees that had at least one service every set number of days. This means that if a beneficiary had 7 days or fewer between services for all except for one pair of services which had a 10-day gap, then this enrollee would not be included in the "one service every 7 days" numerator. The denominator was set to the full number of enrollees with at least one encounter. In other words, we calculated the maximum gap, in days, for each enrollee, between each consecutive pair of encounters, and then found each beneficiary's largest gap in the first 6 months of MCCM enrollment. Then, we calculated the number and percentage of beneficiaries whose largest gap in care was less than 8 days, less than 15 days, less than 31 days, or less than 61 days.

[a] Enrollees can have more than one qualifying condition.

[b] Due to the change in available variables starting January 1, 2018, functional status from the beneficiary level at enrollment file (available through only December 31, 2017) was merged with the first value of functional status for an enrollee from the encounter level file starting with January 1, 2018, data.

[c] Due to the change in available variables starting January 1, 2018, caregiver from the beneficiary level at enrollment file (available through only December 31, 2017) was merged with the first value of caregiver for an enrollee from the encounter level file starting with January 1, 2018, data.

[d] This panel does not show results for beneficiaries with missing data.

MCCM = Medicare Care Choices Model.

Table A.23. MCCM quality measures, by hospice characteristic

Measure	Ownership status				Size			Location		Facility		Chain affiliation	
	For profit	Non-profit	Government	Other	Small	Medium	Large	Urban	Rural	Free-standing	Facility-based	No	Yes
Pain screening and management (% of eligible encounters)[a]													
Screening	100	99	91	99	95	98	99	99	98	99	99	99	99
Management	94	93	98	96	99	99	93	93	96	94	93	96	91
Management effective	74	78	47	72	88	75	76	77	70	77	75	76	76
Shortness of breath screening and management (% of eligible encounters)[a]													
Screening	99	99	93	98	93	98	99	99	98	99	99	98	99
Management	83	78	71	73	94	82	77	77	84	77	82	79	77
Management effective	74	68	100	67	93	75	68	68	76	66	79	69	70
Psychological/emotional well-being screening and management (% of eligible encounters)[a]													
Screening	89	91	78	92	95	92	90	91	89	92	87	90	91
Management	93	89	100	93	99	93	90	90	95	90	93	92	89
Management effective	24	24	14	26	72	22	23	25	18	22	29	26	22
Bowel regimen for opioid use (% of eligible encounters)[a]													
Management	93	92	100	86	95	94	91	91	92	93	88	93	89
Management effective	85	91	98	86	88	84	91	90	87	90	89	90	89
Other quality measures (% of eligible encounters)													
Spiritual/religious discussion[a]	8	12	0	16	9	14	11	10	20	11	13	12	12
Advance care planning discussion[a]	84	70	94	77	94	85	71	73	76	73	74	70	78
Encounters before March 2020 delivered in-person (that is, before the COVID-19 pandemic)	85	70	39	77	92	75	73	73	82	71	79	71	77
Encounters before March 2020 delivered in the home (that is, before the COVID-19 pandemic)	94	89	76	86	93	88	89	90	85	89	90	87	92

Measure	Ownership status				Size			Location		Facility		Chain affiliation	
	For profit	Non-profit	Government	Other	Small	Medium	Large	Urban	Rural	Free-standing	Facility-based	No	Yes
MCCM enrollment process (% of beneficiaries)													
Referrals meeting eligibility criteria	63	59	15	60	48	55	60	59	64	58	63	60	59
Eligible referrals who enrolled in MCCM	75	66	48	63	96	67	66	66	73	67	68	66	69
Continuity in care (% of MCCM enrollees)													
At least one encounter every 1 to 14 days[b]	59	64	27	52	90	63	60	60	68	60	61	63	58
At least one encounter every 1 to 30 days[b]	81	92	88	82	100	90	88	88	91	88	89	90	87
Other													
Average number of encounters per enrolled beneficiary per week	0.2	0.3	0.2	0.8	0.3	0.2	0.4	0.4	0.2	0.4	0.2	0.3	0.5

Source: MCCM program data, January 1, 2016 to December 31, 2021, merged with a data set constructed by Abt Associates for previous MCCM evaluation reports (Abt Associates 2020a, 2020b) and organizational survey data collected by Abt Associates.

[a] CMS updated the MCCM program data collection protocol on January 1, 2018, limiting the comparability of services delivered before and after that date. Therefore, certain analyses in this table were restricted to encounters on or after January 1, 2018, for 5,685 MCCM enrollees who enrolled on or after January 1, 2018. As noted in the data dictionary, each of these measures has a condition denoting which encounters are eligible. Each rate was calculated based on the eligible encounters.

[b] These measures are explained in the footnotes for Table A.22.

Table A.24. MCCM quality measures, for hospices with and without pre-hospice or palliative care programs

Measure	Pre-hospice program[a]		Any palliative care program[b]	
	No	Yes	No	Yes
Pain screening and management (% of eligible encounters)[c]				
Screening	99	100	99	99
Management	91	97	95	93
Management effective	74	80	81	76
Shortness of breath screening and management (% of eligible encounters)[c]				
Screening	99	99	99	99
Management	80	75	76	78
Management effective	72	72	81	71
Psychological/emotional well-being screening and management (% of eligible encounters)[c]				
Screening	92	93	95	92
Management	94	84	90	89
Management effective	23	22	21	23
Bowel regimen for opioid use (% of eligible encounters)				
Management	90	93	90	91
Management effective	88	92	88	90
Other quality measures (% of eligible encounters)				
Spiritual or religious discussions[c]	11	15	6	14
Advance care planning discussion[c]	77	73	90	72
Encounters before March 2020 delivered in person (that is, before the COVID-19 pandemic)	73	70	77	71
Encounters before March 2020 delivered in home (that is, before the COVID-19 pandemic)	88	89	92	88
MCCM enrollment process (% of beneficiaries)				
Referrals meeting eligibility criteria	62	65	60	64
Eligible referrals who enrolled in MCCM	62	73	66	67
Continuity of care (% of MCCM enrollees)				
At least one encounter every 1 to 14 days[d]	62	60	79	57
At least one encounter every 1 to 30 days[d]	89	93	94	90
Other				
Average number of encounters per enrolled beneficiary per week	0.3	0.6	0.3	0.4

Source: MCCM program data, January 1, 2016 to December 31, 2021 merged in with survey data collected from an organizational survey conducted by Abt Associates.

[a] This is defined by the organizational survey as a pre-hospice program or bridge program, to promote eventual hospice enrollment for persons with serious illnesses who either do not want to enter hospice or are not yet eligible for hospice.

[b] This is defined by the organizational survey as a traditional hospice program operate or affiliate with a hospital-based palliative care program that refers beneficiaries into MCCM.

[c] CMS updated the MCCM program data collection protocol on January 1, 2018, limiting the comparability of services delivered before and after that date. Therefore, certain analyses in this table were restricted to encounters on or after January 1, 2018 for 5,685 MCCM enrollees who enrolled on or after January 1, 2018. As noted in the data dictionary, each of these measures has a condition denoting which encounters are eligible. Each rate was calculated based on the eligible encounters.

[d] These measures are explained in the footnotes for Table A.22.

Table A.25. Payments to hospices for providing MCCM services, overall and by hospices' number of enrollees

Total and average payments for MCCM services	Number of MCCM enrollees [a]			All hospices with at least one enrollee [a]
	Less than 25 enrollees	Between 25 and 300 enrollees	More than 300 enrollees	
1. Total payments for MCCM services (percentage of total payments) (%)	$ 745,956 (4%)	$ 7,984,952 (48%)	$ 8,000,920 (48%)	$ 16,731,828 (100%)
2. Number (and percentage) of hospices[a]	37 (26%)	39 (28%)	5 (4%)	81 (100%)
3. Average MCCM payments *per hospice* *[row 1 divided by row 2]*	$ 20,161	$ 204,742	$ 1,600,184	$ 206,566
4. Number (and percentage) of enrollees[a]	337 (5%)	3,022 (46%)	3,200 (49%)	6,559 (100%)
5. Average MCCM payments *per enrollee* *[row 1 divided by row 4]*	$ 2,214	$ 2,642	$ 2,500	$ 2,551
6. Number (and percentage) of enrollee-months[b]	1,895 (4%)	20,225 (48%)	20,257 (48%)	42,377 (100%)
7. Average MCCM payments *per enrollee-month* *[row 1 divided by row 6]*	$ 394	$ 395	$ 395	$ 395
8. Number (and percentage) of encounters[c]	11,035 (5%)	104,252 (48%)	101,008 (47%)	216,295 (100%)
9. Average MCCM payments *per encounter* *[row 1 divided by row 8]*	$ 68	$ 77	$ 79	$ 77

Sources: MCCM program data merged with a claims data for MCCM payments, January 1, 2016 through December 31, 2021.

Note: Row percentages might not sum to 100 percent due to rounding.

[a] The number of hospices or model enrollees with at least one paid claim for MCCM services. As described elsewhere in the report, this does not align with the number of enrollees reported in MCCM program data. Sixty of the 141 hospices did not receive any MCCM payments.

[b] Based on paid claims for MCCM services. We calculated the number of enrollee-month for each enrollee as their total MCCM payments divided by $200 (or $198) per half-month times 2. We then summed this amount across all the hospice's enrollees to compute its total number of enrollee-months.

[c] Based on MCCM program data submitted by hospices with at least one paid claim for MCCM services. Does not include 861 encounters at one of the 60 hospices that did not receive MCCM payments.

MCCM = Medicare Care Choices Model.

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Appendix B

Exemplar and Exit Interviews: Methods and Discussion Guides

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To identify effective strategies for addressing common challenges to implementing the Medicare Care Choices Model (MCCM), we conducted final interviews with staff from a sample of exemplar hospices—hospices that met several criteria for successful implementation—and with a convenience sample of providers who referred beneficiaries to those hospices.

Building on the methods the previous evaluation contractor used to collect information from hospices that withdrew from MCCM, we also conducted a final round of interviews with staff from a sample of participating hospices that decided not to participate in the one-year extension of the model.

This appendix begins by describing our methods for selecting the exemplar hospices and their referring providers, and the hospices that did not participate in the one-year extension, as well as how we analyzed the interview data. We provide the hospice staff and referring provider interview guides for the exemplar interviews and the hospice interview guides for the exit interviews at the end of this appendix.

1. Methods for conducting the exemplar interviews

Through this exemplar study, we sought to achieve the following aims:

- Identify effective strategies for obtaining referrals and enrolling beneficiaries in the model, providing them with supportive services, and facilitating the transition of MCCM enrollees to the Medicare hospice benefit, when appropriate
- Better understand why some eligible beneficiaries chose to enroll in MCCM, whereas others with the same demographic and clinical characteristics (as observed in administrative data) did not
- Solicit hospice staff's perspectives on the effect of MCCM on the use of acute care and the specific activities they conducted under the model that brought about that perceived effect
- Learn about referring providers' perceptions of MCCM and the strategies they found helpful in referring beneficiaries to the model
- Learn whether hospice staff wanted the Centers for Medicare & Medicaid Services (CMS) to continue the model and, if so, the changes that would make the model more appealing to hospices and their referring providers

1.1. Selection and characteristics of exemplar hospices

Our exemplar study was based on interviews with staff at hospices that met several criteria for successful implementation. We used three measures to assess implementation success:

1. The percentage of referred beneficiaries who enrolled in the model
2. The percentage of enrolled beneficiaries who received an initial comprehensive assessment within five days of enrollment
3. The percentage of enrolled beneficiaries who transitioned from MCCM to the Medicare hospice benefit

We calculated regression-adjusted percentages for each of these measures using multilevel regression models that adjusted for differences in beneficiary and hospice characteristics to minimize the risk of drawing spurious conclusions. The regression models incorporated 71 hospices that participated in

MCCM through December 31, 2020 (including those that did not participate in the one-year model extension in 2021) and had enrolled at least one beneficiary before March 31, 2021. We used MCCM program data (described in Appendix A) to identify referred and enrolled beneficiaries and assessments within five days of enrollment. We used Medicare claims and enrollment data to measure hospice transition and beneficiary-level covariates. We used the monthly MCCM rosters from CMS' implementation contractor to acquire hospice withdrawal dates and obtained facility characteristics from the hospice-level data set created by the previous evaluation contractor. This hospice ranking exercise was conducted in May 2021 using the most up-to-date data available.

For each hospice, we produced a composite score that combined information across the three performance measures. We calculated the final score as a weighted average of the three outcome-specific scores, where the weights were 40 percent, 20 percent, and 40 percent for enrollment, assessment, and transition to hospice, respectively. We gave less weight to the assessment measure, because most hospices scored high on this outcome, and it was a required component of the model. We scaled each set of scores by dividing them by their respective standard deviations before taking the weighted average.

To ensure diversity and replacements, we selected the 15 highest-scoring exemplar hospices. We contacted 10 of them about participating in the study, striving to maximize the representation of hospices based on facility type, ownership status, independent versus chain affiliated, and regional and urban versus rural location. One of the 10 hospices we contacted did not respond to our request to participate, 1 declined to participate, and 1 could not provide useful information on its implementation strategies. We replaced the 3 nonrespondents with hospices from the same strata, when possible, and completed interviews with 10 hospices.

The top-scoring exemplar hospices in the study were more likely to be large and independent and to have taken part in the extended model compared with hospices that had lower composite implementation scores (Table B.1). They were also more likely to be freestanding and nonprofit facilities in metropolitan areas, but the differences between high- versus low-scoring hospices were less pronounced than the other characteristics. Half of the participating hospices were in Cohort 1 and half in Cohort 2, similar to lower-scoring hospices.

Table B.1. Characteristics of hospices participating in the exemplar study

Hospice characteristic	Number (and percentage) of hospices	
	Included in exemplar study	Not included in exemplar study[a]
Number of hospices	10 (15%)	56 (85%)
Average number of enrolled beneficiaries per hospice	75	74
Median number of enrolled beneficiaries per hospice	56	30
Cohort type[b]		
Cohort 1	5 (50%)	29 (52%)
Cohort 2	5 (50%)	27 (48%)
Participated in MCCM extension		
Yes	9 (90%)	35 (62%)
No	1 (10%)	21 (38%)
Size		
Large (≥ 20,000 days of routine home care in 2016)	10 (100%)	42 (71%)
Small or medium (< 20,000 days of routine home care in 2016)	0 (0%)	14 (29%)
Facility type		
Freestanding	8 (80%)	40 (71%)
Facility-based	2 (20%)	16 (29%)
Ownership		
Nonprofit	8 (80%)	36 (64%)
For profit	1 (10%)	10 (18%)
Other	1 (10%)	10 (18%)
Independent		
Yes	9 (90%)	24 (43%)
No	1 (10%)	32 (57%)
Region		
Northeast	2 (20%)	11 (20%)
South	4 (40%)	19 (34%)
Midwest	2 (20%)	19 (34%)
West	2 (20%)	7 (13%)
Location		
Urban	9 (90%)	48 (86%)
Rural	1 (10%)	8 (14%)

Source: Medicare Care Choices Model program data, May 2021, merged with a data set constructed by Abt Associates for previous evaluation reports (Abt Associates 2020a, 2020b).

[a] The nonincluded hospices exclude the five top-scoring hospices that were selected but did not participate in the study.

[b] Cohort 1 hospices implemented the model beginning January 1, 2016, and Cohort 2 hospices began January 1, 2018.

1.2. Identification and selection of referring providers

We identified all providers who referred at least one beneficiary to each of the 10 exemplar hospices, as reported in the MCCM program data. We shared this list of referring physicians with each exemplar hospice and asked the hospice staff to recommend and provide email addresses for the physicians they thought would be willing to speak with us. Staff from all 10 exemplar hospices in the study recommended a total of 93 referring providers. We acknowledge that providers recommended by hospices might have been predisposed toward a favorable impression of MCCM and not representative of all providers, but we had no other way of identifying and recruiting them for this study.

We reached out to these providers via email or, in a couple of cases, by phone and asked them to answer a few questions about their experience with MCCM, either via email or during a 15-minute phone call. We received 17 responses from physicians who referred beneficiaries to seven of the exemplar hospices (representing all four regions of the country).

1.3. Data collection and analysis

We conducted the interviews from October through December 2021 (the last three months of the model). We sought to interview key hospice staff (such as hospice directors, program coordinators, and frontline clinicians, depending on the staffing model they used) who led and oversaw the implementation of MCCM. We conducted all hospice interviews by telephone, usually with two senior researchers and a junior analyst from the Mathematica evaluation team; the interviews typically lasted about 90 minutes. Of the 17 referring providers who responded, 13 answered our questions via email. We conducted short telephone interviews with the remaining 4. We recorded and transcribed all interviews. Our interview guides for conducting the interviews with hospice staff and referring providers are presented later in this appendix (Sections 3 and 4, respectively).

We developed a codebook specific to the study questions to facilitate coding and analysis of the hospice and referring provider responses. We used NVivo, a qualitative data analysis software program, to code and analyze the interview transcripts and email responses. To ensure consistency with coding, our team coded a single transcript and ran a coding comparison query in NVivo to assess the percentage of agreement in coding across team members using the Cohen's Kappa test. Our team reviewed the query results to identify areas of improvement in the codebook and to ensure a common understanding among the team of how to code the data.

After coding the interview transcripts and email responses, we reviewed the coded data across hospice and physician responses to identify themes related to the objectives of the exemplar study.

2. Methods for conducting the exit interviews

The previous MCCM evaluation contractor conducted exit interviews with hospices that withdrew from MCCM before the original model end date. To build on the findings from those interviews and to generate information that can help to address new research questions, we used a similar approach for interviewing staff involved with MCCM at hospices that decided not to participate in the model during the one-year extension. The interviews covered seven topics:

1. Reasons why hospices decided not to participate in the model during the one-year extension

2. Hospices' plans for transitioning beneficiaries enrolled in MCCM after ending their programs (that is, after the hospice withdrew from MCCM)
3. Referral and enrollment barriers experienced by MCCM hospices
4. The financial impact of participating in MCCM on hospices
5. Hospices' perceptions of the impact of MCCM on care quality, costs, and service use
6. The impact of COVID-19 on hospices and MCCM implementation
7. Future directions for MCCM hospices and recommended changes to the model

We purposively selected 6 hospices that represented the characteristics of the 30 hospices that chose not to participate in the extension, based on MCCM enrollment, census region, size, ownership status, rural location, and cohort. To develop our interview guide, we first reviewed the interview guide developed by the previous evaluation contractor for hospices that withdrew from MCCM before the original end date and identified questions that related to the interview topics listed above. To those, we added new questions related to the decision not to participate in the model extension, the impact of the COVID-19 pandemic on program operations, and perspectives of the impact of MCCM on intended outcomes. Our interview guide is in Section 5 of this appendix.

We used the interview guide to conduct telephone interviews, lasting up to 60 minutes each, with administrative and clinical staff involved with MCCM at the participating hospices. Interview participants included the primary point of contact for the hospice's MCCM program. For all but two hospices, additional staff involved in MCCM also participated in the interview. They included registered nurses who served as care coordinators and hospice leadership responsible for oversight of MCCM implementation.

An experienced researcher conducted the interviews from December 1 to 10, 2020, before the MCCM participation agreements for these hospices ended. We audio-recorded the interviews after receiving participants' consent and sent the recordings via a secure server to a professional transcription service. The researcher who conducted each interview reviewed the associated transcript for accuracy and completeness. The same researchers developed a codebook based on the structure and topics covered in the interview guide and used it to analyze the transcripts to identify common themes and points of departure. To protect interviewees' confidentiality, we do not attribute responses to individual hospices in this report.

3. Interview guide for exemplar hospices

This section reproduces the discussion guide we used when interviewing staff at exemplar hospices.

3.1. Consent and recording

Hello, I'm [NAME] from Mathematica and I'm joined by my colleague [NAME]. Thank you for your willingness to participate in today's discussion.

Mathematica has been hired by the Centers for Medicare & Medicaid Services (CMS) to evaluate the Medicare Care Choices Model (or MCCM). We are conducting a series of interviews with staff at hospices that we consider having successfully implemented the Model based on three measures: (1)

percentage of referrals enrolled, (2) proportion of enrollees who received an assessment within five days, and (3) percentage of enrollees who transitioned to the Medicare hospice benefit. By speaking with you, we hope to identify the factors and strategies you think contributed to your success.

Participating in this interview is voluntary. We would like to audio-record this interview, with your permission, to help us write our report. We will not share the recording with anyone outside of Mathematica. If you do not wish to be recorded, that is fine.

Based on this interview and others, we will write a report for CMS that includes information we learn from hospices that participated in the Model through December 2021. Although CMS knows which hospices are participating in this effort, nothing you share with us will be attributed to you or your organization in any report to the government.

Do you have any questions?

Given the information that I have just reviewed with you, do I have your permission to proceed with this interview and record our conversation?

If yes, great. [RECORD VERBAL CONSENT AND START RECORDER]

If yes to proceeding with the interview but not recording it: That is fine. We will just take notes during the interview. Thank you.

3.2. Introduction

To start, can you please introduce yourself and describe how you were involved in MCCM?

3.3. MCCM referral sources and outreach approaches

Previous evaluations have shown that one of the biggest challenges with the model was getting referrals. We'd like to ask you a few questions about the sources and strategies you think were most effective in getting referrals to the program.

- To start, please walk us through the process for how a typical patient was referred to your MCCM program (before enrollment). Please be as specific as possible.
- Where did most of your referrals come from (for example, a hospital or a local oncology practice)?
- What were the most effective strategies for connecting and communicating with potential referring providers about the MCCM program, and getting them to refer their eligible patients? Please explain why you think this strategy was particularly effective.
  - How did you describe your MCCM program to referring providers?

3.4. Enrolling beneficiaries in MCCM and delivering services

Another big implementation challenge was getting patients who were referred to you to enroll in the program. We understand that many referrals were ineligible because they were enrolled in Medicare Advantage. However, we'd like to ask you a few questions about the strategies you think were most effective at getting eligible referrals to enroll in the program.

- What were the most effective strategies for getting referred and eligible beneficiaries to enroll in your MCCM program? Please explain why you think this strategy was particularly effective.
- Can you walk us through the initial steps you took after you enrolled a patient in MCCM to get them involved in program services? Please be as specific as possible.
  - PROBE: For example, how and when did you complete the initial assessment or care plan?

3.5. Characteristics of patients who enrolled (compared to those who did not)

One of the biggest challenges we face evaluating MCCM is understanding why some patients are referred and chose to enroll in the program while other patients with the exact same terminal conditions either are not referred or are referred but chose not to enroll. We'd like to ask you a few question to try to understand these referral and enrollment decisions better.

- First, what factors do you think providers considered when deciding which of their terminally ill patients to refer to MCCM? Was there anything different about patients they referred to MCCM compared with those with the same qualifying conditions they did not refer?
  - PROBE: Think specifically about things unrelated to the eligibility requirements—for example patients' underlying health conditions that may not appear in claims data, frailty, mobility, medical history, family or caregiver support, education level, or religious views—that might have influenced providers' decisions about referring patients to palliative versus curative at the end of life.
- If MCCM had not been available, what do you think providers would have recommended for the beneficiaries they referred to your program? Referred to hospice or recommended continued curative care? Please explain why.
- Was there anything different about eligible patients referred to MCCM who chose to enroll compared with those with the same qualifying conditions who were referred but decided not to enroll?
  - PROBE: Again, think specifically about personal characteristics (such as underlying health conditions that might not appear in claims data, frailty, mobility, medical history, family or caregiver support, education level, or religious views) that might have influenced their or their caregivers' decision about receiving palliative versus curative at the end of life.
- If MCCM had not been available, what do you think the patients who were referred and enrolled into MCCM would have done? Enrolled in hospice or continued curative care? Please explain why.
  - PROBE: In general, do you think the MCCM program was more likely to reach people who would have enrolled in hospice or continued receiving curative care if MCCM had not been available?

3.6. Transitioning MCCM patients to traditional hospice

As you know, beneficiaries who enroll in hospice often do so at the very end of their lives, and CMS hoped the MCCM program would encourage them to choose hospice earlier in their disease trajectory. We'd like to hear about the strategies you thought were most effective at facilitating the transition from MCCM to traditional hospice, when appropriate.

- Can you describe how and when you typically talked with your MCCM participants about the possibility of transitioning to hospice, if at all?
- Was there anything you did that you think was especially effective in helping patients make a decision about transitioning to hospice? Please explain why you think this was effective.
- Do you think MCCM affected the likelihood that beneficiaries would enroll in hospice, compared with their likelihood of enrolling in hospice in the absence of the model? Do you think MCCM affected the timing of when beneficiaries enrolled in hospice, compared with when they would have enrolled in the absence of the model, if they would have enrolled at all?
- Did you do anything specific to help facilitate the transition to hospice after the patient made the decision? If so, what did you do?

3.7. MCCM implementation

I'd now like to ask you a few questions about your organization's general experience implementing the MCCM program (after enrollment) and the factors you think were important to your success.

- What do you think were the most important factors in achieving the success you had implementing your MCCM program? Think here about operational practices you'd recommend other hospices considering participating in a similar program do.
  - PROBE: Can you describe how you staffed your MCCM program and how this might (or might not) have contributed to your success implementing the program? Did you use shared versus dedicated staff or existing versus new staff? Did you require specific staff skills or certifications? Did you provide trainings for MCCM?
  - PROBE: Are there any operational practices you believe contributed to your success with implementing the MCCM program? For example, did you need to make changes to your data management system or implement new software programs to facilitate tracking? If so, please describe.
  - PROBE: How did you coordinate care for MCCM patients with their other medical providers, and how important was this to your success?
  - PROBE: How, if at all, did you use existing relationships or new partnerships with health systems or hospitals when implementing the model? And was this important to your success?
- How did COVID-19 affect how you implemented the MCCM program (for example, in staffing, use of telehealth, service delivery, and other areas)? Did COVID-19 make it easier or hard to implement your program?

3.8. Impact of MCCM on care quality, costs, and service use

We'd like to talk about your perception of the impact on MCCM on the care your patients received, compared with the care they would likely have received in the absence of the program.

- How, if at all, do you think the MCCM program affected the quality of end-of-life care your patients received? Please explain.

- How do you think the MCCM program affected patients' satisfaction with their end-of-life care? Please explain.
- Do you think the MCCM program altered the use of health care services at the end of life (for example, the likelihood of being admitted to a hospital, having an emergency department visit, or continuing treatment of a terminal condition)? Please explain.
- Do you think the MCCM program affected the total cost of end-of-life care? If so, in what ways?

3.9. Financial impact of MCCM on the hospice

We'd also like to ask you a few questions about the impact of the MCCM program on the financial status of your hospice.

- How did the cost of caring for beneficiaries under MCCM compare with the monthly payment amount you received under the MCCM program? Was it sufficient to cover the costs associated with the program?
  - PROBE: If not, how did you cover the extra costs?
  - PROBE: Do you have any recommendations for how Medicare payment for these services should be structured?

3.10. Sustainability of the model

- Finally, as we mentioned, one of the biggest challenges to the program was the low rate of referrals and enrollment. Do you have any suggestions for how to increase the number of terminally ill beneficiaries who are referred to the program? Do you have any suggestions for how to increase the number of eligible referrals who enroll?
- Also, only about one-third of the hospices that joined the program continued to participate all the way through the one-year extension and many withdrew before the end of the model. Do you have any suggestions for how to make MCCM more attractive to hospices?
- In general, do you think the MCCM is a service model that should be continued or expanded? Please explain your view.
- Is there anything else you'd like to share with us about your experience participating in MCCM that we haven't covered today?

4. Discussion guide for interviews with referring providers

This section reproduces the discussion guide we used when interviewing providers that referred beneficiaries to exemplar hospices.

4.1. Consent and recording

Hello, I'm [NAME] from Mathematica and I'm joined by my colleague [NAME]. Thank you for your willingness to participate in today's discussion.

Mathematica has been hired by the Centers for Medicare & Medicaid Services (CMS) to evaluate the Medicare Care Choices Model (or MCCM). We are conducting a series of interviews with providers who

referred patients to [HOSPICE NAME and NAME OF PROGRAM] to understand their experience with the program and their perception of its impact on their patients.

Participating in this interview is voluntary. We would like to audio-record this interview, with your permission, to help us write the report. The recording and a transcript will not be shared with your employers, with the government, or with anyone outside of Mathematica. If you do not wish to be recorded, that is fine.

Based on this interview and others, we will write a report for CMS that includes information we learn from providers as well as from interviews we are conducting with hospice staff. Nothing you share will be attributed to you or your practice in any report to the government.

Do you have any questions?

Given the information that I have just reviewed with you, do I have your permission to proceed with this interview and record our conversation?

If yes, great. [RECORD VERBAL CONSENT AND START RECORDER]

If yes to proceeding with the interview but not recording it: That is fine. We will just take notes during the interview. Thank you.

4.2. Interview guide

- Can you confirm that, as part of your practice, you treat Medicare patients with terminal illnesses who are likely to be eligible for hospice care?
  - How frequently do you refer patients to hospice care? How frequently do you refer patients to palliative care? PROBE [FOR TELEPHONE INTERVIEWS ONLY]: Would you say it's a rare occurrence or a common option for patients with a prognosis of less than six months?
- Are you familiar with the Medicare Care Choices Model [or NAME OF HOSPICE PROGRAM]? If so, how did you learn about your local MCCM program? What were you told about the benefits of the program?
  [NOTE: The program, which stopped enrolling patients in June, allowed Medicare beneficiaries with certain conditions and a certificate of terminal illness from their physician to receive hospice services while maintaining access to curative care.]
- Can you describe your experiences referring patients to the local MCCM program?
- In your opinion, what are the most effective approaches for letting providers like yourself know about new programs that aim to improve quality of care for patients with terminal illnesses and encouraging them to refer patients?
  - PROBE [FOR TELEPHONE INTERVIEWS ONLY]: Can you think of specific communication strategies, processes, or activities that would make physicians treating terminally ill patients more likely to refer them to programs like MCCM?
- How did you decide which of your terminally ill patients to refer to MCCM? Was there anything different about those you referred compared with those with the same prognosis that you did not?

- If the MCCM program had not been available, would you have referred the same patient to hospice or continued offering them curative care? Why?
- In your experience, why did the patients you referred to MCCM decide to enroll in the program? Do you think they would have enrolled in hospice or continued receiving curative care if the MCCM program had not been available?
- In general, do you think the MCCM program was more likely to reach people who would have enrolled in hospice or who would have continued receiving curative care if MCCM had not been available?
- What are the primary reasons you did not refer more of your Medicare patients with terminal illnesses to a local MCCM program?

5. Discussion guide for MCCM hospice exit interviews

Hello, I'm [NAME] from Mathematica. Thank you for your willingness to participate in today's discussion.

Mathematica is an independent research company that has been hired by the Centers for Medicare & Medicaid Services (CMS) to evaluate the Medicare Care Choices Model (or MCCM). The purpose of this interview is to understand your hospice's experience implementing MCCM, why your organization decided not to participate in the one-year extension of MCCM, and the impact of COVID-19 on your hospice and your MCCM program.

Our interview today should last about 30 to 45 minutes. Participation is voluntary. If you choose not to participate, or to stop the interview at any time, you will not be penalized in any way. Also, we would like to audio-record this interview, with your permission, to help as we are writing our report. The transcript and recording of our interview will not be shared with your employers, with the government, or with anyone outside of Mathematica. If you do not wish to be recorded, that is fine. We will write a report for CMS that includes information we learn from hospices that participated in the model, but subsequently chose not to participate in the model extension. Although CMS knows which hospices are participating in this effort, nothing that you share will be personally attributed to you or your organization in any report to the government. Although there is a minimal risk that your organization's confidentiality might not be preserved, we have safeguards that will protect the confidentiality of your information to the extent allowable under the law.

Do you have any questions?

If you have any questions that I cannot answer, or at any time after this interview, you may contact CMS' evaluation contract director, Lynn Miescier, or Mathematica's project director, Valerie Cheh. We have shared their contact information as part of the outreach emails and will share it again after this call. Given the information that I have just reviewed with you, do I have your permission to proceed with this interview and record our conversation?

[If yes] Great. [RECORD VERBAL CONSENT]

If yes to proceeding with the interview but not recording it: That is fine. We will just take notes during the interview. Thank you.

5.1. Background

I'd like to start by asking you a few questions about you and your organization.

- Please briefly describe your role at [HOSPICE NAME].
- How long have you had this role?
- What is your involvement with the MCCM program?
  - Please briefly describe the hospice organization in terms of the type of patients it serves, number of staff, affiliation with health systems or other health care organizations, and any special services it offers.
- How, if at all, has this changed over the past year?

5.2. Factors affecting hospices' decisions not to participate in extension

Thank you. Now we would like to discuss why your organization chose not to participate in the one-year extension of MCCM.

- What are the primary reasons that your organization decided not to participate in the one-year extension of MCCM?
- How, if at all, did the referral patterns to your MCCM program affect your decision?
- How, if at all, did MCCM's eligibility criteria for beneficiaries affect your decision?
- How, if at all, did the need to coordinate with medical providers for enrollees who continued to receive curative treatments for their conditions affect your decision?
- What were the perceived advantages and disadvantages of participation in MCCM? Have those changed over time in a way that led to your decision to forgo participation in the MCCM extension?
- [POTENTIAL PROBE] Did palliative care programs at your hospice or in the same market influence your decision to participate in MCCM? In the one-year extension? If so, how?
  - How, if at all, has the COVID-19 pandemic impacted the perceived advantages or disadvantages of participating in MCCM?
  - Is your hospice participating in other federal, state, or commercial payment or care delivery reform initiatives that overlapped with MCCM?
- [POTENTIAL PROBE] For example, do you participate in or have partnerships with any commercial or federal accountable care organizations? Do you have partnerships with practices participating in other CMS payment models, such as the Oncology Care Model?
- [IF YES] Did these other initiatives impact the advantages and disadvantages of participating in MCCM? If so, how?
  - How will your organization continue to provide care for enrolled beneficiaries who are still alive at the end of December? For example, will they transition to a palliative care program, stop receiving services from your organization, or have the option to elect the Medicare hospice benefit?

5.3. Impact of COVID-19 on hospices and MCCM implementation

We have several questions about the impact of the COVID-19 pandemic on your organization and the implementation of MCCM.

- In general, how was your hospice affected by COVID-19?
- Have you experienced any changes to staffing following the start of the COVID-19 pandemic? If so, please describe.
  - How did your hospice change the way it delivers services to MCCM enrollees following the start of the COVID-19 pandemic?
  - How did the COVID-19 pandemic affect your hospice's ability to coordinate care for MCCM enrollees?
- With internal staff?
- With outside providers?
  - Please describe if and how you are using technology or telehealth to help with visits and how this was affected by COVID-19.
  - [IF YES:] What technology have you used?
- Have you or your staff had to learn any new skills to implement telehealth for MCCM beneficiaries? If so, please describe.
- How has this changed your workflow?
  - Following the start of the COVID-19 pandemic, have MCCM beneficiaries changed the way they interact with hospice staff in terms of contact or utilization?
- [POTENTIAL PROBE] For example, are you conducting more or fewer in-person visits with MCCM beneficiaries? Did the types of services you provide to MCCM beneficiaries change?
  - How, if at all, did referral patterns to your MCCM program change following the start of the COVID-19 pandemic?

5.4. Hospices' perceptions of the impact of MCCM on care quality, costs, and service use

We'd like to talk about your perception of the impact MCCM had on the care your patients received while your hospice participated in the program.

- In general, what effect do you think MCCM had on the quality of care your MCCM enrolled beneficiaries received?
- What effect do you think MCCM had on beneficiaries' satisfaction with the care they received?
  - Do you think MCCM affected the overall end-of-life medical costs? How? Were you monitoring any key financial indicators?
  - Do you believe MCCM changed any patterns of end-of-life health care service use among enrolled beneficiaries?

- [POTENTIAL PROBE] For example, the likelihood of having a hospitalization or emergency department visit among enrolled beneficiaries or the likelihood of continuing treatment of terminal conditions.
  - Did your perception of MCCM's impact on service use and costs influence your decision not to participate in the one-year extension of the model? How?

5.5. Financial impact of MCCM on the hospice

We'd also like to learn how MCCM affected your finances.

- How did MCCM affect your finances—positively or negatively? Was this what you expected? Why or why not?
- How has this changed since the start of the COVID-19 pandemic?
  - In your experience, how did the cost of caring for beneficiaries under MCCM compare with the current per beneficiary per month payment for MCCM?
- What changes, if any, would you suggest that CMS make to the payment rates or payment methodology for MCCM, if the model were to continue?

5.6. Potential unintended effects of MCCM on hospices and enrolled beneficiaries

Our final set of questions relates to the potential unintended effects of MCCM and your future plans.

- Stepping back and considering the MCCM program as a whole, we're interested in your thoughts about the potential unintended effects, both negative and positive, that MCCM might have had on your patients and hospices.
- [POTENTIAL PROBE] Did the changes you made to implement MCCM have any effect on traditional hospice patients? If so, please explain.
  - Are there any aspects of your MCCM program that you plan to continue after your participation in the model ends? If so, which ones and why do you want to continue offering them?
- [POTENTIAL PROBES] For example, will you offer a palliative care program if you did not previously have one? Are there any staffing changes you decided to keep? Are there practices you have implemented for getting physician referrals that you will continue?
- Is there anything else you'd like to share with us about your participation in MCCM that we haven't covered today?

Appendix C

Model Impacts: Data and Methods

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This appendix provides an overview of the evaluation's impact analysis approach, a detailed description of how we constructed the analytic files and measures used in the analysis, and a description of the statistical methods we used.

1. Overview of the impact evaluation approach

The goal of our impact analyses was to determine whether the Medicare Care Choices Model (MCCM) decreased service use and Medicare expenditures, increased frequency or earlier timing of entering hospice, or improved quality of care and experiences of care among terminally ill enrolled beneficiaries. We used claims data to measure a range of claims-based outcomes from date of MCCM enrollment until death, and then we estimated impacts of the model—overall and for key subgroups. The impact evaluation used a matched comparison group evaluation design. Specifically, we measured differences in outcomes between deceased beneficiaries enrolled in MCCM and a matched comparison group of deceased beneficiaries who (1) lived in the market area of a hospice participating in MCCM; (2) were not referred to or enrolled in MCCM; (3) satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data, and (4) resembled MCCM enrollees in terms of prognosis (expected length of life), prior experience of care, and other observed characteristics.[85] We designed this comparison group to provide a counterfactual of beneficiaries' outcomes had they not enrolled in MCCM and, thus, received usual care or received the Medicare hospice benefit. Regression models, described later in this appendix, improve the precision of the estimates, and adjust for observed differences between MCCM beneficiaries and the matched comparison group (that is, they control for residual differences that remain after matching). In Appendix E, robustness analyses test the sensitivity of the impact estimates to core evaluation design decisions.

We drew comparison beneficiaries from the regions served by MCCM hospices. A careful comparison group selection approach provides both the rigor to estimate impacts of MCCM and, as we describe later, the flexibility to examine impacts under alternative definitions of the beneficiary study population. The benefit of the internal comparison areas is that it limits the risk that regional differences unrelated to true model impacts might drive the impact estimates. This was especially important in 2020 and 2021, when the COVID-19 pandemic might have had different effects in different parts of the country. Drawing comparison regions from the same areas as MCCM beneficiaries introduces the potential for either beneficiary selection or spillover to affect the impact estimates, but we think these concerns are minimal considering the enrollment rates.[86] Low MCCM enrollment rates among eligible beneficiaries suggest (1) that selection bias would be similar regardless of whether we matched to non-enrolled

[85] The following eligibility criteria were not directly observable in CMS administrative data: (1) 6-month prognosis, which requires clinical judgement, and (2) residing in a traditional home and not a long-term care or assisted living facility.

[86] For the period covered by this report, we observed referrals to MCCM for 11,094 eligible beneficiaries, of whom 7,263 (65 percent) enrolled in MCCM. (See Chapter 3,Figure 6in this report.) As a point of comparison, our potential comparison group (described below in Section C.2.4) included 1,934,407 unique beneficiaries who lived in the market areas of MCCM hospices and met MCCM eligibility criteria we can observe in Medicare claims and enrollment data. This latter figure suggests that less than 0.6 percent of eligible beneficiaries in these markets were referred to MCCM and less than 0.4 percent were enrolled.

beneficiaries from within or outside of areas served by MCCM hospices and (2) that spillover was negligible.

A primary challenge to constructing the comparison group was to narrow the pool of potential comparison beneficiaries to those who met all MCCM eligibility criteria—to limit the sample to those with a certifiable prognosis of six months or less to live. Beneficiaries' prognoses were not universally assessed and reported in extant data sources. The prior evaluation contractor, Abt Associates, limited the pool of comparison beneficiaries to those who died (Abt Associates 2020a, 2020b), an approach that implicitly assumes health care providers accurately judge a beneficiary's prognosis. That is, the approach used actual dates of death to determine the period in which each beneficiary would have been certified as having a prognosis of less than six months to live. We used this decedent analysis approach in this report, with some important methodological changes. In the decedent approach, we measured regression-adjusted differences in outcomes between (1) beneficiaries who died and were enrolled in MCCM and (2) a matched comparison group of beneficiaries who died; were not enrolled in or referred to MCCM; lived in the market area of a hospice participating in MCCM; satisfied the model eligibility criteria we can observe in Medicare claims and enrollment data (see Footnote 85); and otherwise appeared similar to MCCM enrollees on health status, prior experience of care, and other observed baseline characteristics. A unique advantage of the decedents approach was that we could ensure the distribution of the length of follow-up—the time from enrollment to death, or survival time—was similar between MCCM and comparison groups. Because we know when each comparison beneficiary died, we could count backward to establish pseudo-enrollment dates for each comparison beneficiary and match in a way that ensured balance on survival times between intervention and comparison beneficiaries. If the length of follow-up were to have different distributions between the intervention and comparison groups, we would expect mean outcomes to differ between the two groups as well, biasing impact estimates.

Because comparison beneficiaries did not enroll in the model or the evaluation, we had to determine, for each matched comparison beneficiary, when to begin measuring outcomes—a *pseudo-enrollment* date. We considered multiple potential pseudo-enrollment dates for each beneficiary, and then we picked the best available pseudo-enrollment date using a novel matching technique named `GroupMatch` that originated at Mathematica (Pimentel et al. 2019). `GroupMatch` allowed us to use variable-ratio optimal matching and select just one observation—the best pseudo-enrollment date—per comparison beneficiary. We used various matching techniques (discussed more in Section 3 of this appendix) to ensure intervention beneficiaries and their matched comparison beneficiaries had the same qualifying conditions, lived in the same areas, and (as mentioned above) had the same length of time between enrollment (or pseudo-enrollment) and death.

2. Analytic file construction

In this section, we describe how we constructed the analytic files for the impact analysis. We start with a short overview of the sources of data used and then describe the approaches to identifying the beneficiaries we included in the intervention and potential comparison groups. We also provide detailed descriptions of the variables we constructed and included in the analytic files.

2.1. Data sources

For the impact analyses, we supplemented the MCCM program and evaluation data (described in Appendix A) with Medicare fee-for-service claims and enrollment data; other Medicare data sets; and publicly available data.

2.1.1. Medicare claims and enrollment data

We used Medicare Part A, B, and D claims and Medicare enrollment data as key inputs to our analytic files for the impact evaluation. These files enabled us to generate outcomes measures to estimate the impacts of the model (including measures of quality of care, service use, and Medicare fee-for-service expenditures) and to construct beneficiary-level covariates for matching, balance tests, and regression models. These files span from 2014 (to accommodate constructing quality measures with two-year look-back periods for beneficiaries enrolled as early as January 1, 2016) to December 31, 2021, allowing for 90 days of run-out (in accordance with standard research practices).[87] We processed Medicare enrollment data from the Medicare Enrollment Database and Master Beneficiary Summary Files, and we processed Medicare Part A and B claims data from the Medicare Research Identifiable Files within the Chronic Conditions Warehouse Virtual Research Data Center and incorporated monthly updates into our analytic file. We also used Part D Characteristics, Denominator, and Event files as key inputs to our analytic files.[88] The Part D Event files are as current as Part A and B data files with 99 percent of pharmacy events available within three months of the service month. These data covered most, but not all, Medicare beneficiaries enrolled in a stand-alone prescription drug plan.

We also used software developed by the Centers for Medicare & Medicaid Services (CMS), coupled with International Classification of Diseases 9 and 10 diagnosis codes found in claims data, to assign hierarchical condition category flags and calculate hierarchical condition category scores. We used the Medicare Enrollment Database and the Master Beneficiary Summary File (by year) to extract information on beneficiaries, including (1) Medicare Part A, B, C, and D enrollment and termination dates, (2) residence state and zip code, (3) whether Medicare was the primary payer for a beneficiary's medical expenses, (4) reasons for entitlement, (5) Medicare–Medicaid dual eligibility, and (6) basic demographic information.

MCCM hospices submitted claims to receive payment for model services. We used these data to identify the list of beneficiaries enrolled in MCCM when we constructed our beneficiary finder file (see details below). In addition, we used these data to measure Medicare payments for MCCM services and to construct measures of MCCM service receipt.

2.1.2. Other Medicare data sources

We supplemented claims and enrollment data with additional CMS data sets to obtain details on beneficiaries' participation in other Center for Medicare & Medicaid Innovation models, receipt of long-term care services, and difficulties with activities of daily living. We also used the Chronic Conditions Warehouse beneficiary crosswalk to link across different files.

[87] We extracted claims in early April 2022 to allow for at least 90 days of claims runout.

[88] In all, 77 percent of MCCM beneficiaries were enrolled in Medicare Part D the month they enrolled in MCCM.

- *Master Data Management.* This data set provides information on the enrollment of Medicare beneficiaries in CMS Innovation Center models. We used the Master Data Management to identify beneficiaries who were participating in certain CMS Innovation Center's accountable care organization models or the Oncology Care First Model (see details in Appendix D, Section 2).
- *Minimum Data Set and Outcome and Assessment Information Set.* The Minimum Data Set collects information on all users of nursing facilities for quality purposes, and Outcome and Assessment Information Set does the same for all recipients of home health care. We used the 2015 to 2021 Minimum Data Set and Outcome and Assessment Information Set data to determine whether beneficiaries were likely living in a long-term care nursing setting or in an assisted living facility, respectively, at the time of enrollment (or pseudo-enrollment). We also used the Outcome and Assessment Information Set data to identify any recorded activities of daily living for beneficiaries within 30 days of their [pseudo-] enrollment date.
- *Chronic Conditions Warehouse Beneficiary Crosswalk Files.* We used the Chronic Conditions Warehouse beneficiary crosswalk files to link Medicare claims and enrollment data to other data sources. These crosswalk files link beneficiaries' Chronic Conditions Warehouse identification numbers to their Health Insurance Claim number, Social Security number, or Medicare Beneficiary Identifier. We used these identifiers to link various data on the Virtual Research Data Center and to link Medicare claims and enrollment data with MCCM program data.[89]

2.1.3. Publicly available data

The final data sets used were the American Community Survey, the Federal Office of Rural Health Policy, and the Dartmouth Atlas.

- *American Community Survey.* This ongoing survey is used to measure topics such as education and employment. We used the five-year American Community Survey files to identify characteristics of the zip codes where each beneficiary lived. We used the 2015 data (2011–2015) for Cohort 1 hospices, which started enrolling MCCM beneficiaries in 2016, and we used the 2017 data (2013–2017) for Cohort 2 hospices, which started enrolling MCCM beneficiaries in 2018. We accessed the data through the Agency for Healthcare Research and Quality's Social Determinants of Health data files.[90]
- *Federal Office of Rural Health Policy.* The Federal Office of Rural Health Policy data identify which areas of the country are defined as rural. We downloaded the rural zip code-level definitions of "rural" from the office's website.[91]
- *The Dartmouth Atlas.* This project aggregates Medicare and Medicaid data at the geographic level to provide information on national and regional health care markets. We downloaded data from the

[89] MCCM program data did not always include Medicare identification numbers, so we used a "fuzzy matching" process that used Medicare beneficiary identification numbers when identifiers were available and valid; we used names, dates of birth, genders, and zip codes where identifiers were not available or not valid. We successfully matched all MCCM enrollees to Medicare claims and enrollment data. Further, we were able to match 21,316 out of 22,653 beneficiaries (94 percent) who were referred to MCCM but were not enrolled with Medicare claims and enrollment data.

[90] https://www.ahrq.gov/sdoh/data-analytics/sdoh-data.html.

[91] https://www.hrsa.gov/rural-health/about-us/definition/datafiles.html.

Dartmouth Atlas to identify the zip codes in each hospital referral region.[92] As we describe later, MCCM hospice market areas were defined as one or more hospital referral region where a hospice's enrollees commonly lived.

2.2. Identifying MCCM enrollees

The study population for the decedents analysis in the final report was first limited to 5,774 beneficiaries who enrolled in MCCM between January 1, 2016, and June 30, 2021 (the last date beneficiaries could be enrolled in MCCM), and who had a verified death date on or before December 31, 2021.[93] To be included in the intervention group, the beneficiary had to have at least one paid Medicare hospice claim with the associated MCCM demonstration identification number (73).[94] We assigned an MCCM enrollment date based on the earliest MCCM paid claim date.

Next, we restricted the intervention group to 5,153 beneficiaries who met the model eligibility criteria that we could assess using Medicare claims and enrollment data. We did this so that the same criteria would apply to both MCCM enrollees and the comparison group. Specifically, beneficiaries had to meet the following seven criteria:

1. Have been enrolled in fee-for-service Medicare Part A and B as the primary payer (that is, observable) for at least 12 consecutive months before MCCM enrollment
2. Have had at least one claim with a primary diagnosis for one of the four MCCM-qualifying terminal conditions (cancer, congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS, using the definition from the MCCM Resource Manual) in claims for 12 months before enrollment[95]
3. Did not reside in an institutional setting for 30 days before enrollment[96]

[92] See https://data.dartmouthatlas.org/supplemental/.

[93] The December 2021 cutoff aligns with the end of MCCM. Using this cutoff allows for up to six months of observability before death, and adequate claims runout per the requirements outlined in Section 2.1.1 above.

[94] Enrollees were screened for eligibility at the time of MCCM enrollment, and MCCM claims were later validated by the Medicare Administrative Contractor based on program eligibility standards. We initially considered using MCCM program data as a data source to identify MCCM enrollees, but ultimately decided on limiting the intervention group to those beneficiaries with positive paid MCCM claims to ensure that these beneficiaries were eligible and would continue receiving services. That is, we did not include beneficiaries who were enrolled in the model but did not receive any services according to MCCM claims data. Our understanding is that because the sites did not have the ability to verify all the information needed for enrollment, beneficiaries could be enrolled in the model but not have claims paid because the Medicare Administrative Contractor deemed the beneficiary was ineligible. Among 7,399 beneficiaries who were enrolled in the model (in MCCM program data) or had MCCM claims before July 1, 2021, there were 6,559 beneficiaries (89 percent) who had a MCCM claim with a positive payment amount to participating hospices for providing MCCM services from January 1, 2016, to June 30, 2021. A small number (N = 138) of these 5,774 beneficiaries were represented in MCCM claims but not included in the MCCM program data.

[95] Appendix Table D.1 provides all the International Classification of Diseases 9 and 10 codes used to identify these conditions.

[96] The actual eligibility rule is that an individual must live in a regular home, with an exception for short skilled nursing facility stays. However, living in a regular home cannot be identified with available data. Instead, we excluded beneficiaries that resided in an institutional setting. See Appendix D, Section 1 for additional details.

4. Did not use the Medicare hospice benefit (receive hospice benefits) within 30 days before enrollment[97]
5. Had at least one hospital encounter (inpatient stay, observation stay, or emergency department visit) within 12 months before enrollment
6. Had at least 3 office visits within 12 months before enrollment.
7. Met more strict inclusion criteria applicable at time of enrollment (if applicable). During the first year, CMS also required enrollment in Medicare Part D and at least two hospital encounters (January 1, 2016, to March 31, 2016) and at least three office visits with the same provider for the MCCM-qualifying terminal condition (January 1, 2016, to December 31, 2016), but these stricter eligibility requirements were discontinued. We applied these criteria only in the periods where they were applicable.[98]

We could not verify life expectancy of six months or fewer. Finally, so that outcomes could be measured accurately, we restricted the sample to beneficiaries enrolled in fee-for-service Medicare Part A and B with Medicare as the primary payer from the date they enrolled MCCM through their date of death. In Appendix D, Section 1, we provide details on how we defined each of these eligibility criteria; in Appendix Table C.1, we report the number of observations that we originally identified, the number excluded with each additional criterion, and the dollar value of the claims paid for MCCM services for each of these excluded groups.

Table C.1. Sample sizes for report after sequentially applying model inclusion criteria using claims

#	Criteria	Number of beneficiaries		CMS payments for MCCM claims ($)	
		Excluded	Remaining	Excluded	Remaining
—	Beneficiaries who had MCCM services before July 1, 2021[a]	—	6,559	—	$16,731,828
1	Exclude beneficiaries alive after December 31, 2021 (that is, after the model ended)[b]	785	5,774	$4,985,900	$11,745,928
2	Exclude beneficiaries who were not observable during the entire baseline period[c]	51	5,723	$75,408	$11,670,520
3	Exclude beneficiaries without one of the four MCCM qualifying conditions	167	5,556	$383,004	$11,287,516
4	Exclude beneficiaries residing in an institutional setting	134	5,422	$347,500	$10,940,016
5	Exclude beneficiaries receiving hospice benefits	1	5,421	$588	$10,939,428
6	Exclude beneficiaries without a hospital encounter	42	5,379	$79,084	$10,860,344
7	Exclude beneficiaries without three office visits	15	5,364	$31,780	$10,828,564

[97] Although no intervention beneficiaries received hospice services in the 30 days before enrollment in MCCM, a few did receive hospice services in the year before MCCM enrollment.

[98] During the COVID-19 pandemic, CMS broadened access to telehealth services, and telehealth encounters were counted in determining MCCM eligibility. We included telehealth visit procedure codes in our measure of total office visits after March 6, 2020 (when the change in the eligibility criterion occurred).

#	Criteria	Number of beneficiaries		CMS payments for MCCM claims ($)	
		Excluded	Remaining	Excluded	Remaining
8	Exclude beneficiaries who did not meet more strict inclusion criteria applicable at time of enrollment	109	5,255	$400,720	$10,427,844
9	Exclude beneficiaries who were not observable in the entire study period[c]	102	**5,153**	$270,168	**$10,157,676**

Notes: Bolded green text indicates the final sample and final payments included.

[a] The first row is limited to beneficiaries with at least one paid Medicare hospice claim for MCCM services. See Appendix A, Table A.2 for a comparison of the number of enrollees in MCCM program data and in MCCM claims.

[b] Among beneficiaries with paid MCCM services before July 1, 2021 who met criteria 2 through 8 in this table, 5,251 out of 5,965 beneficiaries (88.0 percent) died before the model ended.

[c] *Observable* beneficiaries were enrolled in Medicare Part A and B (traditional Medicare) with Medicare as the primary payer.

MCCM = Medicare Care Choices Model.

2.3. Identifying MCCM hospices' market areas

Our process for identifying potential comparison beneficiaries required identifying a *geographic market area* for each MCCM hospice.[99] For each hospice, we identified a market area that consists of one or more hospital referral regions. These regions were defined in 1996 to represent regional health care markets for tertiary medical care (Dartmouth Atlas Project 2020a). We chose to define hospice market areas by hospital referral regions because they are small enough to capture local variation in patterns of end-of-life care (Dartmouth Atlas Project 2020b) but are still large enough to provide an adequate number of comparison beneficiaries to support our design.

Three factors influence whether any particular hospital referral region is included in the market area for a given hospice: (1) the geographic location of the hospital referral region relative to the hospital referral region of the hospice, (2) the zip code of residence of all beneficiaries who filed claims at the hospice, and (3) the zip code of residence for beneficiaries enrolled in MCCM by the hospice. More specifically, we defined the market area for any hospice to include all hospital referral regions that meet **any** of the following criteria:

1. The hospice was physically located in the hospital referral region
2. Among beneficiaries who received hospice services from the hospice (regardless of participation in MCCM), at least 25 percent had a zip code of residence in the hospital referral region and the region was adjacent to the hospital referral region where the hospice was physically located
3. At least 25 percent of the beneficiaries enrolled in MCCM by the hospice had a zip code of residence in the hospital referral region
4. At least 10 percent of the beneficiaries enrolled in MCCM by the hospice had a zip code of residence if the 10 percent number constitutes at least 5 beneficiaries

[99] Our impact analyses focused on beneficiaries enrolled in MCCM, so hospices needed to enroll at least one beneficiary in MCCM to be included in the impact analyses. We were not able to, but did not need to, identify market areas for the participating hospices that enrolled zero beneficiaries.

5. At least 10 of the beneficiaries enrolled in MCCM by the hospice had a zip code of residence in the hospital referral region

To implement the first two criteria, we reviewed all Medicare fee-for-service hospice claims submitted by the hospice during the year before model implementation (2015 for Cohort 1 hospices and 2017 for Cohort 2 hospices) and assigned the hospice to an hospital referral region based on the facility zip code recorded on their claims.[100] Next, we assigned each Medicare beneficiary in the hospice's claims to a single hospital referral region based on the beneficiary's zip code of residence recorded on the hospice claims, then counted the number of beneficiaries served by the hospice who were from each hospital referral region.[101] We used files provided by the Dartmouth Atlas (Dartmouth Atlas Project 2020a) to map all zip codes to hospital referral regions and to identify neighboring (adjacent) hospital referral regions. Finally, for each hospice, we determined the proportion of beneficiaries who live in each hospital referral region and selected all hospital referral regions that meet the 25 percent threshold.

The last three criteria were based on enrolled MCCM beneficiaries. We identified all enrolled beneficiaries (through June 2021) and their zip codes from the MCCM program data and mapped the beneficiaries' zip codes to a hospital referral region using the Dartmouth Atlas. For each hospice, we then determined the total number of beneficiaries that live in each hospital referral region and identified the regions that met any of the three criteria.

In the end, we were able to identify a market area for each MCCM hospice: we identified a total of 102 unique hospital referral regions as the market areas for the 89 hospices that enrolled at least one beneficiary in MCCM. Sixty hospices (67 percent) had a market area comprising a single hospital referral region—the region where the hospice was physically located—and the remaining 29 hospices (33 percent) had a market area that included two or more hospital referral regions (Appendix Table C.2).

Table C.2. Hospice market area sizes

Number of hospital referral regions in the hospice's market area	Number of hospices (hospice market areas)	Percentage of hospices
1	60	67
2	21	24
3	6	7
4	1	1
9	1[a]	1

Note: This analysis reports the number of hospital referral regions that constitute a hospice market area. It includes the 89 hospices that enrolled one or more beneficiaries in MCCM.

[a] This market area corresponds to the hospice JourneyCare in Barrington, Illinois, a town which is close to a relatively large number of small hospital referral regions. The hospice eventually withdrew from MCCM.

MCCM = Medicare Care Choices Model.

[100] After the hospice's facility zip code on each claim was mapped to a hospital referral region using the Dartmouth Atlas, we selected the hospital referral region that was recoded most often among the hospice's claims. If two hospital referral regions were recorded the same number of times, we chose the one recorded most recently.

[101] For cases where the beneficiary had multiple hospice claims and the zip codes of residence on these claims indicated the beneficiary lived in more than one hospital referral region, we assigned the beneficiary to a single region, selecting the hospital referral region corresponding to the most days of service.

There was some overlap in the market areas of the MCCM hospices. Specifically, among all hospital referral regions that were selected as belonging to a hospice's market area, 25 percent of the time the hospital referral region was in the market area of two or three different hospices (Appendix Table C.3). There were a few beneficiaries enrolled in MCCM who lived outside the hospital referral regions that we selected as the market areas of the MCCM hospices, but this was rare.[102]

Table C.3. Overlap of hospice market areas

Number of hospices whose market area includes the hospital referral region	Number of hospital referral regions	Percentage of hospital referral regions
1	76	75
2	21	21
3	5	5

Note: This analysis includes the 102 hospital referral regions that were selected as belonging to the market area of one or more hospices.

2.4. Identifying potential comparison beneficiaries

We identified potential comparison beneficiaries from among fee-for-service Medicare beneficiaries who lived in the MCCM hospices' market area, met the MCCM eligibility criteria observable in Medicare claims and enrollment data, and subsequently died between January 1, 2016, and December 31, 2021 (the end of the analysis period). From the potential comparison pool, we removed any beneficiaries who were (1) ever enrolled in MCCM or (2) ever referred to MCCM (according to MCCM program data) but did not enroll.

To identify the potential comparison beneficiary pool, we took the following steps. First, we identified the set of potential comparison beneficiaries who died between January 1, 2016, and December 31, 2021. We then excluded those beneficiaries who never lived in any of the MCCM hospice market areas during the potential pseudo-enrollment period (January 1, 2016, to June 30, 2021) or who did not have a claim with an MCCM qualifying diagnoses during the potential baseline period (January 1, 2015, to June 30, 2021) or were referred or enrolled in MCCM (according to MCCM program data and Medicare claims).

For each remaining potential comparison beneficiary, we created 29 potential pseudo-enrollment dates which were then used to construct time-varying eligibility measures, such as the number of office visits in the 12 months before the pseudo-enrollment date. To assign pseudo-enrollment dates, we calculated the empirical distribution of survival times (in days) for the enrolled group that met all inclusion criteria and then used this distribution to assign 29 different possible survival times for each potential comparison beneficiary.[103] To ensure that we had copies of each comparison beneficiary with short and

[102] The market areas we selected included the hospital referral region of 7,139 of the 7,263 MCCM beneficiaries, or 98 percent. Here, 7,263 is total number of beneficiary-hospice records in MCCM program data as of December 2021. The final impact analysis, which excludes beneficiaries for various reasons (see Appendix Table C.1), is based on 5,153 MCCM enrollees.

[103] Specifically, we observed the survival times for MCCM enrollees in our analysis sample (see the previous section) and measured the distribution in the following increments: minimum, 1st percentile, 2nd percentile, 3rd percentile, 4th percentile, 5th percentile, 7.5th percentile, 10th percentile, 12.5th percentile, 15th percentile, 17.5th percentile,

long survival times, we used stratified random draws so that one observation falls in each stratum. Thus, we created 29 "copies" for each eligible beneficiary (that is, 29 observations of the same individual, same date of death, and a unique pseudo-enrollment date). This step was designed to *approximately* balance between the survival time distributions for beneficiaries in the intervention and potential comparison groups.

Finally, we assessed whether the beneficiary met our inclusion criteria on each pseudo-enrollment date, keeping only the copies where the pseudo-enrollment date fell between January 1, 2016, and June 30, 2021, and where the beneficiary met the inclusion criteria on the pseudo-enrollment date. Inclusion criteria included requiring the beneficiary to have died before January 1, 2022; lived in one of the hospice market areas on their pseudo-enrollment date; and met MCCM eligibility criteria on their pseudo-enrollment date (as best we could determine using claims and enrollment data, per the criteria described in Section 2.2 of this appendix.) That is, we applied the time-varying eligibility criteria to each person/enrollment date combination and excluded any copy that did not meet the criteria.

The potential comparison group comprised 1,959,525 unique beneficiaries, with 1 to 29 potential pseudo-enrollment dates available for each beneficiary. In total, there were 25,394,282 potential comparison observations that met our inclusion criteria. We then removed a relatively small number of potential comparison observations that had outlier values for one or more matching variables and could not possibly be good matches for any intervention beneficiary, which left 25,117,555 potential comparison observations for 1,954,272 unique beneficiaries. Finally, we dropped comparisons who did not meet the exact-match restrictions for any enrolled beneficiaries (see details below), which left a final sample of 23,687,256 potential comparison observations for 1,934,407 unique beneficiaries (12.2 observations per unique beneficiary on average) to use in matching.

2.5. Constructing baseline measures to use in matching and as control variables

To conduct propensity score matching, we constructed the following kinds of variables:

- Demographic and Medicare enrollment characteristics, which include beneficiaries' age, sex, race, Medicaid status, and characteristics of their local area (such as average income)
- Prior health care use, which includes beneficiaries' use of health care services such as hospitalizations, emergency department, and Part B drug use over the prior year
- Health at enrollment, which includes beneficiaries' qualifying MCCM diagnosis, hierarchical condition category score at enrollment, and hierarchical condition category score in the year prior to enrollment
- Disease-specific measures, which include measures specific to the MCCM qualifying diagnosis

20th percentile, 22.5th percentile, 25th percentile, 27.5th percentile, 30th percentile, 35th percentile, 40th percentile, 45th percentile, …, 90th percentile, 95th percentile, and maximum. Next, we created 29 copies of each potential comparison beneficiary. Each copy was assigned a survival time: for the first copy, we randomly drew a survival time between the minimum and 1st percentile; for the second copy, we randomly drew a survival time between the 1st and 2nd percentile; for the third copy, we randomly drew a survival time between the 2nd and 3rd percentile; and so on. Finally, for each potential comparison copy, we set the pseudo-enrollment date equal to their date of death minus the survival time. Using this procedure, MCCM enrollees' and the potential comparison group beneficiaries' distributions of survival times were reasonably balanced before matching.

The details of these variables are available in Appendix D, Section 2, including each variable's data source. (We always used the same data source for both intervention and potential comparison beneficiaries when constructing variables.)

Two categories of matching variables consisted of many potentially correlated predictors: binary hierarchical condition category flags (63 variables) and county-level demographic variables (10 variables). Including all 73 of these variables in the propensity score model could have negatively impacted the balance on other matching variables. To reduce this likelihood while still achieving adequate balance on each variable, we conducted a principal component analysis for the two sets of variables. Then we included the principal component scores in the propensity score model instead of using all 73 indicator variables in matching. Principal component analysis is a common dimension-reduction technique that can be used to represent the most important patterns in a set of covariates, using as few variables as possible. By matching on the principal component scores, we aimed to achieve balance on the underlying variables, without having to include dozens of additional covariates in the propensity score model.

We fit each model using only the intervention beneficiaries because our goal was to match the patterns in the intervention group. We selected the number of principal component scores to include in the final models based on the percentage of the total variance explained for each additional principal component. Our propensity score models included eight principal components corresponding to hierarchical condition category flags and three corresponding to county-level demographics. Because hierarchical condition category flags are all binary, we used a specialized version of principal components analysis designed for binary data (Landgraf and Lee 2020); for county-level demographics, we used standard principal components analysis designed for continuous measures.

2.6. Constructing outcome measures

Once we identified the comparison group, we constructed the following outcomes measures. These measures fall into four groups:

1. *Expenditures.* We measured total Medicare Part A and B (fee-for-service) expenditures, with and without MCCM payments, as well as expenditures stratified by type of service (including inpatient, hospice, skilled nursing facility, home health, Part B drugs, and others).
2. *Service use.* We measured the number of inpatient admissions and length of stay (both within and outside of the intensive care unit), 30-day readmissions, number of ambulance transports, and number of emergency department visits.
3. *Hospice-related measures.* We measured admission to hospice, the length of time until beneficiaries entered hospice, the number of days in hospice care, and entering hospice less than three days before death.
4. *Quality of end-of-life care*. We measured receipt of an aggressive life-prolonging treatment in the last 30 days of life; days at home; emergency department visits, hospitalizations, and intensive care unit admissions in the last 30 days of life; receipt of advance care planning; and rate of death in an inpatient facility.

Appendix D, Section 3 provides the details on how we constructed these variables.

3. Identifying the matched comparison beneficiaries

3.1. Matching process

To select matched comparison beneficiaries and their associated pseudo-enrollment dates, we used a matching technique called GroupMatch (Pimentel et al. 2019). GroupMatch is a propensity score matching procedure designed for situations in which the intervention group is enrolled into a model on a rolling basis, and there is no corresponding enrollment date for members of the comparison group. The key innovation of GroupMatch is that the model considers many potential pseudo-enrollment dates for each potential comparison beneficiary, while simultaneously imposing restrictions such that at most one version of each potential comparison is selected for the final match. We implemented this algorithm in such a way that each potential comparison beneficiary is selected as a comparison beneficiary (exactly) once or not at all. An optimal matching algorithm determines the resulting matched comparison group, including the choice of pseudo-enrollment date for each member. We used exact matching and calipers to make sure intervention and comparison beneficiaries matched closely on key matching variables, as described in more detail below.

We favored GroupMatch, and more generally the optimal matching algorithm that it extends (Hansen 2006), based on its advantageous theoretical properties and Mathematica's track record using optimal matching to produce well-matched comparison groups for previous evaluations. By considering many potential pseudo-enrollment dates for each potential comparison beneficiary, GroupMatch can identify a comparison group that more closely resembles the intervention group than alternative approaches that choose a fixed pseudo-enrollment date per beneficiary. **Each potential comparison beneficiary is used exactly once (with their corresponding optimized pseudo-enrollment date) or not at all.**[104] At the same time, by using variable-ratio matching (where the number of comparisons assigned to each intervention beneficiary can vary), we make the best possible use of our comparison pool: we select more comparisons for intervention beneficiaries with many high-quality matches and fewer comparisons for intervention beneficiaries with few high-quality matches. We allowed one to three comparison beneficiaries to match to each intervention beneficiary.

Propensity scores. As in optimal matching (Hansen 2006), GroupMatch assigns matches that minimize the difference in propensity scores between the MCCM and comparison groups.[105] The propensity score

[104] This is the key innovation in the GroupMatch algorithm, which grew out of the need to apply this restriction on other evaluations with rolling enrollment. Allowing each potential comparison to take on different pseudo-enrollment dates avoids the arbitrariness of selecting a single date at random but introduces the challenge of accounting correctly for correlation between two pseudo-enrollment dates for the same comparison if both are selected. To solve this problem, GroupMatch takes as input the beneficiary ID number, which it uses to ensure that at most one version of a beneficiary is matched.

[105] The GroupMatch algorithm extends the optimal matching approach in the optmatch package in R as implemented by Ben Hansen and coauthors. The main difference between GroupMatch and optmatch is precisely the feature mentioned in the previous footnote: GroupMatch allows us to give the algorithm more than one copy of each potential comparison beneficiary and subsequently constrains the algorithm to pick only one copy in the matched comparison group. Otherwise GroupMatch solves the same optimization problem as optmatch and requires that the solution meets the same constrains (for example, for this analysis, we required that the solution include no more than three comparison beneficiaries for each intervention beneficiary). The main input to the optmatch package is a large matrix containing the distances between each intervention and potential comparison

summarizes the beneficiary's characteristics in a single value; by matching the MCCM and comparison groups' propensity score distributions, we can theoretically expect the two groups to have similar covariate distributions (Rosenbaum and Rubin 1983; Rosenbaum 1989; Stuart 2020). After an initial round of matching, we manually removed a few terms with zero prevalence in the MCCM group that led to unstable estimates of the propensity scores, and also excluded potential comparison beneficiaries who had these characteristics from the pool.[106]

For this evaluation, we estimated propensity scores separately for each of the six qualifying condition groups listed in Appendix Table C.4. Estimating propensity score models for the six groups had two advantages. First, it allowed the relationship between the matching variables and MCCM participation to vary across groups. For example, it allowed any particular variable to be more or less strongly associated with MCCM participation among beneficiaries with cancer compared to the association among beneficiaries with congestive heart failure. Second, separating the propensity score models let us tailor the variables included to those that are most salient for each set of diagnoses. Specifically, the propensity score models contained a set of core matching variables common to each diagnosis group, plus additional variables specific to the diagnosis group. For example, in the cancer-only diagnosis group, we included indicators for cancer type (such as breast, colorectal, and lung) in addition to the core matching variables. In addition, we were able to include interaction terms targeting subgroup balance, for diagnosis groups where these were relevant. Appendix Table C.5 categorizes the variables, identifying those used in matching across diagnosis groupings and those specific to one or more diagnoses. Because only 20 intervention beneficiaries were in Group 6, we were able to use only the most important matching variables for that group.

beneficiary (of the difference in propensity scores between two beneficiaries). This distance matrix can be manipulated before matching using all our usual matching techniques (including exact matching, calipers, and penalties).

[106] For example, if none of the enrolled beneficiaries in the chronic obstructive pulmonary disease-only diagnosis group (group 4 in Table C.4) were in a skilled nursing facility on their enrollment date, we removed all potential comparison beneficiaries in the chronic obstructive pulmonary disease-only diagnosis group who were in a skilled nursing facility on their pseudo-enrollment date and removed this variable from the propensity score model for the beneficiaries with chronic obstructive pulmonary disease (only). Removing these variables improved the fit of the propensity score models and the stability of the estimated propensity scores.

Table C.4. Qualifying condition groupings used to estimate propensity scores

Group	Qualifying condition combinations included	Number of MCCM enrollees in the group
1	Cancer	2,263
2	Cancer and COPD Cancer and CHF Cancer and COPD and CHF	1,421
3	CHF	632
4	COPD	310
5	COPD and CHF	507
6	HIV/AIDS HIV/AIDS and cancer HIV/AIDS and cancer and COPD HIV/AIDS and cancer and CHF HIV/AIDS and COPD HIV/AIDS and COPD and CHF	20

CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome; MCCM = Medicare Care Choices Model.

Matching constraints. We placed several constraints on the matching algorithm to ensure that certain key covariates are well-balanced between the intervention and comparison groups. These constraints fall into three categories:

1. *Exact matching*. Exact matching is the strictest constraint applied to the matching algorithm and is appropriate for binary or categorical variables. For variables with exact matching constraints, we required matched comparison beneficiaries to have the same value as that of the intervention beneficiary. We matched exactly on the beneficiary's qualifying condition group (from Appendix Table C.4), as well as hospice market area; whether the beneficiary's (pseudo-) enrollment date occurred before September 1, 2019 (about six months before the COVID-19 pandemic began); and the beneficiary's dual eligibility status.[107]
2. *Strict calipers*. A caliper is a constraint that is appropriate for continuous variables. Whereas exact matching requires matched comparisons to have the same value of a variable as the intervention beneficiary, a caliper restricts the matched comparisons to have a value of the variable within a small window around the value of the intervention beneficiary. For example, we placed calipers on both the survival time and (pseudo-) enrollment date variables to ensure that intervention and matched comparison beneficiaries have similar survival times and were enrolled around the same date.[108]
3. *Penalized calipers*. Like the strict calipers described above, a penalized caliper defines a small window around the intervention beneficiary's value of a certain variable. However, instead of not

[107] An added benefit of exact matching was that we could run the optimal matching algorithm separately for subgroups of beneficiaries, decreasing computation time.

[108] For beneficiaries with shorter survival times, we matched closely on survival time. For beneficiaries in the right tail of the distribution (longer time between MCCM enrollment and death) where survival times are more dispersed, we allowed for wider calipers.

allowing potential comparisons to match to the intervention beneficiary if their value of the variable falls outside the window, a penalized caliper imposes a penalty on these potential comparisons—making them less likely to match. A penalized caliper can also serve as an alternative to exact matching on a binary or categorical variable; in this case, rather than removing potential comparisons from consideration if they do not have the same value of the variable as the intervention beneficiary, we penalize the match. This type of constraint is appropriate for cases when a strict caliper may be overly restrictive, leaving some intervention beneficiaries without any potential comparisons that meet all the matching criteria. We applied penalized calipers to both categorical variables (such as hospital referral region) and continuous variables (such as the number of days between hospital admission and enrollment).[109]

In some cases, we applied more than one of these constraints on the same variable. For example, for any given matched set, we placed the following restrictions on enrollment date: (1) we did not allow any matches with enrollment dates more than one year apart, (2) we penalized any potential matches that are more than six months apart (so matches more than six months apart are very rare), and (3) we had even tighter restrictions on beneficiaries enrolled during the COVID-19 pandemic, depending on whether they enrolled before or after vaccines became widely available (for this purpose, defined as December 1, 2020).

3.2. Results of propensity score matching and final analysis number of observations

Our matching approach proved feasible, and we successfully identified matched comparison beneficiaries for each of the 5,153 MCCM enrollees. Specifically, 5,030 MCCM enrollees (97.6 percent) were matched to 3 comparison beneficiaries, 56 (1.1 percent) were matched to 2 comparison beneficiaries, and 67 (1.3 percent) were matched to 1 comparison beneficiary.[110] Across the matched sets, there are 15,269 unique matched comparison beneficiaries in total, or an average ratio of 2.96 comparison beneficiaries per intervention beneficiary.

Each matched comparison beneficiary was given a single pseudo-enrollment date through the methods described earlier. Pseudo-enrollment dates for matched comparison beneficiaries were broadly the same as the enrollment dates for MCCM enrollees, with similar percentages of beneficiaries in each group enrolling per year. At their pseudo-enrollment date, the matched comparison beneficiaries always resided in the market area of the hospice that enrolled the intervention beneficiary in MCCM. Because some MCCM hospices had market areas with more than one hospital referral region, 82 percent of the comparison beneficiaries lived in the same hospital referral region as the MCCM beneficiary in their matched set.

In Appendix Table C.5, we present descriptive statistics for each of the baseline characteristics (matching variables) for MCCM enrollees, the potential comparison group before matching, and the matched

[109] As discussed earlier, beneficiaries included in our analysis were eligible for the model at their enrollment or pseudo-enrollment, as best we can determine from claims. Model eligibility requirements changed over time, and we accounted for this in matching using calipers that required matched comparison beneficiaries to meet, at a minimum, all the same eligibility criteria that MCCM participant met.

[110] MCCM participants were slightly less likely to be matched to three comparison beneficiaries if they (1) had HIV/AIDS or (2) had cancer only (that is, cancer without congestive heart failure, chronic obstructive pulmonary disease, or HIV/AIDS).

comparison group. The standardized difference column in the table presents the difference between MCCM enrollees and matched comparison beneficiaries after matching, expressed in standard deviation units. (In a supplement submitted to CMS, we also showed that we achieved balance on a number of other baseline characteristics that we had not included in matching. Those covariates are omitted from Appendix Table C.5 for the sake of brevity.)

Table C.5. Matching variables and characteristics of deceased MCCM enrollees and comparison beneficiaries, before and after matching

Variable	Used in matching[a]	Enhancements[b]	Potential comparison group (N = 23,687,256)	MCCM participants (N = 5,153)	Matched comparison group (N = 15,269)	Standardized difference
COVID-19 cohort	Yes*	Exact matching	29.0	29.0	29.0	0.000
Dual eligibility	Yes*	Exact matching	19.4	11.4	11.4	0.000
Primary diagnosis cancer	Yes*	Penalized caliper[c]	44.6	71.8	71.7	0.001
Primary diagnosis CHF	Yes*	Penalized caliper[c]	49.5	38.0	38.0	0.000
Primary diagnosis COPD	Yes*	Penalized caliper[c]	36.0	33.4	33.4	-0.001
Primary diagnosis HIV/AIDS	Yes*	Penalized caliper[c]	0.4	0.4	0.4	0.000
Indicator for rural zip code	Yes*	Penalized caliper	21.8	13.3	13.7	-0.012
Medicare A/B as primary payer in previous 2 years	Yes*	Penalized caliper	96.4	95.8	98.8	-0.152
Age	Yes*	Penalized caliper	79.0	77.3	77.1	0.025
Age less than 65	Yes*	n/a	8.0	6.7	5.1	0.065
Age 65-80	Yes*	n/a	40.7	51.7	56.6	-0.098
Age 80 or over	Yes*	n/a	51.3	41.5	38.3	0.066
Medicare entitlement: OASI	Yes	n/a	79.0	81.6	82.1	-0.013
Medicare entitlement: disability	Yes	n/a	19.1	17.6	17.1	0.013
Medicare entitlement: ESRD	Yes	n/a	1.0	0.6	0.5	0.014
Medicare entitlement: disability/ESRD	Yes	n/a	0.9	0.2	0.3	-0.016
Male	Yes*	Exact matching*	50.5	49.5	52.1	-0.052
Female	Yes*	Exact matching*	49.5	50.5	47.9	0.052
Northeast region	Yes	n/a	20.6	18.6	18.8	-0.007
Midwest region	Yes	n/a	28.3	19.6	19.2	0.009
South region	Yes	n/a	39.0	40.2	39.6	0.011
West region	Yes	n/a	12.0	21.6	22.3	-0.016
Days in COVID-19 period	Yes*	Strict caliper	94.6	77.1	82.1	-0.031
HCC score at enrollment	Yes*	n/a	4.7	5.6	5.4	0.062
HCC score one year before enrollment	Yes	n/a	2.6	3.1	3.2	-0.057
HCC: Ischemic or unspecified stroke	Yes	n/a	10.6	9.3	9.2	0.004
HCC: Dialysis status	Yes	n/a	7.0	5.5	5.6	-0.004
HCC: Kidney disease	Yes	n/a	50.7	48.9	50.9	-0.040
HCC: Diabetes with acute/chronic complications	Yes	n/a	36.0	33.7	36.0	-0.048

Variable	Used in matching[a]	Enhancements[b]	Potential comparison group (N = 23,687,256)	MCCM participants (N = 5,153)	Matched comparison group (N = 15,269)	Standardized difference
HCC: Dementia with or without complication	Yes	n/a	23.8	15.3	12.7	0.070
HCC: Coma	Yes	n/a	3.8	6.4	4.5	0.076
HCC: Cardio-respiratory failure	Yes	n/a	34.3	36.8	36.2	0.012
HCC: Acute myocardial infarction	Yes	n/a	13.3	11.6	10.9	0.021
Primary diagnosis breast cancer	Condition	n/a	5.0	8.8	8.0	0.025
Primary diagnosis colorectal cancer	Condition	n/a	4.6	7.9	7.6	0.013
Primary diagnosis lung cancer	Condition	n/a	10.6	24.3	21.2	0.070
Primary diagnosis other cancer	Condition	n/a	32.3	62.7	60.5	0.045
Primary diagnosis prostate cancer	Condition	n/a	6.9	9.4	10.2	-0.030
Days from most recent IP discharge and enrollment	Yes	Penalized caliper	90.3	69.5	66.3	0.040
Logit of propensity score	Yes*	n/a	-8.0	-4.7	-4.9	0.213
Non-Hispanic White	Yes	Penalized caliper	81.9	86.4	87.7	-0.037
Black or African American	Yes	n/a	10.2	8.1	8.0	0.006
Other, unknown, missing race/ethnicity	Yes	n/a	7.9	5.5	4.4	0.049
Days between enrollment and death	Yes*	Strict caliper	184.5	198.8	196.5	0.009
Medicare Part A and B expenditures Q1	Yes	n/a	24,458	31,211	30,621	0.023
Medicare Part A and B expenditures Q2	Yes	n/a	13,498	20,493	20,343	0.006
Medicare Part A and B expenditures Q3	Yes	n/a	10,547	15,328	15,590	-0.012
Medicare Part A and B expenditures Q4	Yes	n/a	9,499	12,981	13,101	-0.006
Medicare Part A and B expenditures Q5-Q8 (total)	Balance	n/a	24,371	36,016	37,827	-0.039
Inpatient admissions Q1	Yes	n/a	0.8	1.1	1.0	0.049
0 inpatient admissions Q1	Yes	Penalized caliper	0.5	0.3	0.3	-0.009
1-2 inpatient admissions Q1	Yes	Penalized caliper	0.5	0.6	0.6	-0.025
3+ inpatient admissions Q1	Yes	Penalized caliper	0.1	0.1	0.1	0.057
Inpatient admissions Q2	Yes	n/a	0.4	0.5	0.5	0.006
Inpatient admissions Q3	Yes	n/a	0.3	0.4	0.4	-0.012
Inpatient admissions Q4	Yes	n/a	0.3	0.3	0.3	-0.008
Outpatient ED visits/observation stays Q1	Yes	n/a	0.5	0.7	0.7	0.002
Outpatient ED visits/observation stays Q2-4	Yes	n/a	0.9	1.0	1.1	-0.093
Advanced care planning visit in previous 2 years	Yes	n/a	11.5	21.9	16.8	0.123
Inpatient stay on enrollment date	Yes	n/a	19.2	0.4	0.5	-0.007
Admitted to hospital on enrollment date	Yes	n/a	2.5	0.3	0.2	0.018
Discharged from hospital on enrollment date	Yes	n/a	1.5	1.7	1.4	0.024
Length of most recent inpatient stay	Yes	n/a	6.7	6.7	6.1	0.100

Variable	Used in matching[a]	Enhancements[b]	Potential comparison group (N = 23,687,256)	MCCM participants (N = 5,153)	Matched comparison group (N = 15,269)	Standardized difference
Inpatient days Q1	Yes	n/a	6.8	7.0	6.3	0.093
Inpatient days Q2-4	Yes	n/a	6.7	8.1	7.9	0.020
Inpatient expenditures Q1	Yes	n/a	14,032	14,129	14,070	0.003
Inpatient expenditures Q2-4	Yes	n/a	14,467	18,139	17,978	0.005
Admitted to SNF on enrollment date	Yes	n/a	1.2	0.0	0.4	-0.248
Discharged from SNF on enrollment date	Yes	n/a	1.2	0.5	0.7	-0.027
Any DME claims Q1-4	Yes	n/a	59.3	72.6	71.5	0.025
DME hospital bed claims Q1-4	Yes	n/a	0.2	0.3	0.2	0.085
DME oxygen claims Q1-4	Yes	n/a	1.6	2.1	2.0	0.022
Any DME walker/cane claims Q1-4	Yes	n/a	0.1	0.1	0.1	0.034
DME wheelchair claims Q1-4	Yes	n/a	0.4	0.4	0.3	0.050
SNF stay on enrollment date	Yes	n/a	3.2	0.1	0.1	-0.014
SNF days Q1	Yes	n/a	5.0	3.7	3.4	0.033
SNF days Q2-4	Yes	n/a	6.5	4.9	4.7	0.009
Post-acute care Q1	Yes	n/a	10.5	11.6	9.9	0.110
Post-acute care Q2-4	Yes	n/a	17.5	15.1	13.5	0.059
ADLs at most recent assessment	Yes	n/a	4.5	4.7	4.5	0.147
OASIS care assessment D30	Yes	n/a	15.0	36.9	29.0	0.163
OASIS discharge assessment D30	Yes	n/a	26.4	26.5	25.2	0.030
Inpatient ICU days Q1	Yes	n/a	2.5	2.1	1.8	0.056
Inpatient ICU days Q2-4	Yes	n/a	2.2	2.5	2.3	0.021
Outpatient expenditures Q1	Yes	n/a	2,027	3,745	3,861	-0.021
Outpatient expenditures Q2-4	Yes	n/a	4,565	7,628	7,946	-0.026
Part B drug expenditures Q1	Yes	n/a	1,447	4,781	5,051	-0.026
Part B drug expenditures Q2-4	Yes	n/a	3,336	10,175	10,509	-0.015
Unique inpatient procedures Q1	Yes	n/a	1.7	1.4	1.4	0.001
Unique inpatient procedures Q2-4	Yes	n/a	1.7	2.0	2.0	-0.021
Home health days Q1	Yes	n/a	4.6	7.3	5.9	0.140
Home health days Q2-4	Yes	n/a	10.0	9.4	8.1	0.078
ED visits resulting in inpatient admission Q1	Yes	n/a	0.7	0.9	0.8	0.080
ED visits resulting in inpatient admission Q2-4	Yes	n/a	0.8	1.0	1.0	0.003
PCP visits Q1	Yes	n/a	3.4	4.2	4.0	0.052
PCP visits Q2-4	Yes	n/a	7.0	7.8	8.0	-0.021
Specialist visits Q1	Yes	n/a	2.8	4.9	4.8	0.028
Specialist visits Q2-4	Yes	n/a	7.0	10.6	11.0	-0.054
Number of EMS ambulance transports Q1	Yes	n/a	0.5	0.6	0.5	0.063
Number of EMS ambulance transports Q2	Yes	n/a	0.2	0.3	0.25	0.007

Variable	Used in matching[a]	Enhancements[b]	Potential comparison group (N = 23,687,256)	MCCM participants (N = 5,153)	Matched comparison group (N = 15,269)	Standardized difference
Number of EMS ambulance transports Q3	Yes	n/a	0.2	0.2	0.20	-0.001
Number of EMS ambulance transports Q4	Yes	n/a	0.2	0.2	0.16	0.010
Encounters for cancer Q1	Condition	n/a	2.5	7.1	6.8	0.036
Encounters for cancer Q2-4	Condition	n/a	4.7	12.4	12.8	-0.022
Encounters for CHF Q1	Condition	n/a	1.5	2.1	2.0	0.033
Encounters for CHF Q2-4	Condition	n/a	2.7	3.3	3.3	-0.001
Encounters for COPD Q1	Condition	n/a	1.3	2.0	1.8	0.035
Encounters for COPD Q2-4	Condition	n/a	2.6	3.5	3.5	-0.004
Encounters for HIV/AIDS Q1	Condition	n/a	0.0	0.0	0.0	0.014
Encounters for HIV/AIDS Q2-4	Condition	n/a	0.0	0.0	0.0	0.008
Drugs for advanced stage cancer Q1	Condition	n/a	13.2	35.9	35.3	0.014
Drugs for advanced stage cancer Q2-4	Condition	n/a	15.9	35.4	38.2	-0.058
Diagnoses of advanced stage cancer Q1	Condition	n/a	33.1	53.0	53.3	-0.005
Diagnoses of advanced stage cancer Q2-4	Condition	n/a	38.9	51.1	54.3	-0.065
Diagnostic tests/procedures for advanced stage cancer Q1	Condition	n/a	10.8	33.3	31.1	0.046
Diagnostic tests/procedures for advanced stage cancer Q2-4	Condition	n/a	12.2	33.7	34.9	-0.026
Hormonal therapies Q1	Condition	n/a	0.3	1.0	1.0	-0.003
Hormonal therapies Q2-4	Condition	n/a	0.2	0.5	0.6	-0.021
Hospitalization with cardiac procedure Q1	Condition	n/a	0.2	0.1	0.0	0.009
Hospitalization with cardiac procedure Q2-4	Condition	n/a	0.1	0.2	0.1	0.010
Participation in OCM at enrollment	Condition	n/a	2.2	9.9	10.2	-0.010
Participation in ACO at enrollment	Balance	n/a	39.1	43.9	43.5	0.008
Hospitalization with lung-related procedure Q1	Condition	n/a	4.5	5.5	4.4	0.051
Hospitalization with lung-related procedure Q2-4	Condition	n/a	4.1	6.2	6.0	0.010
Automatic implantable cardioverter defibrillator Q1-4	Condition	n/a	0.5	0.4	0.6	-0.017
Coronary artery bypass surgery Q1-4	Condition	n/a	0.4	0.1	0.3	-0.037
Percutaneous intervention Q1-4	Condition	n/a	1.6	1.0	1.3	-0.027
Used the Medicare hospice benefit Q1	Balance	n/a	0.5	1.4	0.3	0.093
Used the Medicare hospice benefit Q2-4	Balance	n/a	1.1	1.6	0.7	0.068

Note: The fourth, fifth, and sixth columns present the intervention or comparison group mean for continuous variables or the percentage of beneficiaries for binary and categorical variables. The fourth column is based on 23,687,256 observations (copies) for 1,934,407 unique beneficiaries, with beneficiaries weighted equally.

[a] "Yes*" identifies variables used for matching all 6 qualifying condition groups. "Yes" identifies variables used for matching for 5 out of 6 qualifying condition groups (all except the HIV/AIDS group). "Condition" identifies variables used for matching at more than 1 but less than 5 qualifying condition groups. "Balance" identifies variables that were included in this table but not in the matching process.

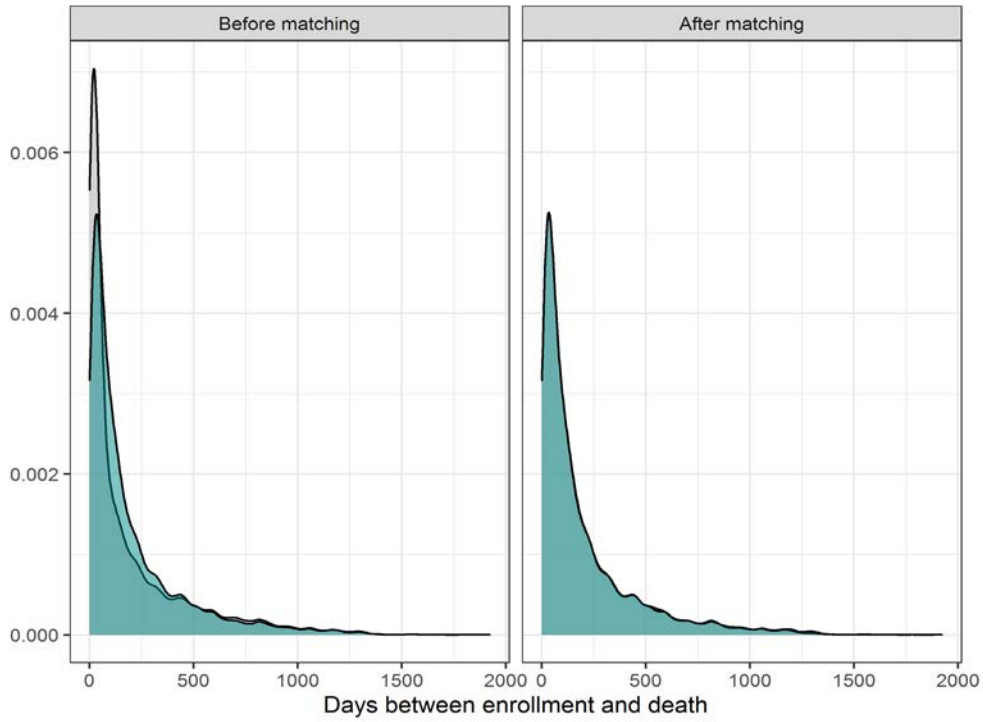
[b] Exact matching" identifies variables used as exact matching variables for all diagnosis groups, while "Exact matching*" identifies variables used as exact-matching variables in the HIV/AIDS qualifying condition group only. "Strict caliper" and "Penalized caliper" identify variables with strict and penalized calipers, respectively.

[c] In addition, we exactly matched on the qualifying condition groups described in Appendix Table C.4.

ACO = accountable care organization; ADL = activities of daily living; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; DME = durable medical equipment; ED = emergency department; ESRD = end-stage renal disease; HCC = hierarchical condition category; HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome; ICU = intensive care unit; IP = inpatient; MCCM = Medicare Care Choices Model; n/a = not applicable; OASI = Old-Age and Survivors Insurance; OASIS = Outcome and Assessment Information Set.; OCM = Oncology Care Model; PCP = primary care provider; Q1 = 1st quarter before enrollment or pseudo enrollment; Q2 = 2nd quarter before enrollment or pseudo enrollment; Q3 = 3rd quarter before enrollment or pseudo enrollment; Q4 = 4th quarter before enrollment or pseudo enrollment; SNF = skilled nursing facility.

The table, and other diagnostic analyses not presented here, show that the intervention and comparison groups are closely balanced for many of the matching variables and we generally met or exceeded our goal that differences for high-priority measures would be no larger than 0.10 standard deviations while differences for lower priority measures would be no larger than 0.25 standard deviations. It was especially important that the distribution of survival times—time between enrollment and death—for MCCM and comparison beneficiaries align closely. As Appendix Figure C.1 and Appendix Table C.6 show, we achieved that goal.

Figure C.1. Survival time kernel densities for deceased MCCM and comparison beneficiaries, before and after matching



Note: The figure shows survival time kernel densities for deceased MCCM enrollees in green and for comparison beneficiaries in gray. In the right panel (after inverse propensity weighting), the kernel densities for MCCM enrollees and comparison beneficiaries are almost identical.

MCCM = Medicare Care Choices Model.

Table C.6. The distribution of survival times for deceased MCCM and matched comparison beneficiaries, before and after matching

Variable	MCCM enrollees (N = 5,153)	Matched comparison group (N = 15,269)
Percentage of beneficiaries with survival times		
Between 1 and 7 days	3.2	3.1
Between 8 and 30 days	16.3	16.2
Between 31 and 90 days	26.3	26.5
Between 91 and 180 days	20.1	20.3
Between 181 and 365 days	17.2	17.3
More than 365 days	16.9	16.6
Distribution of survival times		
Minimum	1 day	1 day
10th percentile	17 days	17 days
25th percentile	40 days	40 days
50th percentile	105 days	104 days
75th percentile	254 days	252 days
90th percentile	519 days	515 days
Maximum	1,899 days	1,923 days

MCCM = Medicare Care Choices Model.

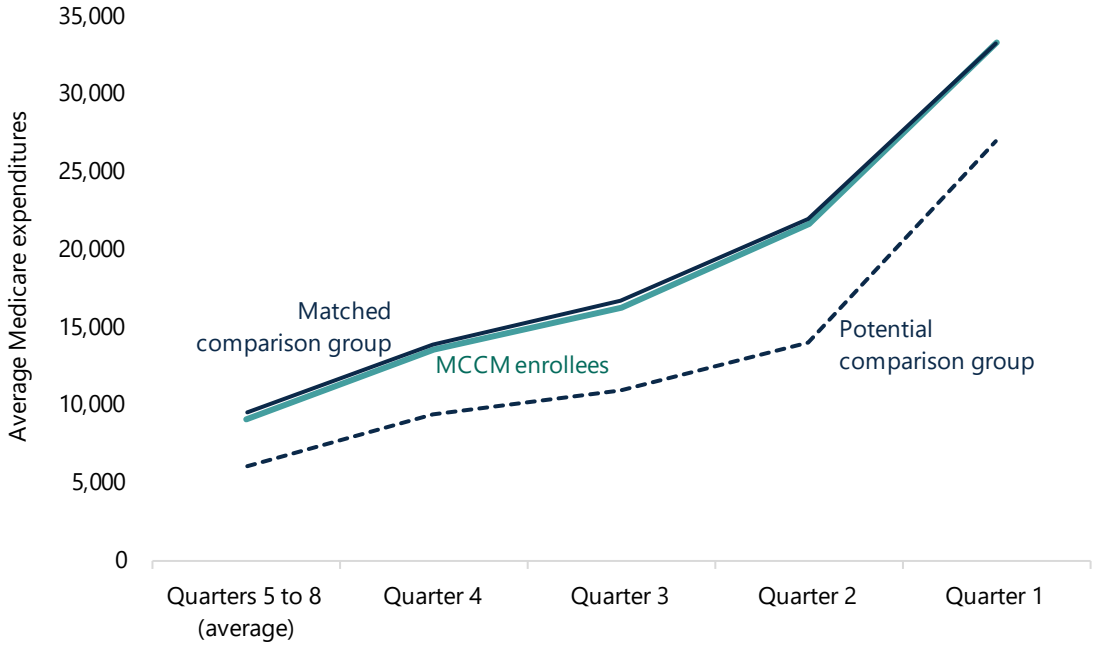
Notable findings include the following:

1. Because of the exact-matching constraints discussed earlier, the intervention and matched comparison groups had virtually the same percentage of beneficiaries with each of the four qualifying conditions (cancer, congestive heart failure, chronic obstructive pulmonary disease, and HIV/AIDS), the same percentage who are dually eligible for Medicare and Medicaid, and the same percentage enrolled on or after September 1, 2019 (those most likely affected by the COVID-19 pandemic).
2. Pseudo-enrollment dates for matched comparison beneficiaries were broadly the same as the enrollment dates for MCCM enrollees, with similar percentages of beneficiaries in each group enrolling per year.
3. At their pseudo-enrollment date, the matched comparison beneficiaries always resided in the market area of the hospice that enrolled the intervention beneficiary in MCCM. Because some MCCM hospices had market areas with more than one hospital referral region, 82 percent of the comparison beneficiaries lived in the same hospital referral region as the MCCM enrollee to whom they were matched.
4. The decedents approach was explicitly designed to produce a matched comparison group that closely resembled the intervention group in terms of the distribution of time from enrollment (or pseudo-enrollment) until death—that is, survival time. After matching beneficiaries on survival time (and other variables), MCCM enrollees and matched comparison beneficiaries had highly similar survival time distributions (Appendix Figure C.1 and Table C.6). On average, MCCM enrollees lived 198.8 days, compared to 196.5 days in the matched comparison group—a difference of only 0.009 standard deviations (Appendix Table C.5). In addition, there was little difference in the survival times *within each matched set*—that is, each MCCM enrollee and their matched comparison beneficiaries had similar survival times.
5. MCCM enrollees and matched comparison beneficiaries were similar in terms of demographics, with good balance on sex (50.5 versus 47.9 percent female), age (both groups age 77 on average), and race/ethnicity (86.4 versus 87.7 percent non-Hispanic White and 8.1 versus 8.0 percent Black).[111]
6. The two groups had similar numbers and distributions of chronic conditions. The average hierarchical condition category score at enrollment for MCCM beneficiaries was 5.6, compared to 5.4 for matched comparison beneficiaries—a difference of 0.06 standard deviations. The two groups also were well matched in the prevalence of many of the specific chronic conditions we examined, such as history of diabetes (33.7 versus 36.0 percent), stroke (9.3 versus 9.2 percent), acute myocardial infarction (11.6 versus 10.9 percent), and dementia (15.3 versus 12.7 percent).
7. Compared with the pool of potential comparison beneficiaries, MCCM enrollees had notably high Medicare expenditures and service use in the year before enrollment, and they had very high expenditures and service use in the quarter before enrollment. Through matching, we were able to identify comparison beneficiaries that also fit this pattern (Appendix Figure C.2). For instance, in the quarter immediately before the pseudo-enrollment date, matched comparison beneficiaries had $30,621 in Medicare expenditures and 1.03 inpatient admissions on average, similar to MCCM

[111] Although the average age of beneficiaries in the intervention and comparison groups is similar, the comparison group has fewer very old and very young beneficiaries and more beneficiaries in their late 70s and early 80s.

enrollees, who had $31,211 in Medicare expenditures and 1.08 inpatient admissions on average. The two groups also appeared similar on other expenditures and utilization measures and had similar rates of condition-specific medical encounters and procedures.

Figure C.2. Baseline trends in Medicare Part A and B expenditures, 1 to 8 quarters before enrollment, for MCCM and matched comparison beneficiaries, before and after matching



Note: The figure shows baseline trends in Medicare Part A and B expenditures for deceased MCCM enrollees in green and for comparison beneficiaries in blue. The blue solid line shows the comparison group after matching while the blue dashed line shows the unmatched comparison beneficiaries (potential comparison group) before matching.

MCCM = Medicare Care Choices Model.

4. Regression models for estimating impacts

In this section, we describe the regression models we used to estimate impacts. The regression models used a data set that combines data for the beneficiaries who enrolled in MCCM during the model period with data for the matched comparison beneficiaries. We included one observation per beneficiary because most beneficiaries remained alive a relatively short time before their deaths (MCCM enrollees lived 167.6 days, on average) and many outcomes are defined only on the beneficiary level (for example, whether a beneficiary died with more than one emergency department visit in the last 30 days of life). Therefore, it would not be very informative to estimate a longitudinal model that can distinguish between impacts in the first and second year of enrollment, and so on.

4.1. Primary impact analyses

Our main impact estimation regression model included observations from model years 2016 to 2021, pooling data from the two MCCM cohorts (that started in 2016 and 2018) and their matched comparison beneficiaries. The unit of observation was a beneficiary. Specifically, we compared outcomes

of beneficiaries enrolled in MCCM to those of matched comparison beneficiaries by estimating the following regression:

(1) $$y_i^1 = \alpha + MCCM_i\,\delta + Y_i^{0'}\gamma + X_{ir}^{'}\beta + \mu_r + \varepsilon_i$$

In this model, y_i^1 represents the outcome for beneficiary i in the intervention period—that is, measured after enrollment in MCCM for intervention group beneficiaries and after the pseudo-enrollment date for matched comparison group beneficiaries. $MCCM_i$ is an indicator variable that equals 1 for the beneficiaries enrolled in MCCM and 0 for beneficiaries in the matched comparison group. Y_i^0 is a vector of pre-intervention outcomes measured at baseline—that is, before the intervention. We cannot include all considered outcome variables in Y_i^0 because some outcomes are not defined at baseline (for example, outcomes related to health care use in the last 30 days of life), but we can include a vector of variables that capture pre-intervention Medicare expenditures and health care service use. X_{ir} is a set of independent beneficiary- or region-level covariates, which is a subset of the variables used to obtain the matched comparison group (Appendix Table C.7 shows the variables included in Y_i^0 and X_{ir}); μ_r is a hospice market area fixed effect; and ε_i is an error term that is independent of the included regressors and has the same distribution for all beneficiaries.[112]

Table C.7. Variables used for regression adjustment

Variables included as covariates in regression models
Demographics and eligibility
Age at (pseudo) enrollment
Age category (younger than 65, 65 to 74, 75 to 84, and 85 or older)
Sex
Dually eligible
Non-Hispanic White
Black
Other race
Old-Age and Survivors Insurance
Disability insurance benefits
End-stage renal disease
Both disability insurance benefits and end-stage renal disease
Rural zip code
Northeast
Midwest
South
West
Zip code demographics 1st principal component

[112] We combined hospice market areas for hospices that enrolled fewer than 25 beneficiaries into one residual market area category. This affected 44 hospices and about 10 percent of beneficiaries.

Variables included as covariates in regression models
Zip code demographics 2nd principal component
Zip code demographics 3rd principal component
Had two hospital encounters (inpatient stay, ED visit, or observation stay) in the 12 months before enrollment
Part D drug plan requirement
Had three office visits for with the same provider for the MCCM-qualifying terminal condition in the 12 months before enrollment
Participated in an ACO at the time of enrollment
Year of (pseudo) enrollment
Quarter of (pseudo) enrollment
Date of (pseudo) enrollment occurred more than 6 months before the start of the COVID-19 public health emergency (on or before August 31, 2019)
Time from (pseudo) enrollment to death[a]
Time from (pseudo) enrollment to death squared[a]
Time from (pseudo) enrollment to death cubed[a]
Indicator for which MCCM hospice enrolled the beneficiary
Health at (pseudo) enrollment
HCC: 1st principal component
HCC: 2nd principal component
HCC: 3rd principal component
HCC: 4th principal component
HCC: 5th principal component
HCC: 6th principal component
HCC: 7th principal component
HCC: 8th principal component
HCC Score at (pseudo) enrollment
HCC Score one year before (pseudo) enrollment
HCC: Ischemic or Unspecified Stroke
HCC: Kidney Disease
HCC: Diabetes with Acute or Chronic Complications
HCC: Hip Fracture/Dislocation
HCC: Artificial Openings for Feeding or Elimination
HCC: Dementia with or Without Complication
HCC: Multiple Sclerosis
HCC: Parkinson's and Huntington's Diseases
HCC: Coma, Brain Compression/Anoxic Damage
HCC: Respirator Dependence/Tracheostomy Status
HCC: Cardio-Respiratory Failure and Shock
HCC: Acute Myocardial Infarction
Had primary diagnosis of cancer
Had primary diagnosis of CHF
Had primary diagnosis of COPD
Had primary diagnosis of HIV/AIDS

Variables included as covariates in regression models
Breast cancer
Colorectal cancer
Lung cancer
Prostate cancer
Other cancer
Health care use at baseline: variables used in all regression models
Advance care planning visit in the two years before enrollment
Admitted to hospital on (pseudo-) enrollment date
Discharged from hospital on (pseudo-) enrollment date
Inpatient stay on (pseudo-) enrollment date
Number of days between enrollment or pseudo-enrollment date and most recent inpatient discharge (using admission date)
Length of stay for most recent baseline inpatient stay
Flag for no inpatient stays in baseline year
Discharged from SNF on (pseudo-) enrollment date
Total Medicare Part A and B expenditures in quarter 1 before (pseudo) enrollment
Total Medicare Part A and B expenditures in quarters 2 to 4 before (pseudo) enrollment
Number of inpatient admissions in quarter 1 before (pseudo) enrollment
Number of inpatient admissions in quarters 2 to 4 before (pseudo) enrollment
Number of outpatient ED visits and observation stays in quarter 1 before (pseudo) enrollment
Number of outpatient ED visits and observation stays in quarters 2 to 4 before (pseudo) enrollment
Diagnostic tests and procedures indicating advanced stage or poor prognosis cancer in quarter 1 before (pseudo) enrollment
Diagnostic tests and procedures indicating advanced stage or poor prognosis cancer in quarters 2 to 4 before (pseudo) enrollment
Diagnoses indicating advanced stage or poor prognosis cancer in quarter 1 before (pseudo) enrollment
Diagnoses indicating advanced stage or poor prognosis cancer in quarters 2 to 4 before (pseudo) enrollment
Drugs indicating advanced stage or poor prognosis cancer in quarter 1 before (pseudo) enrollment
Drugs indicating advanced stage or poor prognosis cancer in quarters 2 to 4 before (pseudo) enrollment
Flag for receipt of hormonal therapies in quarter 1 before (pseudo) enrollment
Flag for receipt of hormonal therapies in quarters 2 to 4 before (pseudo) enrollment
Hospitalization with lung volume reduction surgery, oxygen therapy, or ventilation in quarter 1 before (pseudo) enrollment
Hospitalization with lung volume reduction surgery, oxygen therapy, or ventilation in quarters 2 to 4 before (pseudo) enrollment
History of an automatic implantable cardioverter defibrillator in the 12 months before enrollment
History of artery bypass surgery in the 12 months before enrollment
History of percutaneous coronary intervention in the 12 months before enrollment
Health care use at baseline: variables used in outcome-specific regression models [b]
Inpatient expenditures in quarter 1 before (pseudo) enrollment
Inpatient expenditures in quarters 2 to 4 before (pseudo) enrollment
Drug expenditures in quarter 1 before (pseudo) enrollment

Variables included as covariates in regression models
Drug expenditures in quarters 2 to 4 before (pseudo) enrollment
SNF expenditures in quarter 1 before (pseudo) enrollment
SNF expenditures in quarters 2 to 4 before (pseudo) enrollment
Home health expenditures in quarter 1 before (pseudo) enrollment
Home health expenditures in quarters 2 to 4 before (pseudo) enrollment
DME expenditures in quarter 1 before (pseudo) enrollment
DME expenditures in quarters 2 to 4 before (pseudo) enrollment
Hospice expenditures in quarter 1 before (pseudo) enrollment
Hospice expenditures in quarters 2 to 4 before (pseudo) enrollment
Other expenditures in quarter 1 before (pseudo) enrollment[c]
Other expenditures in quarters 2 to 4 before (pseudo) enrollment[c]
Outpatient ED visits in quarter 1 before (pseudo) enrollment
Outpatient ED visits in quarters 2 to 4 before (pseudo) enrollment
Outpatient observation stays in quarter 1 before (pseudo) enrollment
Outpatient observation stays in quarters 2 to 4 before (pseudo) enrollment
Ambulatory visits with primary care providers in quarter 1 before (pseudo) enrollment
Ambulatory visits with primary care providers in quarters 2 to 4 before (pseudo) enrollment
Ambulatory visits with specialist physicians in quarter 1 before (pseudo) enrollment
Ambulatory visits with specialist physicians in quarters 2 to 4 before (pseudo) enrollment
Ambulatory visits with primary care providers and specialist physicians in quarter 1 before (pseudo) enrollment
Ambulatory visits with primary care providers and specialist physicians in quarters 2 to 4 before (pseudo) enrollment
Number of days in hospice in quarter 1 before (pseudo) enrollment
Number of days in hospice in quarters 2 to 4 before (pseudo) enrollment
Number of post-acute care days in quarter 1 before (pseudo) enrollment
Number of post-acute care days in quarters 2 to 4 before (pseudo) enrollment
Number of home health visits in quarter 1 before (pseudo) enrollment
Number of home health visits in quarters 2 to 4 before (pseudo) enrollment
Inpatient days in quarter 1 before (pseudo) enrollment
Inpatient days in quarters 2 to 4 before (pseudo) enrollment
Inpatient ICU days in quarter 1 before (pseudo) enrollment
Inpatient ICU days in quarters 2 to 4 before (pseudo) enrollment
Days in hospital without ICU in quarter 1 before (pseudo) enrollment
Days in hospital without ICU in quarters 2 to 4 before (pseudo) enrollment
EMS ambulance transports in quarter 1 before (pseudo) enrollment
EMS ambulance transports in quarters 2 to 4 before (pseudo) enrollment

[a] This is not used in hazard models.

[b] These variables were selectively included in regressions with the corresponding outcome. For example, when analyzing impacts on inpatient expenditures, we added to the regression models two variables with inpatient expenditures in (1) quarter 1 and (2) quarters 2 to 4 before (pseudo) enrollment.

[c] *Other expenditures* include outpatient emergency department visits, ambulatory care visits, and other clinically necessary services. For more details, see the definition in Appendix D.

ACO = accountable care organization; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; DME = durable medical equipment; ED = emergency department; EMS = emergency medical services; HCC = hierarchical condition category; HIV/AIDS = human immunodeficiency virus/acquired immunodeficiency syndrome; ICU = intensive care unit; SNF = skilled nursing facility.

The Greek letters (α, δ, γ, β, and μ_r) are the parameters we estimated. The key parameter of interest is δ, which represents the impact of the model. In a linear model, δ equals the difference in regression-adjusted mean outcomes between the intervention and comparison groups. The parameters γ and β represent the effects of baseline outcomes and covariates, respectively. These terms improve the precision of the impact estimates and net out effects of any observed residual differences in characteristics between the intervention and comparison groups that remain after matching. We note in particular that including baseline outcomes (Y_i^0) is important because any pre-intervention differences in health care use could be associated with health care use in the study period and thereby affect impact estimates if not accounted for.[113,114] Finally, we included a fixed effect for each hospice market area, which we defined to include a single hospice and all matched comparison beneficiaries. These fixed effects net out the effects of any characteristics shared within a hospice's market area, including characteristics of the health care system, care delivery patterns, local policies, and other factors.[115] Collectively, these terms improve the precision of the impact estimates by reducing the amount of unexplained variation in the outcome (ε_i).

We estimated the regression shown in Equation (1) using a model that corresponds to the distribution of the outcome variable. We used ordinary least squares to estimate the models described by Equation (1) for most outcomes, including Medicare Part A and B expenditures, service use, and other continuous outcomes.[116] We used similar regression models for binary outcomes (such as enrollment in the hospice benefit). For binary outcomes, we used a logistic regression model that is analogous to Equation (1). Then, we expressed impacts from these models as average marginal effects, so they are on the same scale as the outcome (that is, in percentage point impacts). For time-to-event outcomes, we used survival analysis techniques (details provided later in this section).

[113] By including baseline outcomes on the right-hand side of the regression in Equation (1), we implicitly assume unconfoundedness of MCCM enrollment conditional on the baseline outcomes. That is, when comparing intervention and matched comparison beneficiaries with the same pre-(pseudo-) enrollment outcomes, there are no unobserved beneficiary characteristics that correlate with MCCM enrollment: that is, there is no selection on unobserved variables conditional on baseline outcomes (Imbens and Wooldridge 2009).

[114] Note that in this model, the parameter γ governs regression to the mean whenever the vector of pre-intervention outcomes, Y_i^0 includes the pre-intervention outcome model corresponding to the outcome measure, y_i^1. We do not restrict the parameter γ to equal 1 and this is a not a difference-in-differences model; thus, we avoid some recently raised concerns about difference-in-differences models combined with beneficiary-level matching if there is regression to the mean (Daw and Hatfield 2018).

[115] Our model with hospice market area fixed effects is analogous to what we would do if instead this were a randomized controlled trial, stratified by hospice market area, with random assignment of beneficiaries within each market area to the intervention or comparison group.

[116] To obtain impacts on Medicare Part A and B expenditures plus MCCM payments per enrollee, we (1) estimated regression-adjusted impacts on Medicare Part A and B expenditures (without MCCM payments) and (2) added average (unadjusted) MCCM payments. We used seemingly unrelated estimation to combine the two estimates and obtain standard errors.

Appropriate standard errors and weighting. We assigned beneficiaries to the intervention or comparison group based on their enrollment on an individual level. That is, we did not assign entire hospice market areas to the intervention or comparison group. Therefore, it was not appropriate to calculate standard errors that account for clustering on hospice market areas or any other geographic-level regions (Abadie et al. 2023). Because we include only one observation per beneficiary, it was also not necessary to cluster standard errors on the beneficiary level. Instead, we calculated robust standard errors.

We followed beneficiaries after their enrollment (or pseudo enrollment) until they died. That is, we reported a single impact estimate rather than different impact estimates for different follow-up lengths ("in last X days of life"). Thus, the regression models produced the average impact *per beneficiary*, averaging across beneficiaries that have shorter and longer survival times. For example, impacts on Medicare expenditures can be interpreted as the average change in Medicare expenditures that result from enrolling one more beneficiary in MCCM. For the comparison group, we also employed matching weights to balance the intervention and comparison groups, to account for our matched comparison group design. (Weights equal 1 for intervention beneficiaries and equal $1/n$ for the comparison beneficiaries, where n equals the number of matched comparison beneficiaries matched to the beneficiary enrolled in MCCM. The sum of the weights across comparison group beneficiaries equaled the number of MCCM enrollees.)

4.2. Time-to-event analyses

We used survival analysis techniques to estimate impacts of MCCM on the length of time from enrollment to entering hospice. For this outcome, our analyses used data at the beneficiary level. We used two variables to describe each outcome: (1) a variable with the length of time (number of days) a beneficiary was in the sample and observed after the (pseudo-) enrollment date and (2) an indicator variable that equals 1 if the outcome occurred and 0 if the beneficiary's data were censored before the event occurred. Censoring occurs (1) for the hospice benefit when beneficiaries do not enter hospice before their death or (2) for death when beneficiaries are alive at the end of the study period (when applicable, depending on the study population).

We used hazard modeling to estimate impacts of enrollment in MCCM on the risk of having these events throughout the study period. Specifically, we used a Cox proportional hazard model. A hazard is the estimated probability of the event occurring at a certain time. Biostatistics and clinical trials frequently use Cox proportional hazard models to model impacts on event data. A major advantage of this model is that it uses data for all beneficiaries, including beneficiaries who enrolled in MCCM late during the study period (and their matched comparisons). For the hospice benefit outcome, this included beneficiaries who died before they could enroll in the hospice benefit. The Cox proportional hazards model is expressed as:

$$(2) \qquad h_i(t) = h_0(t) e^{\left(\alpha + m_r\delta + Y_i^{0'}\gamma + X_{ir}'\beta + \mu_r\right)},$$

where $h_i(t)$ is the hazard (that is, the estimated probability the event occurs at time t) for beneficiary i; $h_0(t)$ is a baseline hazard (which does not need to be known for us to estimate the other model

parameters); and the other variables are defined as in Equation (1). The Greek letters ($\delta, \gamma, \beta, \mu$) are parameters to be estimated. As in Equation (1), we included covariates (X_{ir}), baseline outcomes (Y_i^0), and hospice market area fixed effects (μ_r) to account for observed differences between the intervention and comparison groups at baseline and differences across hospice market areas.[117]

The coefficient δ captures the effect of MCCM on the outcome $\left(h_i(t)\right)$, adjusted for the remaining covariates in the model. We expressed δ as a hazard ratio for intervention versus comparison beneficiaries, along with its *p*-value and confidence interval. The hazard ratio is the ratio between the intervention and comparison groups in the risk of enrolling in the hospice benefit or dying at each time point throughout the study period, with values less than 1 indicating that risk is lower in the intervention group than the comparison group.

4.3. Accounting for differences due to impacts on hospice enrollment

One possible effect of the model is that it increases enrollment in the Medicare hospice benefit. Because beneficiaries receiving hospice benefits must forgo payment for treatments of their terminal conditions, Medicare expenditures (per day) and rates of service use might be lower after a beneficiary enrolls in hospice. By extension, MCCM's impacts on hospice use could have driven at least some of the model's overall impacts on Medicare expenditures and service use for beneficiaries in MCCM.[118]

To disentangle the impact of MCCM on expenditures and hospice use, we used a simple model in which beneficiaries can either be in hospice (h) or the community (c). Total expenditures from enrollment to death, y, are the weighted sum of expenditures for beneficiaries in hospice (y_h) and expenditures for beneficiaries in the community (y_c), where weights are the fractions of time from enrollment to death spent in hospice (f_h) and the community (f_c), respectively:

(3) $$y = y_h f_h + y_c f_c$$

In this model, the difference in expenditures between MCCM enrollees (indicated by 1) and comparison group beneficiaries (indicated by 0) is the difference:

(4) $$\Delta y = y_1 - y_0 = \left(y_{h1} f_{h1} + y_{c1} f_{c1}\right) - \left(y_{h0} f_{h0} + y_{c0} f_{c0}\right)$$

After some algebra to rearrange terms, we can write the difference in expenditures as:

(5) $$\Delta y = \underbrace{(y_{h0} - y_{c0})(f_{h1} - f_{h0})}_{A} + \underbrace{(y_{h1} - y_{h0}) f_{h0}}_{B} + \underbrace{(y_{c1} - y_{c0}) f_{c1}}_{C} + \underbrace{(y_{h1} - y_{h0})(f_{h1} - f_{h0})}_{D}$$

[117] We also estimated logistic regression models for the outcomes that equaled 1 if a beneficiary died within 30, 90, 180, and 365 days, respectively, after (pseudo) enrollment. These models yielded qualitatively similar results to the proportional hazard model.

[118] For simplicity, this section focuses on Medicare expenditures as the outcome of interest. We repeated the same analysis for other outcomes, including inpatient admissions and emergency department visits and observation stays.

The four terms in equation (5) show that the effect of MCCM on Medicare expenditures can be decomposed into the following:

A. The effect on expenditures that is the result of MCCM moving some beneficiaries from the community to hospice or prolonging the time that beneficiaries spend enrolled in the Medicare hospice benefit. The term $y_{h0} - y_{c0}$ is the difference in expenditures between hospice and the community that we see in the comparison group, and the term $f_{h1} - f_{h0}$ is the difference in the fraction of time in hospice between MCCM enrollees and beneficiaries in the comparison group.

B. The effect of MCCM on expenditures for beneficiaries in hospice.

C. The effect of MCCM on expenditures for beneficiaries in the community.

D. The interaction of effects (A) and (B). This term captures the effect of MCCM on expenditures for beneficiaries in hospice among the beneficiaries who moved from the community to hospice.

Equation (5) shows that the total impact of MCCM on expenditures (or other outcomes) operates through the expenditure difference between being in hospice and being in the community multiplied by the impact of MCCM on time spent in hospice $\left(\left(y_{h0} - y_{c0}\right)\left(f_{h1} - f_{h0}\right)\right)$ and the remainder $\left(\Delta y - \left(y_{h0} - y_{c0}\right)\left(f_{h1} - f_{h0}\right)\right)$.

To disentangle the total impact of MCCM on the key outcomes total Medicare expenditures, we separately measured expenditures (1) for the time from MCCM enrollment until enrollment in the Medicare hospice benefit and (2) for the time from hospice enrollment to death.[119] For beneficiaries who did not enroll in the Medicare hospice benefit, we set outcomes corresponding to the time from hospice enrollment until death to zero dollars. We also created a variable for the fraction of time after Medicare hospice enrollment relative to the total study period.[120]

We jointly estimated regressions for the following four outcomes: (1) the fraction of the study period spent in hospice, (2) the total outcome during the study period, (3) the outcome before enrollment in the Medicare hospice benefit, and (4) the outcome after hospice enrollment. Each regression was specified the same as in equation (1) and included Y_i^0, X_{ir}, and μ_r as covariates. We specified a general linear model with a log link function and a negative binomial distribution for outcome (1) and standard linear models for outcomes (2) to (4). By estimating these regressions jointly, we were able to obtain robust standard errors that account for dependencies between these outcomes.

We then obtained predicted outcomes corresponding to the terms in equation (5) that allowed us to construct the impact of MCCM that operated though hospice enrollment and the impact that was attributable to other factors. Specifically, we obtained the term $y_{h0} - y_{c0}$ by calculating the difference in predicted outcomes for the periods after and before hospice enrollment, respectively, for each

[119] A few beneficiaries in our sample enrolled and then disenrolled from the Medicare Hospice Benefit before their death. We excluded the 0.5 percent of beneficiaries from this analysis for whom more than 30 days passed between hospice disenrollment and death.

[120] For most beneficiaries, this variable equals the fraction of the study period spent in hospice. For some beneficiaries who disenrolled from the hospice benefit before their death, this variable can (slightly) overstate the fraction of the study period spent in hospice.

beneficiary in the comparison group. We calculated $f_{h1} - f_{h0}$ as the impact of MCCM on the fraction of the study period after enrollment in the hospice benefit. Finally, we obtained the impact of MCCM that did not operate through hospice (for each beneficiary) as the difference between the overall impact of MCCM on Medicare expenditures during the study period and $\left(y_{h0} - y_{c0}\right)\left(f_{h1} - f_{h0}\right)$. Finally, we took averages for each of these parameters, averaging across MCCM enrollees.

5. Subgroup analyses

5.1. Subgroups of interest

We conducted several subgroup analyses to provide insight into where, when, for whom, and in what context MCCM is most effective. Subgroup analyses focused on impacts on our primary outcome measures for the following groups:

1. Beneficiaries with different survival times: 1 to 30, 31 to 90, 91 to 180, 181 to 365, and more than 365 days (Chapter 7, Section 7.1)
2. Beneficiaries with each of the three most common qualifying conditions: cancer, congestive heart failure, and chronic obstructive pulmonary disease (Chapter 7, Section 7.2)[121]
3. Beneficiaries who lived in rural areas, compared to beneficiaries who lived in non-rural (that is, other) areas (Chapter 7, Section 7.3)
4. Beneficiaries who are non-Hispanic White beneficiaries, compared beneficiaries with another race or ethnicity (Chapter 7, Section 7.3)
5. Beneficiaries who were dually eligible for Medicaid, compared to non-dually eligible beneficiaries (Chapter 7, Section 7.3)
6. Beneficiaries at each participating hospice (Chapter 7, Section 7.4)
7. Beneficiaries enrolled January 1, 2016, to August 31, 2019 (the pre-COVID-19 cohort), and those enrolled September 1, 2019, to June 30, 2021 (the COVID-19 cohort), to provide an estimate of the models' effect before and during the COVID-19 pandemic (Appendix E, Section 5)
8. Beneficiaries enrolled by MCCM hospices that started participating in the model in 2016 (Cohort 1) versus 2018 (Cohort 2) because there were some differences in model implementation between the two cohorts (Appendix E, Section 5)
9. Beneficiaries enrolled by the top five enrolling hospices, compared to all other hospices (Appendix E, Section 5)

5.2. Bayesian hierarchical modeling for subgroup analysis

Low levels of participation in MCCM make it difficult to detect either impacts for the subgroups themselves or differences in impacts between a subgroup and other enrollees. For example, non-White or Hispanic, dually eligible, and rural beneficiaries represent 12 to 14 percent of model enrollees in our impact analysis, with correspondingly large minimal detectable effects for the primary outcomes of interest in this evaluation. To mitigate this concern, we estimated subgroup effects in a hierarchical

[121] Our model for estimating impacts included the 20 beneficiaries with HIV/AIDS, but we did not report results separately for beneficiaries with HIV/AIDS due to the small sample sizes.

Bayesian modeling framework, which increases the precision and plausibility of the impact estimates. Mathematica has used Bayesian hierarchical models to estimate subgroup-specific impacts for several previous CMS evaluations, including the evaluations of the Comprehensive Primary Care initiative, Comprehensive Primary Care Plus, and the Transforming Clinical Practice Initiative. However, this evaluation is the first time we have used these methods with beneficiary-level analytic data files for a CMS evaluation. This approach offers two key advantages over a more traditional (frequentist) subgroup analysis.

1. **Increase efficiency (statistical power).** A Bayesian model makes these gains possible by incorporating structured assumptions—for example, about how subgroup impacts relate to the overall MCCM impact—that enhance both the precision and the plausibility of the impact estimates. These assumptions enable the Bayesian model to increase the precision and plausibility of impact estimates for small subgroups that might otherwise produce extreme, highly uncertain estimates (Vollmer et al. 2020). For example, although comparatively few rural beneficiaries enrolled in MCCM, we can obtain a stronger estimate of the model's effect on these beneficiaries by placing the impact for rural beneficiaries in the context of the overall impact. To the extent that the impact for rural beneficiaries appears to be extreme compared with the overall impact, the model moderates the estimate, thereby increasing its precision. These precision gains are especially important for evaluating MCCM, in which overall enrollment is moderate and some subgroups of interest are quite small.
2. **Guard against spurious findings.** A Bayesian approach guards against spurious findings due to multiple comparisons by fitting a single, unified model that estimates impacts for all subgroups simultaneously. In this context, the Bayesian model's natural penalty on model complexity reduces the likelihood of observing extreme impact estimates for small subgroups by chance alone, obviating the need for post hoc corrections (Gelman et al. 2012).

The regression equation for this unified Bayesian model builds on the main frequentist regression equation:

(6) $$y_i^1 = \alpha_{g[i]} + m_i \ \delta_{g[i]} + X_{ir}^{'}\beta + \varepsilon_i, \quad \varepsilon_i \sim N\left(0, \sigma^2\right)$$

In Equation (6), we introduce the subscript $g[i]$, which refers to the subgroup g to which beneficiary i belongs. Rather than estimating an overall intercept a, model effect δ, and relationship with pre-intervention outcomes γ, we now estimate subgroup-specific intercepts $a_{g[i]}$ and model effects $\delta_{g[i]}$. These terms include components that enable us to account for the effects of membership in individual subgroup variables as well as the interaction among different subgroup variables. For example, we decompose $\alpha_{g[i]}$ as follows:

(7) $$\alpha_{g[i]} = \alpha_0 + \alpha_{c[i]}^{Diagnosis} + \alpha_{d[i]}^{Dual} + \ldots + \alpha_{g[i]}^{Residual}$$

In Equation (7), the first term, α_0, represents an overall intercept. The terms between the overall intercept and the ellipses represent the main effects of individual subgroup variables, such as diagnosis

category and dual eligibility for Medicare and Medicaid.[122] Finally, the $\alpha_{g[i]}^{Residual}$ term represents the interaction of all the subgroup variables—for example, the effect of having both a cancer diagnosis and being dually eligible. The $\delta_{g[i]}$ terms subsume analogous components. Because the Bayesian statistical framework increases precision and plausibility for small subgroups, in this model we included finer-grained subgroup definitions than those reported elsewhere. For example, the Bayesian model included the 20 beneficiaries with a qualifying diagnosis of HIV/AIDS and categorized beneficiaries' ethnicity as non-Hispanic White, Black, or other, rather than simply non-Hispanic White or non-White and Hispanic. (We do not report estimates for enrollees with HIV/AIDS in this report, however, because the statistical precision is very poor.) The model included the following subgroups as components:

- Survival time category: 1 to 30 days, 31 to 90 days, 91 to 180 days, 181 to 365 days, or more than 365 days
- Race and ethnicity: non-Hispanic White, Black, or other
- Dual eligibility: dually eligible for Medicaid or non-dually eligible
- Rural status: rural versus other (that is, non-rural)
- Diagnosis group: cancer only, cancer and either congestive heart failure or chronic obstructive pulmonary disease, HIV/AIDS, congestive heart failure only, congestive heart failure only, congestive heart failure and congestive heart failure
- MCCM model cohort of the hospice: cohort one (2016 start date) or cohort two (2018 start date)
- COVID-19 cohort: before COVID-19 pandemic or during COVID-19 pandemic (see definition above);
- Year of enrollment: 2016, 2017, 2018, 2019, 2020, or 2021
- Hospice of the intervention beneficiary (up to 79 unique hospices)

The inclusion of hospice as one of the subgroup components in the model allows us both to account for regional effects associated with a hospice's market area and to estimate hospice-specific model impacts. These were reported as subgroup impact estimates and used as inputs for the synthesis analysis (see Appendix F).

Otherwise, the Bayesian regression models follow the conventions used in the frequentist models, including the set of covariates X_i used for regression adjustment (see Table C.7 for the complete list). We use linear models for continuous outcomes, such as Medicare expenditures; logistic regression models for binary outcomes, such as whether the beneficiary entered hospice; and a negative binomial model with survival time as the offset for the days at home outcome. As in the frequentist models, we

[122] Unlike in a traditional regression, in which we would model only the nonreference levels of the main effects, in the Bayesian model we include effects for all levels of these subgroup variables and impose constraints to ensure model identifiability. For example, dual eligibility status has two categories: eligible or not eligible. We therefore estimate two parameters, α_{Yes}^{Dual} and α_{No}^{Dual}, with the following prior distribution and constraints: $\alpha_{Yes}^{Dual}, \alpha_{No}^{Dual} \sim N\left(0, \sigma_{\alpha_{Dual}}^2\right)$, $\alpha_{Yes}^{Dual} + \alpha_{No}^{Dual} = 0$. We place a standard weakly informative prior on the top-level variance parameters: $\sigma_\alpha, \sigma_\delta \sim N^+(0,1)$.

weight each observation using the weights w_i, which reflect matching weights for matched comparison beneficiaries. For more detail on the weighting approach, see Appendix C, Section 4.1.

The target of inference in a Bayesian model is the posterior distribution of each parameter, which describes the range of values each parameter is most likely to inhabit, based on the data used to fit the model and prior assumptions that describe the relationships among the parameters. Estimating the full posterior distribution for each model parameter—for example, for MCCM's impact in each subgroup—makes it possible to describe conclusions probabilistically. For example, we can use the posterior distribution to determine the probability that the impact for a subgroup meets policy-relevant thresholds, such as the probability that MCCM reduced Medicare expenditures. We can also compare posterior distributions for different model parameters to obtain probability statements about differences in impacts, such as the probability that MCCM reduced expenditures more for beneficiaries with a qualifying diagnosis of cancer than for beneficiaries with other qualifying diagnoses.

Prior assumptions. As noted before, the advantage of the Bayesian model lies in its ability to incorporate structured assumptions about the relationships among observations in the data. These assumptions take the form of probability distributions for model parameters, called prior distributions. We introduce prior distributions that make weak regularizing assumptions but do not impose any assumptions about the magnitude or direction of expected model effects. Such weakly informative priors are the current best practice in the Bayesian literature (Stan Development Team 2020). Importantly, we will center the prior on δ_0, which represents the overall effect of MCCM, at zero, indicating our a priori agnosticism about the model's impacts; this prior implies that, in the absence of evidence to the contrary, the model assumes MCCM has no effect. This prior reflects the current guidance in the literature, but scholarly interest is growing in developing evidence-based prior distributions that incorporate information about the effectiveness of previous, similar interventions.

5.3. Frequentist regression modeling for subgroup analyses

We also used a frequentist approach as a robustness check for the Bayesian analyses. The frequentist subgroup analysis was similar to our main analysis, but it included interaction terms for subgroup identifiers. We describe those models in more detail in this section.

The way we conducted matching (described earlier in this appendix) has important implications for how we conducted subgroup analyses. We exact-matched on primary MCCM diagnosis, dual eligibility status, and COVID-19 cohort, so all matched sets have the same values for these covariates. We assigned comparison beneficiaries to the same survival time category as their matched MCCM enrollee. Because comparison beneficiaries never enrolled in the model, we assigned them to the same hospice as their matched MCCM enrollee, and therefore all matched sets have the same values for (1) hospice cohort and (2) top five enrolling hospices flag. For other subgroup identifiers, there were sometimes differences between the subgroup of MCCM enrollee and one or more matched comparison beneficiaries. For rural status, we dropped comparison beneficiaries who belonged to a different subgroup than their matched MCCM enrollee. For example, if an MCCM enrollee lived in a rural area and was matched to two comparison beneficiaries in a rural area and one MCCM enrolled beneficiary in a non-rural area, we dropped the matched comparison beneficiary from the non-rural area and changed the weights for the two remaining matched comparisons from 1/3 to 1/2. There were still many

matched comparison beneficiaries, and we retained good balance even in these subgroups. For race and ethnicity subgroups, we did not drop comparison beneficiaries who were in a different race or ethnicity subgroup than their matched MCCM enrollee because there were more discordant matched pairs (than for rural area and pre-COVID-19 subgroup analyses). Therefore, the race and ethnicity subgroup analyses included complete matched sets.

We used regression models to (1) estimate impacts for each subgroup of MCCM enrollees and (2) implement statistical tests for different estimated impacts between subgroups. The exact method varied across subgroup analyses described in Section 5.1:

- For subgroup analysis 1 (beneficiaries with different survival times), we chose to interact the intervention group indicator with the subgroup indicator and other key covariates, including age, gender, race/ethnicity, living in a rural area, dual-eligibility status, hierarchical condition category score, MCCM qualifying diagnosis, Medicare Part A and B expenditures in the baseline year, inpatient hospitalizations in the baseline year, and emergency department visits and observation stays in the baseline year. We did not have sufficient degrees of freedom to estimate a fully interacted model.
- For subgroup analysis 2 (beneficiaries with cancer, congestive heart failure, and chronic obstructive pulmonary disease), we used a hybrid approach because the subgroups were not mutually exclusive categories: some of the beneficiaries were assigned to two or even three of the subgroups. First, we obtained impact estimates by estimating separate regression models for the three qualifying condition groups (analogous to a fully interacted model). Second, we tested for differences in impacts between subgroups using a pooled regression model with interactions between qualifying condition indicators variables and the intervention group indicator variable.
- For subgroup analyses 3, 4, 5, and 7 (beneficiaries who lived in rural area, compared with beneficiaries who lived in non-rural areas; beneficiaries who are non-White or Hispanic, compared with non-Hispanic White beneficiaries; beneficiaries who were dually eligible for Medicaid, compared with non-dually eligible beneficiaries; and beneficiaries enrolled before versus during the COVID-19 pandemic), we included an interaction term in the regression for the subgroup and intervention group indicator variables. We believe that the COVID-19 period changed many of the associations between health care outcomes and beneficiary covariates, and we would have preferred to estimate a fully interacted model (that is, interact the COVID-19 period indicator with all covariates, not just the intervention indicator). However, we did not have sufficient degrees of freedom to do this, because the subgroup that enrolled during the COVID-19 period was relatively small. Therefore, we only interacted the subgroup indicator with the intervention group indicator.
- For subgroup analyses 8 and 9 (beneficiaries enrolled with the 2016 and 2018 hospice cohorts and beneficiaries enrolled with one of the top five enrolling hospices versus those in other MCCM hospices), we fully interacted all variables in the model (see Equation 1) with the subgroup identifier. This was possible because the subgroups were relatively evenly split (closer to 50 percent in each category).

We did not use frequentist regression models as a robustness check for subgroup analysis 6 (beneficiaries at each participating hospice). The hospice-specific impact estimates were obtained solely using Bayesian methods (described in Section 5.2).

6. Comparing outcomes between MCCM enrollees and beneficiaries who directly entered hospice

For supplemental analyses, presented in Chapter 6, Section 6.7, we compared outcomes between MCCM enrollees and beneficiaries who directly entered hospice on their enrollment date. Because MCCM is an alternative to the Medicare hospice benefit, we decided with CMS that it was worthwhile to directly compare beneficiary outcomes for beneficiaries who enroll in MCCM to outcomes for beneficiaries who enroll directly in hospice—that is, explicitly compare the MCCM and hospice options. This alternative comparison group provided a new and different reference point for understanding the experience of MCCM enrollees, supplementing the main impact analysis approach. Based on results in Section IV.C of our fourth annual report (Kranker et al. 2022), we hypothesized comparison beneficiaries who enroll directly into hospice will have lower Medicare expenditures and less acute care utilization than MCCM enrollees; this analysis was designed to estimate *how much* lower. We also suspected this new analysis could be less affected by unobserved selection bias than our main analysis because (1) MCCM enrollees and beneficiaries who chose hospice may have shared more unobserved characteristics (preferences for end-of-life care, for example) with the enrolled group and (2) both groups were known to have a prognosis of less than six months to live as of their enrollment or enrollment date.

To conduct this analysis, we constructed a separate comparison group that consists of beneficiaries who did not enroll in MCCM but did enter hospice. This section describes the procedure for selecting this comparison group, followed by statistics on the balance between MCCM enrollees and the matched comparison group. Two key differences between the methods used to select the comparison group of beneficiaries who directly entered hospice and the methods we previously used to select the comparison group for our primary impact analysis are (1) we restricted the comparison beneficiary pool to a single version of each potentially comparison beneficiary with a pseudo enrollment date set to the start of their first hospice spell and (2) we used inverse probability weights instead of `GroupMatch`. These methods are described in detail in the remainder of this section.

6.1. Identifying intervention and potential comparison beneficiaries

For this analysis, the intervention group included the same 5,153 beneficiaries that we included in our main impact analyses. We describe this group in Appendix C, Section 2.2. We identified potential comparison beneficiaries who (1) entered hospice before death, (2) were not enrolled in or referred to MCCM, and (3) met the same inclusion and exclusion criteria we applied to our main impact analysis' potential comparison group (described in Appendix C, Section 2.4). For these potential comparison beneficiaries, we created a single enrollment date equal to the first date they entered hospice between January 1, 2016, and June 30, 2021.[123] Thus, we included every potential comparison beneficiary in our analytic file once. Finally, we assessed whether the beneficiary met our inclusion criteria on their enrollment date (that is, the date they entered hospice), keeping the beneficiaries only when the enrollment date fell between January 1, 2016, and June 30, 2021, the beneficiary died on or before

[123] The enrollment dates for comparison beneficiaries who enrolled directly into hospice were used in ways that are analogous to the pseudo-enrollment dates we assigned to potential comparison group beneficiaries in our main impact analysis (see Sections 2.4, 2.5, and 2.6).

December 31, 2021, and the beneficiary met the inclusion criteria, specified above, on the enrollment date.

These steps led to a pool of 793,418 potential comparison beneficiaries who entered hospice during our study period. From the potential comparison pool, we excluded (1) 129,366 beneficiaries who resided in a market area without any MCCM enrollees with the corresponding qualifying condition group, (2) 2,905 beneficiaries who were either admitted into or discharged from a skilled nursing facility on the date they entered hospice and no corresponding MCCM enrollees within the diagnosis group did the same, and (3) 107,363 beneficiaries who entered hospice before any hospices in their market area enrolled someone in MCCM. Applying these restrictions resulted in a final potential comparison pool of 553,784 potential comparison beneficiaries (Appendix Table C.8).

We then constructed the same matching and outcome variables from main analysis (see Appendix C, Sections 2.5 and 2.6) based on each beneficiary's enrollment date (that is, the date they entered). The matching variables included demographic and Medicare enrollment characteristics, measures of prior health care use, health at enrollment, and disease-specific measures.

Table C.8. Number of MCCM enrollees and non-MCCM hospice enrollees (potential comparison beneficiaries), overall and by qualifying condition group

Qualifying condition group	MCCM Enrollees	Potential comparison beneficiaries who entered hospice	Ratio
Cancer Only	2,263	218,822	1:97
Cancer with COPD or CHF	1,421	133,442	1:94
HIV/AIDS	20	611	1:31
CHF Only	632	108,737	1:172
COPD Only	310	40,265	1:130
COPD and CHF	507	51,907	1:102
Total	**5,153**	**553,784**	**1:107**

Note: See Table C.4 for additional details about the qualifying condition groupings.

CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; MCCM = Medicare Care Choices Model.

6.2. Identifying the matched comparison beneficiaries

Our methods for identifying the matched comparison beneficiaries who enrolled directly in hospice differed from the from the matching procedure for the primary impact analysis (see Section 3) because our potential comparison pool had one observation per beneficiary rather than multiple copies (multiple enrollment dates) per beneficiary. Thus, we could use more conventional matching and reweighting strategies, rather than relying on the `GroupMatch` algorithm specially developed for situations with rolling enrollment.[124]

Inverse propensity weighting. We found that the inverse propensity weighting method resulted in a comparison group with better overall balance than optimal matching and determined that inverse

[124] `GroupMatch` simultaneously identifies the optimal comparison beneficiaries and the optimal enrollment dates for comparison beneficiaries. The `GroupMatch` algorithm was unnecessary since the enrollment dates are fixed for the potential comparison beneficiaries in the hospice-specific sample,

propensity weighting had adequate statistical power.[125] Thus we used inverse propensity weighting for constructing the comparison group. The remainder of this section describes our approach to implementing inverse propensity weighting and the results.

Propensity scores. We generated propensity scores for each MCCM and hospice-specific comparison beneficiary using a procedure similar to that used for the primary analytic sample. Specifically, we fit separate logistic regression models for each of six groups defined by the beneficiaries' primary diagnosis (see Table C.4 for a description of the six groups). The propensity score models included the same variables as the corresponding models that used the primary sample of potential comparison beneficiaries. (As noted above, we included different matching variables for each of the six qualifying condition groups.) However, we had to add several important matching variables to the propensity score models. These were variables that we had, in the `GroupMatch` and optimal matching approaches, included in our matching constraints (exact matching, strict calipers, or penalized calipers) rather than in the propensity score models. Because matching constraints were unavailable in the inverse propensity weighting approach, we had to include these matching variables in the propensity score models to promote balance on them. We included the following additional terms in the inverse propensity weighting propensity score models: (1) survival time (modeled as a linear spline on the log scale with knots at 30, 90, 180, and 365 days), (2) flags for each market area group (to promote geographic balance), (3) flags for being in each of the 10 largest hospital referral regions, and (4) enrollment year interacted with the earliest hospice cohort (cohort 1 or 2) observed among intervention beneficiaries in the market area group.[126,127] After fitting the six propensity score models, we produced propensity score estimates for each MCCM enrollee and comparison beneficiary in the sample.

Inverse propensity weights and trimming. All MCCM enrollees were assigned a weight of 1, regardless of their propensity score. To generate weights for comparison beneficiaries, first we assigned them each an unnormalized weight equal to $\hat{p}_i / (1 - \hat{p}_i)$, where $\hat{p}_i$ is the estimated propensity score for observation i. These are known as average treatment effect on the treated weights (Austin and Stuart 2015).

We then implemented three modifications to the comparison beneficiaries' weights:

[125] The inverse propensity weighting approach can be seen as a more flexible approach because it does not limit the weights of comparison observations to be 0, 1, 1/2, or 1/3, as was the case for optimal matching. The main issue with optimal matching seemed to be that we had an insufficient number of or dissimilar comparison observations within particular subgroups (such as among beneficiaries with long survival times within particular qualifying condition groups). We attempted optimal matching (Hansen 2004; Hansen and Klopfer 2006), which is similar to the `GroupMatch` procedure used for matching the primary comparison group except that we considered only one enrollment date for each comparison beneficiary, but we did could not achieve sufficient balance.

[126] As described in Appendix C, Sections 2.3 and 3.1, we defined the hospital referral regions that made up the market area for each hospice. Then, we grouped the market areas into overlapping market groups based on whether more than one hospice shared a hospital referral region.

[127] Flags for the 10 hospital referral regions with the highest MCCM enrollment promotes balance on the percentage of beneficiaries residing in each hospital referral region. Specifically, we create balance for large hospital referral regions through the propensity score model, and then the remaining hospital referral regions have balance within a few percentage points. We could not include these flags for the HIV/AIDS diagnosis group, which has few MCCM enrollees.

1. We normalized all weights within each of the six qualifying condition groups so that the total weight assigned to comparison beneficiaries was equal to the number of MCCM enrollees. This keeps the proportion of *comparison* beneficiaries in each qualifying condition group equal to the proportion of *intervention* beneficiaries in the respective qualifying condition group.
2. We trimmed weights so that no comparison observation received a weight more than 100 times larger than the average weight among comparison beneficiaries in each qualifying condition group. This keeps specific comparison beneficiaries from receiving outsized weights, and hence prevents any single beneficiary from having an undue influence on our analyses.[128]
3. We set weights to zero for any beneficiaries with weight less than 10 percent of the average comparison beneficiary weight within the qualifying condition group. That is, we effectively removed comparison beneficiaries from the sample who would have otherwise received weights very close to zero—that is, would have had a negligible effect on the analysis.

Since trimming the weights (steps 2 and 3) could result in the total comparison weight no longer equaling the number of enrollees (step 1), we iterated repeatedly through steps 1, 2, and 3 until we achieved stable weights. All beneficiaries with a weight of zero were removed from the final analytic sample, which has the benefit of reducing the size of the analytic sample for subsequent analyses.

6.3. Results of propensity score weighting

We successfully estimated propensity scores and unnormalized weights for all 553,784 comparison beneficiaries in the sample. After trimming and normalizing the weights, 374,616 of the comparison beneficiaries (68 percent) were assigned a weight of 0 and removed from the analysis, leaving an analysis sample of 5,153 MCCM enrollees and 179,168 comparison beneficiaries who enrolled directly in hospice on their pseudo-enrollment date (Appendix Table C.9). Because there were many comparison observations for each MCCM enrollee, the mean weight is 0.029, and 99.8 percent of the comparison beneficiaries had a weight less than one. A very small number of comparisons received weights larger than one, with a maximum of 1.94. We believe this weight distribution, combined with the overall sample sizes, will have adequate statistical power for our planned analyses.

Table C.9. Distribution of inverse propensity weights by qualifying condition group

Qualifying condition group	Non-MCCM beneficiaries who entered hospice	Number (percent) with zero weight	Final analytic sample	Sum of weights[a]	Mean of weights	Standard deviation of weights
Cancer Only	218,822	140,522 (64%)	78,300	2,263	0.032	0.094
Cancer with COPD or CHF	133,442	88,746 (67%)	44,696	1,421	0.029	0.087
HIV/AIDS	611	529 (87%)	82	20	0.022	0.071
CHF Only	108,737	79,581 (73%)	29,156	632	0.031	0.095
COPD Only	40,265	29,760 (74%)	10,505	310	0.030	0.096
COPD and CHF	51,907	35,478 (68%)	16,429	507	0.244	0.460
Total	**553,784**	**374,616 (68%)**	**179,168**	**5,153**	**0.029**	**0.088**

[128] We tried a range of cutoffs for trimming the weights and picked the smallest cutoff that yielded acceptable balance. The ratio of 100:1 between the maximum weight and the average weights resulted in noticeably better balance than, for example, using a cutoff of 50:1.

[a] By design, weights in the comparison group sum to the number of MCCM enrollees within each diagnosis group (in Table 1). Therefore, the mean weight is the number in the intervention group divided by the final number in the analytic sample.

CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease.

Table C.10 presents descriptive statistics for each of the baseline characteristics (matching variables) for MCCM enrollees, the original (unweighted) potential comparison group, and the final (weighted) comparison group of beneficiaries who enrolled directly into hospice. The standardized difference column in the table is the difference in means between the MCCM and weighted comparison group, expressed in standard deviation units. Table C.10 indicates that the intervention and comparison groups are closely balanced for all the matching variables. We exceeded our goal that differences for high-priority measures would be no larger than 0.10 standard deviations while differences for lower priority measures would be no larger than 0.25 standard deviations. In fact, *all* variables included in the propensity score models were matched within the stricter threshold of 0.10 standard deviations. We also prioritized a strong match on the distribution of survival times (time between enrollment and death), and we achieved good balance on this variable. Mean survival time for the intervention group was 198.8 days, mean survival time was 187.2 days for the matched comparison group, and the standardized difference was 0.048. The two groups also had very similar distributions of survival time as shown in Figure C.3.

Table C.10. Matching variables and characteristics of MCCM enrollees and non-MCCM hospice enrollees, before and after weighting

Variable	Used in propensity score models[a]	MCCM participants (N = 5,153)	Non-MCCM beneficiaries who entered hospice		Standardized difference
			Unweighted (N = 553,784)	Weighted (raw N =179,168; weighted N = 5,153)	
COVID-19 cohort	Yes*	29.0	37.3	29.6	-0.014
Dual eligibility	Yes*	11.4	15.7	11.6	-0.007
Primary diagnosis cancer	Yes*	71.8	63.7	71.8	0.000
Primary diagnosis CHF	Yes*	38.0	43.2	37.9	0.002
Primary diagnosis COPD	Yes*	33.4	31.4	33.4	0.000
Primary diagnosis HIV/AIDS	Yes*	0.4	0.1	0.4	0.000
Indicator for rural zip code	Yes*	13.3	22.8	12.5	0.023
Medicare A/B as primary payer in previous 2 years	Yes*	95.8	96.9	95.7	0.006
Age	Yes*	77.3	79.9	77.4	-0.014
Age less than 65	Yes*	6.7	5.3	6.6	0.003
Age 65–80	Yes*	51.7	41.0	51.1	0.013
Age 80 or older	Yes*	41.5	53.7	42.3	-0.015
Medicare entitlement: OASI	Yes	81.6	83.1	81.9	-0.008
Medicare entitlement: disability	Yes	17.6	16.3	17.4	0.006
Medicare entitlement: ESRD	Yes	0.6	0.4	0.5	0.013
Medicare entitlement: disability/ESRD	Yes	0.2	0.3	0.2	-0.003

Variable	Used in propensity score models[a]	MCCM participants (N = 5,153)	Non-MCCM beneficiaries who entered hospice		Standardized difference
			Unweighted (N = 553,784)	Weighted (raw N =179,168; weighted N = 5,153)	
Male	Yes*	49.5	48.9	49.1	0.008
Female	Yes*	50.5	51.1	50.9	-0.008
Northeast region	Yes	18.6	19.7	20.1	-0.040
Midwest region	Yes	19.6	29.8	20.0	-0.011
South region	Yes	40.2	41.2	40.1	0.002
West region	Yes	21.6	9.3	19.7	0.046
Days in COVID-19 period	Yes*	77.1	121.8	81.2	-0.026
Encounters for cancer Q2-4	Condition	12.4	8.2	12.5	-0.004
Encounters for cancer Q1	Condition	7.1	4.6	7.1	-0.006
Encounters for CHF Q2-4	Condition	3.3	2.5	3.2	0.015
Encounters for CHF Q1	Condition	2.1	1.9	2.0	0.013
Encounters for COPD Q2-4	Condition	3.5	2.4	3.5	-0.001
Encounters for COPD Q1	Condition	2.0	1.6	1.9	0.014
Encounters for HIV/AIDS Q2-4	Condition	0.0	0.0	0.0	0.003
Encounters for HIV/AIDS Q1	Condition	0.0	0.0	0.0	-0.008
HCC score at enrollment	Yes*	5.6	5.7	5.5	0.016
HCC score one year before enrollment	Yes	3.1	2.7	3.1	0.015
HCC: Ischemic or unspecified stroke	Yes	9.3	12.2	9.3	0.000
HCC: Dialysis status	Yes	5.5	4.5	5.0	0.021
HCC: Kidney disease	Yes	48.9	56.4	48.7	0.005
HCC: Diabetes with acute/chronic complications	Yes	33.7	33.9	33.3	0.008
HCC: Dementia with or without complications	Yes	15.3	28.1	15.8	-0.014
HCC: Coma	Yes	6.4	6.8	6.4	-0.001
HCC: Cardio-respiratory failure	Yes	36.8	40.6	35.8	0.019
HCC: Acute myocardial infarction	Yes	11.6	14.5	11.2	0.014
Days from most recent IP discharge and enrollment	Yes	69.5	38.5	73.5	-0.050
Inpatient stay on enrollment date	Yes	0.4	0.3	0.4	0.003
Medicare Part A and B expenditures Q1	Yes	31,211	36,542	31,107	0.004
Medicare Part A and B expenditures Q2	Yes	20,493	15,251	19,264	0.046
Medicare Part A and B expenditures Q3	Yes	15,328	11,044	14,759	0.026
Medicare Part A and B expenditures Q4	Yes	12,981	9,315	12,336	0.032

Variable	Used in propensity score models[a]	MCCM participants (N = 5,153)	Non-MCCM beneficiaries who entered hospice		Standardized difference
			Unweighted (N = 553,784)	Weighted (raw N =179,168; weighted N = 5,153)	
Primary diagnosis breast cancer	Condition	8.8	6.6	8.6	0.005
Primary diagnosis colorectal cancer	Condition	7.9	7.2	8.0	-0.004
Primary diagnosis lung cancer	Condition	24.3	18.9	24.5	-0.006
Primary diagnosis other cancer	Condition	62.7	52.0	62.6	0.002
Primary diagnosis prostate cancer	Condition	9.4	7.9	9.3	0.003
Non-Hispanic White	Yes	86.4	85.2	85.8	0.017
Black or African American	Yes	8.1	8.4	8.1	0.001
Other, unknown, missing race/ethnicity	Yes	5.5	6.4	6.1	-0.026
SNF stay on enrollment date	Yes	0.1	0.1	0.1	-0.004
Days between enrollment and death	Yes*	198.8	57.4	187.2	0.048
Outpatient ED visits/observation stays Q1	Yes	0.7	0.7	0.6	0.009
Outpatient ED visits/observation stays Q2-4	Yes	1.0	0.9	0.9	0.014
Inpatient admissions Q1	Yes	1.1	1.4	1.1	0.017
0 inpatient admissions Q1	Yes	0.3	0.2	0.3	-0.016
1-2 inpatient admissions Q1	Yes	0.6	0.7	0.6	0.013
3+ inpatient admissions Q1	Yes	0.1	0.1	0.1	0.004
Inpatient admissions Q2	Yes	0.5	0.4	0.5	0.010
Inpatient admissions Q3	Yes	0.4	0.3	0.4	0.014
Inpatient admissions Q4	Yes	0.3	0.3	0.3	0.012
Advanced care planning visit in previous 2 years	Yes	21.9	22.0	21.2	0.018
Drugs for advanced stage cancer Q2-4	Condition	35.4	24.0	35.6	-0.003
Drugs for advanced stage cancer Q1	Condition	35.9	23.1	35.7	0.004
Diagnoses of advanced stage cancer Q2-4	Condition	51.1	41.9	50.9	0.005
Diagnoses of advanced stage cancer Q1	Condition	53.0	47.6	52.8	0.004
Diagnostic tests/procedures for advanced stage cancer Q2-4	Condition	33.7	21.2	34.0	-0.006
Diagnostic tests/procedures for advanced stage cancer Q1	Condition	33.3	18.4	33.2	0.001
Hormonal therapies Q2-4	Condition	0.5	0.3	0.5	0.001
Hormonal therapies Q1	Condition	1.0	0.5	1.0	0.003
Hospitalization with cardiac procedure Q2-4	Condition	0.2	0.1	0.1	0.008

Variable	Used in propensity score models[a]	MCCM participants (N = 5,153)	Non-MCCM beneficiaries who entered hospice		Standardized difference
			Unweighted (N = 553,784)	Weighted (raw N =179,168; weighted N = 5,153)	
Hospitalization with cardiac procedure Q1	Condition	0.1	0.1	0.0	0.017
Participation in OCM at enrollment	Condition	9.9	3.6	9.8	0.003
Hospitalization with lung-related procedure Q2-4	Condition	6.2	4.0	6.0	0.012
Hospitalization with lung-related procedure Q1	Condition	5.5	6.7	5.1	0.019
Automatic implantable cardioverter defibrillator Q1-4	Condition	0.4	0.3	0.4	0.013
Coronary artery bypass surgery Q1-4	Condition	0.1	0.2	0.2	-0.016
Percutaneous intervention Q1-4	Condition	1.0	1.2	0.9	0.010
Admitted to hospital on enrollment date	Yes	0.3	0.6	0.3	0.009
Discharged from hospital on enrollment date	Yes	1.7	43.7	1.8	-0.005
Length of most recent inpatient stay	Yes	6.7	7.7	6.6	0.018
Inpatient days Q1	Yes	7.0	10.3	6.9	0.020
Inpatient days Q2-4	Yes	8.1	6.5	7.7	0.030
Inpatient expenditures Q1	Yes	14,129	19,556	13,275	0.046
Inpatient expenditures Q2-4	Yes	18,139	13,819	17,007	0.035
Admitted to SNF on enrollment date	Yes	0.0	0.0	0.0	-0.006
Discharged from SNF on enrollment date	Yes	0.5	4.3	0.5	-0.006
Any DME claims Q1-4	Yes	72.6	60.6	71.9	0.016
DME hospital bed claims Q1-4	Yes	0.3	0.3	0.3	-0.004
DME oxygen claims Q1-4	Yes	2.1	1.5	2.0	0.007
Any DME walker/cane claims Q1-4	Yes	0.1	0.1	0.1	0.001
DME wheelchair claims Q1-4	Yes	0.4	0.4	0.4	0.003
SNF days Q1	Yes	3.7	7.5	3.7	0.001
SNF days Q2-4	Yes	4.9	5.9	4.9	-0.004
Post-acute care Q1	Yes	11.6	14.0	11.4	0.012
Post-acute care Q2-4	Yes	15.1	16.6	15.0	0.004
ADLs at most recent assessment	Yes	4.7	4.9	4.7	0.033
OASIS care assessment D30	Yes	36.9	24.7	34.9	0.041
OASIS discharge assessment D30	Yes	26.5	56.9	29.6	-0.070
Inpatient ICU days Q1	Yes	2.1	3.2	2.0	0.020

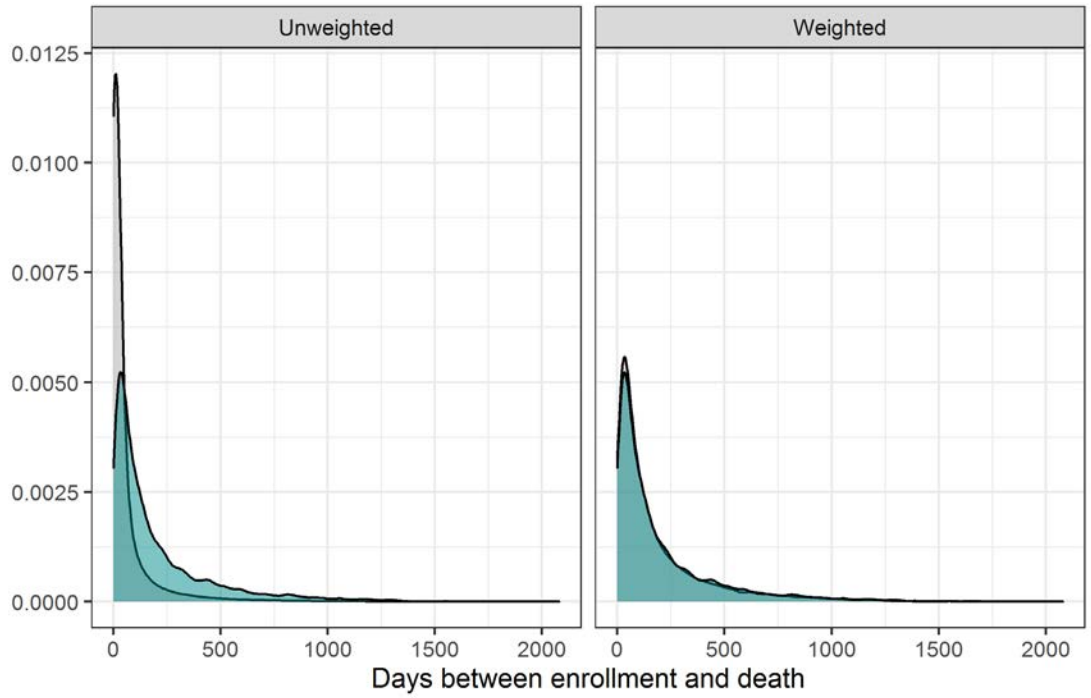
Variable	Used in propensity score models[a]	MCCM participants (N = 5,153)	Non-MCCM beneficiaries who entered hospice		Standardized difference
			Unweighted (N = 553,784)	Weighted (raw N =179,168; weighted N = 5,153)	
Inpatient ICU days Q2-4	Yes	2.5	1.8	2.3	0.023
Outpatient expenditures Q1	Yes	3,745	2,385	3,273	0.086
Outpatient expenditures Q2-4	Yes	7,628	5,007	7,113	0.043
Part B drug expenditures Q1	Yes	4,781	2,096	3,895	0.086
Part B drug expenditures Q2-4	Yes	10,175	5,900	9,953	0.010
Unique inpatient procedures Q1	Yes	1.4	2.1	1.4	0.014
Unique inpatient procedures Q2-4	Yes	2.0	1.5	1.9	0.017
Home health days Q1	Yes	7.3	5.6	7.1	0.016
Home health days Q2-4	Yes	9.4	10.0	9.2	0.010
ED visits resulting in inpatient admission Q1	Yes	0.9	1.2	0.9	0.011
ED visits resulting in inpatient admission Q2-4	Yes	1.0	0.8	1.0	0.010
PCP visits Q1	Yes	4.2	4.4	4.2	0.008
PCP visits Q2-4	Yes	7.8	7.2	7.8	0.008
Specialist visits Q1	Yes	4.9	3.2	4.9	0.008
Specialist visits Q2-4	Yes	10.6	7.7	10.5	0.008
Number of EMS ambulance transports in Q1	Yes	0.6	0.8	0.5	0.008
Number of EMS ambulance transports Q2-4	Yes	0.6	0.6	0.6	0.004
Medicare Part A and B expenditures Q1-4	Condition	80,012	72,151	77,466	0.041
Outpatient ED visits/observation stays Q1-4	Condition	1.6	1.6	1.6	0.015
Inpatient admissions Q1-4	Condition	2.3	2.4	2.3	0.022

Note: The fourth, fifth, and sixth columns present the intervention or comparison group mean for continuous variables or the percentage of beneficiaries for binary and categorical variables. The fourth column is based on 553,784 potential comparison beneficiaries (weighted equally), and the fifth column applies the matching weights (omitting the 74 percent of potential comparison beneficiaries who received no weight).

[a] "Yes*" identifies variables used for matching all 6 qualifying condition groups. "Yes" identifies variables used for matching for 5 out of 6 qualifying condition groups (all except the HIV/AIDS group). "Condition" identifies variables used for matching at more than 1 but fewer than 5 qualifying condition groups.

ADL = activities of daily living; CHF = congestive heart failure; COPD = chronic obstructive pulmonary disease; DME = durable medical equipment; ED = emergency department; EMS = emergency medical service; ESRD = end-stage renal disease; HCC = hierarchical condition category; ICU = intensive care unit; IP = inpatient; MCCM = Medicare Care Choices Model; OASI = Old-Age and Survivors Insurance; OASIS = Outcome and Assessment Information Set.; OCM = Oncology Care Model; PCP = primary care provider; Q1 = 1st quarter before enrollment or pseudo-enrollment; Q2 = 2nd quarter before enrollment or pseudo-enrollment; Q3 = 3rd quarter before enrollment or pseudo-enrollment; Q4 = 4th quarter before enrollment or pseudo-enrollment; SNF = skilled nursing facility.

Figure C.3. Survival time kernel densities for deceased MCCM and non-MCCM beneficiaries who entered hospice, before and after weighting



Note: The figure shows survival time kernel densities for deceased MCCM enrollees in green and for comparison beneficiaries in gray. In the right panel (after inverse propensity weighting), the kernel densities for MCCM enrollees and comparison beneficiaries are almost identical.

MCCM = Medicare Care Choices Model.

6.4. Regression models to estimate differences in beneficiary outcomes

Once we identified the (trimmed) inverse propensity score weights for all possible comparison beneficiaries, we used weighted regression models to estimate regression-adjusted differences in outcomes between the MCCM enrollees and the beneficiaries who directly entered hospice. These regression models were the same as we described in Appendix C, Section 4, the only difference being the comparison group sample sizes were much larger and the weights took on a wide range of values.[129]

[129] In the main analyses, comparison group beneficiaries have weights of 1, 1/2, or 1/3, but in this analysis the weights are continuous numbers.

Appendix D

Model Impacts: File Construction and Description of Variables Used

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1. Description of variables used to identify MCCM enrollees and the comparison beneficiaries

Has been enrolled in Medicare Part A and B for the past 12 months

Beneficiary was continuously enrolled in traditional Medicare (Part A and B) with Medicare as their primary payer for the 12 months prior to their enrollment (or pseudo-enrollment) date. Data came from the Medicare Enrollment Database.

Had a Medicare Care Choices Model- (MCCM-) qualifying diagnosis

Beneficiary had at least one inpatient, outpatient, or carrier claim in the 12 months before their enrollment (or pseudo-enrollment) date with an International Classification of Diseases 10 Clinical Modification or International Classification of Diseases 9 Clinical Modification primary diagnosis for an MCCM-qualifying condition: cancer, chronic obstructive pulmonary disease, congestive heart failure, or human immunodeficiency virus/acquired immunodeficiency syndrome (HIV/AIDS). We used the definition from MCCM Resource Manual; the full list of diagnosis codes can be found in Appendix Table D.1.[130]

Had at least one hospital encounter in past 12 months

Beneficiary had one hospital encounter (inpatient stay, emergency department visit, or observation stay) in the 12 months before their enrollment (or pseudo-enrollment) date. To identify hospital encounters, we used the approach described in Appendix D. Section 2.3 to count the number inpatient admissions, emergency department visits, or observation stays in the 12 months before their enrollment (or pseudo-enrollment) date, and then included those beneficiaries had at least one encounter.

Have had at least three office visits with any Medicare clinician in past 12 months

Beneficiary had at least three office visits with any Medicare eligible providers with the provider types listed in Appendix Table D.2 within the last 12 months before their enrollment (or pseudo-enrollment) date, including visits in a Federally Qualified Health Center, rural health clinic, and critical access hospital setting. Beneficiaries enrolled between January 1, 2016, and December 31, 2016 (as well as their matched comparisons) must also have met the requirement that all three office visits were with the same provider and for the beneficiary's terminal medical condition (cancer, chronic obstructive pulmonary disease, congestive heart failure, or HIV/AIDS). During the COVID-19 pandemic, the CMS model team changed this model inclusion criterion to allow telehealth encounter to count as a visit. We accommodated this change in eligibility by including telehealth visit procedure codes in our measure of total office visits between March 6, 2020, and December 31, 2021. See the approach for defining office visits described in Appendix D, Section 2.

[130] All tables listing diagnosis and other types of codes can be found in Section 4 of this appendix.

Have not used Medicare hospice benefit in past 30 days

Beneficiary was not using the Medicare hospice benefit at enrollment (or pseudo-enrollment) and were not entered hospice in the 30 days prior to enrollment date. Data comes from the Medicare Enrollment Database. (We were unable to screen for enrollment in the Medicaid hospice benefit.)

Did not reside in an institutional setting in the past 30 days

The actual eligibility rule is that an individual must live in a regular home, but this cannot be identified with available data. Instead, we excluded beneficiaries that resided in an institutional setting. Note that we could not reliably observe *all* instances of beneficiaries living outside of a traditional home setting because not all beneficiaries in these settings receive the care or assessments needed to identify them. However, since this rule was enforced for all enrollees, we thought it was important to remove them from the comparison group. We do this as follows:

To identify those that live in a nursing home, we used the Minimum Data Set assessments and identified those that had assessments indicating that they were living in a long-term care setting within four months before their enrollment date.[131] If yes, the individual was deemed ineligible.

To identify those in assisted living facilities and other congregate facilities, we identified those that had had a Part B medical claim with a place of service code indicating assisted living (13), group home (14), custodial care facility (33), or residential substance abuse treatment facility (55), or had a specific procedure codes (99324–99328 or 99334–99337) indicating care received in a domiciliary or rest home within 64 days before enrollment.[132] We used 64 days to allow for the gap between part B home visits (which allow us to identify their residence) because the two service types are often collocated.[133]

We also identified those residing in assisted living facilities using Outcome and Assessment Information Set assessments. If the individual had an Outcome and Assessment Information Set assessment within 4 months (123 days) before their enrollment (or pseudo-enrollment) date that indicated the individual lived in an assisted living facility, we excluded that individual.

2. Description of beneficiary baseline (pre-enrollment) covariates used for matching, balance checking, predictive risk modeling, and regression adjustment

2.1. Demographic and Medicare enrollment characteristics at enrollment or pseudo enrollment

Age

Age in years, as of the beneficiary's enrollment (or pseudo-enrollment) date. We calculated age as the

[131] The four-month requirement excludes beneficiaries who may be in the facility for short-term skilled nursing facility services for 100 days or less.

[132] We allowed for 64 days because current research suggests that is a typical gap between home care visits.

[133] We did not include place of service codes for nursing facility (32) because this resulted in a large number of otherwise eligible MCCM enrollees being labeled ineligible. It is likely that place of service code 32 is picking up skilled nursing facility stays in addition to longer term nursing facility stays.

beneficiary's enrollment (or pseudo-enrollment) date minus their date of birth (as reported in the Medicare Enrollment Database), converted to whole years.

Sex

Beneficiary sex as reported in the Medicare Enrollment Database, equaled 0 if the beneficiary's sex is unknown, 1 if the beneficiary was male, or 2 if the beneficiary was female.[134]

Race and ethnicity

Beneficiary race/ethnicity as reported in the Research Triangle Institute race code (`RTI_RACE_CD`) variable in the Medicare Enrollment Database. The value was set equal to 1 if the beneficiary is non-Hispanic White, 2 if the beneficiary is Black. We modified the variable by combining "missing," "other," and "unknown" as a single category with the value of 3. We also included Asian/Pacific Islander, Hispanic, and American Indian/Alaska Native in category 3.

Dual eligibility

Indicator for beneficiaries who receive full Medicaid benefits or assistance with Medicare premiums or cost sharing as of the beneficiary's enrollment (or pseudo-enrollment) date according to the Medicare Enrollment Database. A beneficiary was determined to be dually eligible for Medicare and Medicaid if values of 0, 1, 2, 3, 4, 5, 6 are the first digit in the Third Party Part B Premium Payer Code (`BENE_TP_PTB_PRM_PYR_CD`) which indicates the state was paying the part B premium during the calendar month.

Original reason for Medicare entitlement

Original reason for beneficiary Medicare entitlement from the Medicare Enrollment Database, equal to 0 if the beneficiary received old age and survivor's insurance, 1 if the beneficiary received disability insurance benefits, 2 if the beneficiary had end-stage renal disease, or 3 if the beneficiary received disability insurance benefits and has end-stage renal disease.

Region

Census region based on beneficiary's address in the Medicare Enrollment Database. This variable takes on one of four values: Northeast, South, Midwest, or West.

Rural

Indicator for rural status of the beneficiary's ZIP code of residence at their enrollment (or pseudo-enrollment) date, as measured by the Medicare Enrollment Database. We used data from the Federal Office of Rural Health Policy to identify rural ZIP codes. The Federal Office of Rural Health Policy counts as rural: (1) all non-Metro counties, (2) all areas with Rural-Urban Commuting Area codes 4-10, and (3) 132 large area census tracts with Rural-Urban Commuting Area codes 2 or 3 that are at least 400 square miles in area with a population density of no more than 35 people per square mile. Following the 2010

[134] In many of the analytic steps, including matching and regression models, we changed categorical variables into an array of binary (indicator) measures indicating whether the beneficiary belonged to each category.

Census the Federal Office of Rural Health Policy definition included approximately 57 million people, about 18% of the U.S. population and 84% of U.S. land area.

ZIP code characteristics

We included the following characteristics for the ZIP code of residence at the beneficiary's enrollment (or pseudo-enrollment) date, as measured by the Medicare Enrollment Database. We used data from the American Community Survey 5-year files for 2011-2015 for Cohort 1 hospices and 2013-2017 for Cohort 2 hospices. We combined all measures in a principal components analysis and used the resulting principal components in matching and as control variables in regression analysis. (For details, see Appendix C.)

1. *Median income*: Median household income (in dollars, inflation-adjusted to file data year)
2. *Poverty rate:* Percentage of families with income below the Federal Poverty level
3. *English proficiency:* Percentage of population ages 5 and over that speaks English well
4. *Percentage of population that was unemployed*: Percentage of population (ages 16 years and over) that was unemployed
5. *Percentage of population with less than high school education:* Percentage of population (ages 25 and over) with no schooling completed to 12th grade and no diploma (inclusive)
6. *Percentage of population with any postsecondary education:* Percentage of population (ages 25 and over) with some college to doctorate degree (inclusive)
7. *Percentage of population living in housing in structures with 10 or more units*: Percentage of population living in housing in structures with 10 or more units
8. *Percentage of population living in institutionalized group quarters*: Percentage of population living in institutionalized group quarters
9. *Percentage of population living in mobile homes*: Percentage of population living in mobile homes
10. *Population density:* Population density (based on 2010 Census)

Month/quarter during year when enrollment (or pseudo-enrollment) date falls

Indicator variable for quarter during the year when the beneficiary's enrollment (or pseudo-enrollment) date occurs. This takes the value of 1 for January, February, and March; 2 for April, May, and June; 3 for July, August, and September; and 4 for October, November, and December. (We described the process for creating beneficiary's enrollment or pseudo-enrollment dates in Appendix C, Sections 2.2, 2.4, and 3.2.)

Participation in an accountable care organization model or program

This variable indicates whether a beneficiary was participating in an accountable care organization model or program at the beneficiary's date of enrollment (or pseudo-enrollment). Accountable care organization enrollment was indicated by program ID code of 07 (Pioneer), 08 (Shared Savings Program), 21 (Next Generation Accountable Care Organization), or 18 (Comprehensive End-Stage Renal Disease Care) in the Master Data Management data set.

Participation in Oncology Care Model

This variable indicates whether a beneficiary was participating in the Oncology Care Model at the beneficiary's date of enrollment (or pseudo-enrollment). We identified a beneficiary as participating in the Oncology Care Model if they had any Carrier claims with a G code of G9678 ("Monthly Enhanced Oncology Services") within 31 days prior to the beneficiary's date of enrollment (or pseudo-enrollment).

COVID-19 cohort

We defined the COVID-19 cohort as those who enrolled on or after September 1, 2019, which was six months before the start of the COVID-19 period on March 1, 2020. All those with enrollment (or pseudo-enrollment) dates on or before August 31, 2019, are assigned to the pre-COVID-19 cohort. (We described the process for creating beneficiary's enrollment or pseudo-enrollment dates in Appendix C, Sections 2.2, 2.4, and 3.2.)

Days in the COVID-19 period

We defined days in the COVID-19 period as days in the study period that occurred on or after March 1, 2020. The variable is set to zero, regardless of survival time, for those whose enrollment (or pseudo-enrollment) date was on or before August 31, 2019 (6 months before the start of the COVID-19 period). (We described the process for creating beneficiary's enrollment or pseudo-enrollment dates in Appendix C, Sections 2.2, 2.4, and 3.2.)

COVID-19 diagnosis

We defined a diagnosis of COVID-19 as a primary diagnosis of B9729 in claims from January 1, 2020, through March 31, 2020, or a primary diagnosis of U071 in claims from April 1, 2020, to the end of the analysis period. We used inpatient, outpatient and carrier Part A and B claims to identify the diagnosis in each beneficiary's study period (that is, between a beneficiary's enrollment or pseudo-enrollment date and death).

2.2. Prior Medicare expenditures

Total Medicare (Part A plus Part B) expenditures in prior year

These measures are the sum of Medicare payments across inpatient, outpatient, skilled nursing facility, home health, hospice, carrier (or Part B), and durable medical equipment claims with from-dates during a baseline period (each of four quarters before the [pseudo] enrollment date). These payments include any payments that the Centers for Medicare & Medicaid Services (CMS) made to providers for (1) participating in advanced alternative payment models (participating providers receive a 5 percent increase in their professional claims), or (2) for their performance under the Merit-Based Incentive Payment System. Medicare adjusts payments to providers through the amounts they pay on Part B claims, and these adjustments are already factored into the Part B claims in the Research Identifiable File. These measures exclude non-claims payments—that is, payments from CMS to providers that were made separately from claims.

Total Medicare (Part A plus Part B) expenditures two years prior

This measure is the sum of Medicare payments across inpatient, outpatient, skilled nursing facility, home health, hospice, carrier (or Part B), and durable medical equipment claims with from-dates during the 12-month period starting 24 months and ending 12 months before the enrollment (or pseudo-enrollment) date.

Inpatient expenditures

These measures are the sum of Medicare Part A payments for inpatient claims with admission dates during a baseline period (each of the four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date).

Outpatient expenditures

These measures are the sum of Medicare Part B payments for outpatient claims and carrier claims not categorized as Part B drugs. This includes facility and professional fees for emergency department visits, observation stays that did not lead to an inpatient admission, and ambulatory care visits during a baseline period (each of four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date).

Part B drug expenditures

These measures are the sum of Medicare Part B payments for drugs covered by during a baseline period (each of four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date). Specifically, we identified Medicare payments for claims lines in outpatient claims, carrier claims, and durable medical equipment claims files where the procedure code (Healthcare Common Procedure Coding System) was for a drug paid for under the Average Sales Price payment and that had a positive payment amount. We compiled a list of the unique Healthcare Common Procedure Coding System codes included in the Average Sales Price payment system, which CMS published quarterly, then identified outpatient, carrier, and durable medical equipment claims (or claim lines) where the Healthcare Common Procedure Coding System code was covered by Average Sales Price in the year in which the claim occurred or in the previous or following year.[135]

2.3. Prior health care use

Number of inpatient admissions

These measures are the number of Medicare-paid hospitalizations in acute, critical access, and children's hospitals in the Research Identifiable File inpatient claims file for the beneficiary with an admission date during a baseline period (each of the four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date). Multiple claims for admissions that involved transfers between

[135] The Medicare Part B drug ASP files are available at https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Part-B-Drugs/McrPartBDrugAvgSalesPrice (accessed December 4, 2020). The list of ASP drugs includes, in some years, temporary ("Q") codes that were only used for ASP drugs in certain years (and used for other purposes in other years). For this reason, we used a list of ASP HCPCS codes that varied by year.

hospitals were combined into a single record, as were multiple claims for the same beneficiary at the same facility with overlapping dates, so that these count as one admission.

Days admitted to hospital

These measures are the number of days in acute, critical access, and children's hospitals reported in the Research Identifiable File inpatient claims file for the beneficiary during a baseline period (each of the four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date). As was the case for the hospital admission measures described above, we combined multi-claim stays and transfers between hospitals into a single record. For a given hospital stay, the number of days was the discharge date minus the admission date plus one. Then we summed the number of days each beneficiary was admitted to the hospital across all hospital stays with an admission date during the respective baseline period.[136]

Number of inpatient intensive care unit days

These measures are the number of Medicare-paid days during which the beneficiary was in the intensive care unit during inpatient stays with an admission date during a baseline period (each of the four quarters before the [pseudo] enrollment date). For each hospitalization, the number of days in the intensive care unit equals the number of revenue units for claim line revenue center codes that equaled 020X or 021X. Then we summed the number of days each beneficiary was in the intensive care unit across all hospital admissions in the respective baseline period.

Number of days between enrollment (or pseudo-enrollment) date and most recent inpatient discharge

This measure is the number of days between the discharge from the Medicare-paid hospital stay with a discharge date closest to and before the enrollment (or pseudo-enrollment) date. The measure equals the enrollment (or pseudo-enrollment) date minus the discharge date. The measure was set to missing in the rare case that there was no discharge during this period.

Length of most recent hospital stay

This measure is the number of days admitted to a hospital for the Medicare-paid hospital admission with an admission date closest to and before the enrollment (or pseudo-enrollment) date. The number of days was the discharge date minus the admission date plus one.

Number of unique inpatient procedures

These measures are the number of Medicare-paid procedures that were performed during hospital stays with an admission date during a baseline period (each of the four quarters before the enrollment (or pseudo-enrollment) date). The measures equal the total number of *unique,* non-missing procedure code variables associated with the beneficiary's hospital stays during the respective baseline period.

[136] If a beneficiary was in the hospital on their [pseudo] enrollment date (this occurred main in the potential comparison group, when pseudo enrollment dates were chosen through an algorithm), we did not count the days after the [pseudo] enrollment as baseline inpatient days. Similar rules were used for related measures discussed below.

Number of emergency department visits resulting in a hospital admission

These measures are the number of Medicare-paid hospitalizations with an admission date during a baseline period (each of the four quarters before the [pseudo] enrollment date) that included an emergency department visit or observation stay for the beneficiary. These measures include all-cause hospital admissions (see definition above) where at least one claim line revenue center code equaled 045X or 0981 (emergency room care) or 0762 (treatment or observation room).

Number of outpatient emergency department visits and observation stays

These measures are the sum of the number of outpatient emergency department visits and outpatient observation stays (see below) for the beneficiary during a baseline period (each of the four quarters before the [pseudo] enrollment date).

Number of outpatient emergency department visits

These measures are the number of Medicare-paid outpatient emergency department visits for the beneficiary during a baseline period (each of the four quarters before the [pseudo] enrollment date) that did not lead to a hospitalization. Visits that did not lead to a hospitalization are identified in the outpatient department Research Identifiable File hospital claims file using revenue center line items equal to 045X or 0981. We then capped the number of visits to one per day.

Number of outpatient observation stays

These measures are the number of Medicare-paid outpatient observation stays for the beneficiary during a baseline period (each of the four quarters before the [pseudo] enrollment date) that did not lead to a hospitalization. Stays that did not lead to a hospitalization are identified in the outpatient department Research Identifiable File hospital claims file using revenue center line items equal to 0760 or 0762, a corresponding Healthcare Common Procedure Coding System code of G0378, and a length of stay of at least eight hours. We then capped the number of visits to one per day.

Number of ambulatory visits with primary care providers and specialist physicians

These measures are the sum of the number of ambulatory visits with primary care providers and the number of ambulatory visits with specialist physicians (see below) for the beneficiary during a baseline period (each of the four quarters before the [pseudo] enrollment date).

Number of ambulatory visits with primary care providers

These measures are the number of Medicare-paid visits with primary care practitioners (regardless of place of service), at clinics (Federally Qualified Health Centers and rural health clinics), and with nurse practitioners, physician assistants, and other advanced practice nurses during a baseline period (each of the four quarters before the [pseudo] enrollment date). This measure includes (1) carrier claim lines with an ambulatory evaluation and management procedure code, and the provider's Medicare provider specialty category indicating the provider was a primary care;[137] (2) carrier claim lines with an ambulatory evaluation and management procedure code, and the provider's Medicare provider

[137] See list of relevant codes in Appendix Table D.3.

specialty category indicating the provider was a nurse practitioner, physician assistant, or other advanced practice nurse; and (3) outpatient claims with an ambulatory evaluation and management procedure code provided at a Federally Qualified Health Center, rural health clinic, or critical access hospital.[138] Provider types are defined in Appendix D, Table D.2. Most of the visits in the latter two categories are expected to be for primary care, although the measure might capture some visits for other services, including visits with specialist or behavioral health providers. The main reason these visits are grouped together is that the Medicare specialty field on the claims data does not include more detailed specialty data for nurse practitioner, physician assistant, and other advanced practice nurses. Multiple claims with the same provider on the same day were counted as one visit, and multiple claims with different providers on the same day were counted as separate visits.

Number of ambulatory visits with specialist physicians

These measures are the number of Medicare-paid visits with specialist during a baseline period (each of the four quarters before the [pseudo] enrollment date). Specifically, they include carrier claim lines with an ambulatory evaluation and management procedure code (see previous definition) and the provider's Medicare provider specialty category indicated the provider was a specialist physician (as defined in Appendix Table D.2). Multiple claims with the same provider on the same day were counted as one visit, and multiple claims with different providers on the same day were counted as separate visits.

Number of ambulance transports

These measures are the number of emergency medical services ambulance transports for the beneficiary during a baseline period (each of the four quarters before the [pseudo] enrollment date). The number of ambulance transports was identified from Medicare carrier and outpatient claims with a procedure code of A0425-A0436 and associated procedure modifier code of "EH," "RH," or "SH" to indicate transport from home, residential facility, or scene of an accident to the hospital and to rule out transports between hospitals or to/from dialysis clinics. We then capped the number of transports to one per day.

Number of skilled nursing facility days

These measures are the number of Medicare-paid days in a skilled nursing facility during the baseline period (each of the four quarters before the [pseudo] enrollment date). For skilled nursing facility claims with overlapping time periods, we only counted each day once. These measures included service use recorded in the Research Identifiable File skilled nursing facility claims file for which Medicare made a positive payment. It included skilled nursing services provided in swing beds in short term acute care hospitals or critical access hospitals.

[138] Outpatient Claims with an Ambulatory Evaluation and Management Procedure Code (from Appendix Table D.3) provided at a Federally Qualified Health Center, rural health clinic, or critical access hospital. Revenue center code equal to 0510, 0513, 0514, 0515, 0517, 0519, 0520, 0521, 0522, 0523, 0527, 0528, or 0529 plus one of the following: (1) Federally Qualified Health Center claim; (2) rural health clinic claim; (3) critical access hospital claim (see Appendix Table D.4).

Number of home health visit days

This measure is the number of Medicare-paid home health visit days in the baseline period (each of the four quarters before the [pseudo] enrollment date). Specifically, we included home health visits covered by Medicare Part A recorded in the Research Identifiable File home health claims file with positive payment amounts, except for interim "request for anticipated payment" claims. We included home health visits covered by Part A alone, covered by Part B alone, or covered by both Part A and B. We identified each day a visit occurred and summed the number of days. If multiple visits occurred on the same day, it was only counted once.

Number of durable medical equipment claims for any equipment and for specific subcategories

These measures are the number of unique Medicare-paid claims for any durable medical equipment during the baseline period (each of the four quarters before the [pseudo] enrollment date) in the durable medical equipment Research Identifiable File. In addition, we measured the number of durable medical equipment claims for oxygen equipment, home hospital beds, walkers or canes, and wheelchairs.[139]

Had an advance care planning visit in the previous two years

This measure is an indicator of whether a beneficiary had advance care planning visit, including the explanation and discussion of standard forms, with a physician or other qualified health care professional within 24 months of their enrollment (or pseudo-enrollment). We set the measure equal to 1 if the beneficiary received a service in carrier claims with billing code 99497 and 0 otherwise.

2.4. Health at enrollment

Indicator for each of four MCCM diagnoses: cancer, chronic obstructive pulmonary disease, congestive heart failure, and HIV/AIDS

These measures are indicators of which MCCM-qualifying diagnosis a beneficiary had. Beneficiaries whose primary diagnosis on inpatient, outpatient, or carrier claims submitted within a year of enrollment (or pseudo-enrollment) falls within a list of MCCM-eligible International Classification of Diseases 10 Clinical Modification diagnosis codes and corresponding International Classification of Diseases 9 Clinical Modification diagnosis codes are considered to have cancer, chronic obstructive pulmonary disease, congestive heart failure, or HIV/AIDS. Among those with an MCCM-qualifying cancer diagnosis, we further stratified beneficiaries by the type of cancer they had: breast, lung, colorectal, prostate, or other. The full list of diagnosis codes can be found in Appendix Table D.1.

CMS hierarchical condition category score

This measure represents the prospective (expected) medical cost of a beneficiary in the coming year and is based on community scores calculated using CMS' 2021 risk-adjustment model.[140] There were 87 hierarchical condition categories each month for each enrolled beneficiary in MCCM impact evaluation

[139] See list of relevant codes in Appendix Table D.5.

[140] CMS' 2021 risk adjustment software and ICD-10 mappings are available at the following link: https://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/Risk-Adjustors.

at the time of their enrollment (or pseudo-enrollment) date. We used the 2019 version 21 model to create the hierarchical condition categories and the 3 scores (community, new enrollee, and institutional). We used a cumulative file of International Classification of Diseases 9 diagnoses from the 2016 to 2019 version 21 models and International Classification of Diseases 10 codes for 2020 and 2021 from the end-stage renal disease model (non-end-stage renal disease models were not updated after 2019). We used the community score for those with at least 10 months of observability in the 13 to 24 months before enrollment (or pseudo-enrollment) and we used the new enrollee score for beneficiaries who were enrolled for less than 10 months during that time period.

CMS hierarchical condition category score prior year

This measure represents the prospective (expected) medical cost one year before a beneficiary's enrollment (or pseudo-enrollment) date. We calculated this measure the same as above, except that we calculated the beneficiary's hierarchical condition category scores as of their enrollment (or pseudo-enrollment) date minus 365 days.

Individual hierarchical condition category condition variables

These are a group of 87 indicators used to consolidate beneficiaries into hierarchical condition categories based on their International Classification of Diseases 9 Clinical Modification and International Classification of Diseases 10 Clinical Modification diagnosis codes in a beneficiary's baseline year (one year before enrollment or pseudo-enrollment date).[141] These indicators are assigned using Medicare claims and a master format library that includes International Classification of Diseases 9 and International Classification of Diseases 10 codes and are equal to 1 when CMS' 2021 risk-adjustment model software identifies the condition as present and 0 otherwise.

Number of medical encounters (in carrier, inpatient, and outpatient claims) for each of 20 conditions from the Gagne comorbidity index

These measures are the number of physician encounters, inpatient stays, and outpatient visits for the beneficiary for each of 20 conditions identified by Gagne et al. (2011) to be significant predictors of mortality among the elderly.[142] We calculated these measures for the baseline period (quarter 1 and quarters 2 to 4 before the [pseudo] enrollment date). The full list of conditions and their definitions are described in Appendix Table D.7.

[141] See list of relevant codes in Appendix Table D.6.

[142] For ICD-9 mappings to condition categories, see Gagne et al.'s SAS program, which is available at the following link: https://scholar.harvard.edu/files/gagne/files/jjg-comorbidity-sas-program.txt. Condition categories include the following: alcohol or other drug abuse or dependence (ICD-9-CM 291x, 3039x, 3050x; ICD-10-CM V113, F101x, F102x, F109x), any tumor (includes leukemia and lymphoma), cardiac arrhythmias, congestive heart failure, coagulopathy, complicated diabetes, chronic obstructive pulmonary disease, deficiency anemias, dementia, fluid and electrolyte disorders), hemiplegia (ICD-9-CM 342x, 344x; ICD-10-CM G81x, G82x, G83x), HIV/AIDS, hypertension (both complicated/uncomplicated), liver disease, metastatic cancer, peripheral vascular disorder, psychosis, pulmonary circulation disorders, renal failure, and weight loss. We identify these types of services using the diagnosis and procedure codes listed in Appendix Table D.7.

Activities of daily living

This measure is a count of the number (up to 6) of activities of daily living from functional status assessments measured in any Outcome and Assessment Information Set data within 30 days prior to a beneficiary's enrollment (or pseudo-enrollment) date. We restricted this measurement to those measured in the 30 days before enrollment (or pseudo-enrollment)—about one-third of MCCM enrollees—to ensure that the measure was reflective of the beneficiary's health status at enrollment (or pseudo-enrollment), because activities of daily living can change over the course of several home health visits, especially if the beneficiary was released from an acute or another post-acute care setting just before the beginning of home health services. We also included an indicator and interaction term for whether the assessment was conducted at discharge from home health services, because activities of daily living measured at discharge are likely to reflect the beneficiary's highest level of functioning, while assessments at entry are expected to improve. Finally, we accounted for missing values through a variable that indicated whether a beneficiary was assessed as a part of receiving home health services in the 30 days before enrollment (or pseudo-enrollment).

Measures of acute care hospitalization at enrollment (or pseudo-enrollment)

In order to capture the trajectory of beneficiary health care utilization, we included indicators for the following events on a beneficiary's enrollment (or pseudo-enrollment) date (1) they were admitted to an acute care hospital, (2) they were in the middle of an acute care hospitalization (admitted before and discharged after [pseudo] enrollment date), or (3) they were discharged from an acute care hospital in the inpatient claims data.

Measures of skilled nursing facility services at enrollment (or pseudo-enrollment)

We also included indicators for the following events on a beneficiary's enrollment (or pseudo-enrollment) date: (1) they were admitted to a skilled nursing facility, (2) they were in the middle of skilled nursing facility stay (admitted before and discharged after [pseudo] enrollment date), or (3) they were discharged from a skilled nursing facility in the skilled nursing facility claims data.

2.5. Disease-specific measures

Number of medical encounters (in carrier, inpatient, outpatient claims) for each of four MCCM diagnoses: cancer, chronic obstructive pulmonary disease, congestive heart failure, and HIV/AIDS

These four measures capture the number of physician encounters, inpatient stays, and outpatient visits that the beneficiary had for each of the four MCCM diagnoses: cancer, chronic obstructive pulmonary disease, congestive heart failure, or HIV/AIDS during the baseline period (each of the four quarters before the [pseudo] enrollment date). We restricted this count to only include up to one encounter per day to avoid double-counting in cases where multiple claims were submitted for the same medical encounter (for example, separate claims for an office visit and laboratory test on the same day).

Congestive heart failure

Any coronary artery bypass surgery in the two years before enrollment

This measure is an indicator of whether a beneficiary with congestive heart failure had an acute stay in the two years prior to their enrollment (or pseudo-enrollment) date involving a coronary artery bypass surgery. We identify these surgeries using the codes listed in Appendix Table D.8 among paid inpatient claims with admission dates in the year prior to enrollment (or pseudo-enrollment).

Any percutaneous intervention in the two years before enrollment

This measure is an indicator of whether a beneficiary with congestive heart failure had an acute stay in the two years prior to their enrollment (or pseudo-enrollment) date involving a percutaneous intervention. We identify percutaneous interventions using the codes listed in Appendix Table D.8 among paid inpatient claims with admissions dates in the year prior to enrollment (or pseudo-enrollment).

Prior insertion of an automatic implantable cardioverter defibrillator in the two years before enrollment

This measure is an indicator of whether a beneficiary with congestive heart failure had an acute stay in the two years prior to their enrollment (or pseudo-enrollment) date involving the insertion of an automatic implantable cardioverter defibrillator. We identify automatic implantable cardioverter defibrillator insertions using the codes listed in Appendix Table D.8 in paid inpatient claims admission dates in the year prior to enrollment (or pseudo-enrollment).

Any hospitalization with inotropes or cardiac procedure (intra-aortic balloon pump, ventricular assist device, or heart transplantation)

This measure is an indicator of whether the beneficiary was hospitalized with inotropes or a cardiac procedure at any point within days 1-90 or days 91-365 prior to enrollment or pseudo-enrollment. We identify these hospitalizations using the codes listed in Appendix Table D.8 in paid inpatient claims with admission dates in the year prior to enrollment (or pseudo-enrollment). These definitions are from Parikh et al. (2019).

Participated in outpatient cardiac rehabilitation program

This measure is an indicator of whether the beneficiary received physician services for outpatient cardiac rehabilitation during the baseline period (each of the four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date). We identify these services in paid carrier and outpatient claims using the codes listed in Appendix Table D.8.

Number of congestive heart failure related events

We defined congestive heart failure related versions of several measures by adding the additional condition that the event also had a primary diagnosis of congestive heart failure (See Appendix Table D.8 for a list of diagnosis codes). All measures were defined using claims data for the same time

periods as the main measures above. We included the following congestive heart failure related measures:

1. Inpatient admissions
2. Inpatient days
3. Intensive care unit days
4. Outpatient emergency department visits and observation stays
5. Primary care visits
6. Specialty care visits
7. Skilled nursing facility days

Chronic obstructive pulmonary disease[143]

Lung cancer or thoracic malignancies

These measures are indicators of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with lung cancer or a thoracic malignancy. We identified lung cancer or thoracic malignancies in outpatient claims using the codes listed in Appendix Table D.9.

Nutritional abnormalities

The measures are indicators of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with nutritional abnormalities. We identified nutritional abnormalities in outpatient claims using the codes listed in Appendix Table D.9.

Skeletal muscle dysfunction

This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with skeletal muscle dysfunction. We identified skeletal muscle dysfunction in outpatient claims using the codes listed in Appendix Table D.9.

Osteoporosis

This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with osteoporosis. We identified osteoporosis in outpatient claims using the codes listed in Appendix Table D.9.

[143] Several of these variables are indicators of chronic obstructive pulmonary disease severity and were described in Macaulay et al. (2013). It should be noted, however, that Macaulay et al. used managed care administrative data, and used older ICD-9 codes which we converted to ICD-10 codes.

Bone fracture

This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with a bone fracture. We identified bone fractures in outpatient claims using the codes listed in Appendix Table D.9.

Glaucoma

This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with glaucoma. We identified glaucoma in outpatient claims using the codes listed in Appendix Table D.9.

Obesity-related condition

This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with an obesity-related condition. We identified obesity and overweight in outpatient claims using the codes listed in Appendix Table D.9.

Chronic obstructive pulmonary disease exacerbation

This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease had any inpatient or outpatient claims indicating a visit in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) where they were diagnosed with exacerbation. We identified chronic obstructive pulmonary disease exacerbation in inpatient claims using International Classification of Diseases 9 Clinical Modification codes 49x and in outpatient claims using the codes listed in Appendix Table D.9.

Number of respiratory therapist visits

These measures are the number of respiratory therapy specialist visits during the baseline period (each of the four quarters and days 1 to 30, days 1 to 7, days 1 to 3, and day 1 before the [pseudo] enrollment date) that were related to chronic obstructive pulmonary disease. We constructed these measures the same way as the number of chronic obstructive pulmonary disease related specialty care visits but restricted to carrier and outpatient claims with the codes listed in Appendix Table D.11.

Any hospitalization with lung volume reduction surgery, oxygen therapy, or ventilation

This measure is an indicator of whether a beneficiary with chronic obstructive pulmonary disease was hospitalized in days 1-90 or days 91-365 prior to enrollment (or pseudo-enrollment) and received lung volume reduction surgery, oxygen therapy, or ventilation, according to inpatient claims data. See Appendix Table D.11.

Number of chronic obstructive pulmonary disease related events

We defined chronic obstructive pulmonary disease related versions of several measures by adding the additional condition that the event also had a primary diagnosis of chronic obstructive pulmonary disease (See Appendix Table D.1 for a list of diagnosis codes). All measures were defined using claims data for the same time periods as the main measures above. We included the following chronic obstructive pulmonary disease related measures:

1. Inpatient admissions
2. Inpatient days
3. Intensive care unit days
4. Outpatient emergency department visits and observation stays
5. Primary care visits
6. Specialty care visits
7. Skilled nursing facility days

Cancer

Type/location of cancer

These are indicators of the specific type or location of cancer diagnoses that beneficiaries had in the year before (pseudo) enrollment. We construct indicator flags for the four most common lethal cancers affecting Medicare beneficiaries—breast, colorectal/anorectal, lung, and prostate—as well as an indicator for other types of cancers (See Appendix Table D.1 for a list of diagnosis codes). Our process for flagging cancer location/type is based on our process for determining whether the beneficiary qualified for MCCM based on having cancer, described in Section 1 of this appendix). To ensure that a beneficiary's specific cancer type is correctly identified, we assign a beneficiary a breast cancer, colorectal cancer, lung cancer, or prostate cancer flag if they have at least one paid inpatient or skilled nursing facility claim or at least two outpatient or provider claims prior to enrollment (or pseudo-enrollment) with International Classification of Diseases 9 Clinical Modification or International Classification of Diseases 10 Clinical Modification codes indicating the condition. We identified beneficiaries as having other cancers if they had at least one paid claim with a diagnosis code falling in the other cancers' category prior to enrollment (or pseudo-enrollment).

Poor prognosis solid and hematological malignancies

This measure is an indicator of poor prognosis cancers *other* than the four main cancers of lung, colon, prostate, or breast (Obermeyer et al. 2014). We identify these cancers in inpatient, outpatient, and carrier claims using the codes listed in Appendix Table D.12. The measure is equal to 1 if one or more of these diagnosis codes is present on inpatient, outpatient, or carrier claims, and 0 otherwise.

Diagnosis, drug, and procedure codes indicating advanced stage or poor prognosis lung, colon, breast, and prostate cancers

These measures indicate whether the beneficiary had diagnosis codes,[144] received drugs,[145] or had procedures[146] indicating advanced-stage or poor-prognosis cancer. There is one indicator for each of the four most common cancer types (based on the beneficiary's primary cancer diagnosis, as defined above), which equals 1 if the beneficiary has an inpatient, outpatient, or carrier claim containing any of these diagnosis, drug, or procedure codes.

Hormonal therapy, alone or with surgery for excision, within one year of enrollment

This measure indicates that a beneficiary with breast cancer may have early-stage disease. We used claims data to identify beneficiaries who received hormonal therapies commonly given to beneficiaries diagnosed with early-stage breast cancer, alone or with a lumpectomy: tamoxifen, anastrozole, letrozole, and exemestane.[147]

Number of cancer related events

We defined cancer related versions of several measures by adding the additional condition that the event also had a primary diagnosis of cancer (See Appendix Table D.1 for a list of diagnosis codes). All measures were defined for the same time periods as the main measures above. We included the following cancer related measures: Inpatient admissions, inpatient days, intensive care unit days, outpatient emergency department visits and observation stays, primary care visits, specialty care visits, and skilled nursing facility days.

Number of cancer-related events

We defined cancer-related versions of several measures by adding the additional condition that the event also had a primary diagnosis of cancer (See Appendix Table D.1 for a list of diagnosis codes). All measures were defined using claims data for the same time periods as the main measures above. We included the following cancer related measures:

1. Inpatient admissions
2. Inpatient days
3. Intensive care unit days
4. Outpatient emergency department visits and observation stays
5. Primary care visits
6. Specialty care visits
7. Skilled nursing facility days

[144] Diagnosis codes indicating advanced-stage or poor-prognosis cancer are listed in Appendix Table D.12.

[145] Drug codes indicating advanced-stage or poor-prognosis cancer are listed in Appendix Table D.13.

[146] Procedure codes indicating advanced-stage or poor-prognosis cancer are listed in Appendix Table D.14.

[147] See list of relevant codes in Appendix Table D.15.

3. Description of outcome variables

The following financial outcome measures are measured from the day after enrollment (or pseudo-enrollment) to the end of the study period (December 31, 2021). We used this study period since it captures all the expenditures that Medicare has paid. The following utilization measures are measured from the day after the enrollment (or pseudo-enrollment) date to the beneficiary's death or the end of the study period, whichever comes first.

3.1. Expenditure measures

Medicare Part A and B expenditures plus MCCM payments

This measure is the sum of Medicare payments for Part A and B services and expenditures for services provided through MCCM. The two components of this measure, payments for Medicare Part A and B services and MCCM payments, are described in more detail below.

Medicare Part A and B expenditures

This measure is the sum of Medicare payments across inpatient, outpatient, skilled nursing facility, home health, hospice, carrier (or Part B), and durable medical equipment claims. These payments will include any payments that CMS made to providers for (1) participating in advanced alternative payment models (participating providers receive a 5 percent increase in their professional claims), or (2) for their performance under the Merit-Based Incentive Payment System. Medicare adjusts payments to providers through the amounts they pay on Part B claims, and these adjustments are already factored into the Part B claims in the Research Identifiable File. This measure excludes MCCM payments and non-claims payments—that is, payments from CMS to providers that were made separately from claims.

Inpatient expenditures

This measure is the sum of Medicare Part A payments for inpatient claims with admission dates during the study period.

Hospice expenditures

This measure is the sum of Medicare payments for hospice services that started during the study period excluding MCCM payments.

Skilled nursing facility expenditures

This measure is the sum of Medicare payments for stays at skilled nursing facilities that started during the study period. We identified skilled nursing facility payments from Medicare skilled nursing facility claims.

Home health expenditures

This measure is the sum of Medicare payments for home health services during the study period. We identified home health payments from Medicare home health claims.

Part B drug expenditures

This measure is the sum of Medicare Part B payments for drugs during the study period. Specifically, we identified Medicare payments for claims lines in outpatient claims, carrier claims, and durable medical equipment claims files where the Healthcare Common Procedure Coding System procedure code was for a drug paid for under the Average Sales Price payment and that had a positive payment amount. We compiled a list of the unique Healthcare Common Procedure Coding System codes included in the Average Sales Price payment system, which CMS published quarterly, then identified outpatient, carrier, and durable medical equipment claims (or claim lines) where the Healthcare Common Procedure Coding System code was covered by Average Sales Price in the year in which the claim occurred or in the previous or following year (see Footnote 135).

Durable medical equipment expenditures

This measure is the sum of Medicare payments for durable medical equipment. We identified durable medical equipment payments from Medicare durable medical equipment claims.

Other expenditures

This measure is the sum of Medicare Part A and B payments that do not fall into the categories of inpatient, hospice, skilled nursing facility, home health, Part B drugs, or durable medical equipment payments. Other expenditures include payments for outpatient, primary care, and specialist visits and were identified from Medicare outpatient and carrier claims.

MCCM payments

This measure is the sum of Medicare payments to participating hospices for MCCM services, identified by code 73.

3.2. Service Use

Number of inpatient admissions

This measure is the number of Medicare-paid hospital admissions reported in the Research Identifiable File inpatient claims file for the beneficiary in the study period. Multiple claims for admissions that involved transfers between hospitals were combined into a single record, as were multiple claims for the same beneficiary at the same facility with overlapping dates, so that these count as one admission.

Days admitted to hospital

This measure is the number of days in the hospital reported in the Research Identifiable File inpatient claims file for the beneficiary in the study period. As was the case for the hospital admission measure described above, we combined multi-claim stays and transfers between hospitals into a single record. For a given hospital stay, the number of days was the discharge date minus the admission date plus one. Then we summed the number of days each beneficiary was admitted to the hospital across all hospital admissions in the period.

Days in hospital intensive care unit

This measure is the number of Medicare-paid days during which the beneficiary was in the intensive care unit during inpatient stays with an admission date during the study period. For each hospitalization, the number of days in the intensive care unit equals the number of revenue units for claim line revenue center codes that equaled 020X or 021X. Then we summed the number of days each beneficiary was in the intensive care unit across all hospital admissions in the period.

Days in hospital without intensive care unit

This measure is the number of Medicare-paid days during which the beneficiary was not in the (intensive care unit during inpatient stays with an admission date during the study period. It was calculated as the difference between the number of days admitted to a hospital and the number of days in hospital intensive care unit.

Number of 30-day all-cause readmissions

This measure is the number of discharges (the "index" admissions) that were followed by a Medicare-paid hospital admission within 30 days, regardless of whether the readmission was planned or unplanned and regardless of whether the readmission occurred at the same hospital or a different hospital. For an inpatient discharge to qualify as an index admission, the beneficiary must have (1) been alive at discharge and (2) not been discharged against medical advice. In addition, certain admissions were excluded from the universe of index admissions, including discharges with lengths of stay longer than one year; stays at cancer hospitals exempt from the Prospective Payment System; and stays for psychiatric conditions, rehabilitation, or cancer. Our definition of this measure is based on the Yale readmission measure developed by the Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation (YNHHSC/CORE 2018) that is used in the Hospital Readmission Reduction Program under Section 3025 of the Affordable Care Act (CMS QualityNet 2020). An admission that counts as a readmission because it fell within 30 days of an earlier index stay also can count as an index stay for a potential subsequent readmission if it meets the index admission inclusion criteria.

Number of ambulance transports

This measure is the number of Medicare-paid land, air, and water ambulance transports for the beneficiary. The number of ambulance transports was identified from Medicare carrier claims with a place of service code indicating either land ambulance (41) or air or water ambulance (42).

Number of outpatient emergency department visits and observation stays

This measure is the sum of the number of Medicare-paid outpatient emergency department visits and the number of observation stays that did not lead to a hospitalization. See below for details on emergency department visits and observation stays.

Number of outpatient emergency department visits

This measure is the number of Medicare-paid outpatient emergency department visits for the beneficiary that did not lead to a hospitalization. Visits that did not lead to a hospitalization are identified in the outpatient department Research Identifiable File hospital claims file using revenue center line items equal to 045X or 0981.

Number of outpatient observation stays

This measure is the number of Medicare-paid outpatient observation stays for the beneficiary that did not lead to a hospitalization. Stays that did not lead to a hospitalization are identified in the outpatient department Research Identifiable File hospital claims file using revenue center line items equal to 0760 or 0762, a corresponding Healthcare Common Procedure Coding System code of G0378, and a length of stay of at least eight hours.

Number of ambulatory visits with primary care providers and specialist physicians

This measure is the sum of number of Medicare-paid ambulatory visits with primary care providers and number of Medicare-paid specialist physicians.

Number of ambulatory visits with primary care providers

This measure is the number of Medicare-paid visits with primary care practitioners, at clinics (Federally Qualified Health Centers and rural health clinics), critical access hospitals, and with nurse practitioners, physician assistants, and other advanced practice nurses. This measure includes (1) carrier claim lines with an ambulatory evaluation and management procedure code, and the provider's Medicare provider specialty category indicating the provider was a primary care; (2) Carrier claim lines with an ambulatory evaluation and management procedure code, and the provider's Medicare provider specialty category indicating the provider was an nurse practitioner, a physician assistant, or other advanced practice nurse; and (3) outpatient claims with an ambulatory evaluation and management procedure code provided at a Federally Qualified Health Center, rural health clinic, or critical access hospital. Provider types are defined in Appendix Table D.2 and additional details can be found in Footnotes 137 and 138. Most of the visits in the latter three categories are expected to be for primary care, although the measure might capture some visits for other services, including visits with specialist or behavioral health providers. The main reason these visits are grouped together is that the Medicare specialty field on the claims data does not include more detailed specialty data for nurse practitioners, physician assistants, and other advanced practice nurses. Multiple claims with the same provider on the same day were counted as one visit, and multiple claims with different providers on the same day were counted as separate visits.

Number of ambulatory visits with specialist physicians

This measure is the number of Medicare-paid visits with specialist during the study period. Specifically, it includes carrier claim lines (see previous definition) with the provider's Medicare provider specialty category indicating the provider was a specialist physician (as defined in Appendix Table D.2). Multiple claims with the same provider on the same day were counted as one visit, and multiple claims with different providers on the same day were counted as separate visits.

Number of post-acute care days

This measure is the number of Medicare-paid days of post-acute care services; it is the sum of four components: (1) skilled nursing facility days, (2) number of home health visit days, (3) inpatient rehabilitation facility days, and (4) long-term care hospital days. The number of days in skilled nursing facilities is the sum of unique days covered by claims in the skilled nursing facility claims file for which Medicare made a positive payment and includes services provided in swing beds in short-term acute care hospitals or critical access hospitals. The number of home health visit days is defined as the number of days during which a home health visit took place. The visits had to be had to be covered by Part A alone or covered by both Part A and B.[148] (If multiple home health visits occurred on the same day, it was counted only as one day. The number of days in inpatient rehabilitation facilities is defined as the sum of unique days covered by claims in the inpatient claims file for which Medicare made a positive payment and (1) the provider was an inpatient rehabilitation hospital or unit; (2) revenue center code or 0024, 0118, 0128, 0138, 0148, or 0158; or (3) an inpatient primary diagnosis that is grouped by the Agency for Healthcare Research and Quality Clinical Classification Software into category 254 (rehabilitation care; fitting of prostheses; and adjustment of devices). The number of days in long-term care hospitals is defined as the sum of unique days covered by claims in the inpatient claims file for which Medicare made a positive payment and the provider was a long-term care hospital.

Number of inpatient hospitalizations with a surgery

This measure is the number of inpatient stays that include any claims with revenue center codes associated with surgery: 0360, 0361, 0362, 0367, or 0369.

Number of days admitted to hospital for a stay with a surgery

This measure is the number of days in the hospital for inpatient stays that include any claims with revenue center codes associated with surgery: 0360, 0361, 0362, 0367, or 0369.

Number of elective inpatient hospitalizations

This measure is the number inpatient stays that include any claims with a claim admission type code of 3, "elective."

Number of days admitted to hospital for an elective stay

This measure is the number of days in the hospital for inpatient stays that include any claims with a claim admission type code of 3, "elective."

Number of inpatient hospitalizations with a potentially preventable diagnosis

This measure is the number of unplanned inpatient stays that include any claims with a primary diagnosis code of anemia, dehydration, diarrhea, emesis, fever, nausea, neutropenia, pain, pneumonia, or sepsis (see Appendix Table D.16 for ICD-10-CM codes); or that include any claims with a primary diagnosis of an MCCM qualifying diagnosis and another diagnosis that includes of anemia, dehydration,

[148] This limits to home health visits most likely provided after qualifying inpatient stays; many home health visits covered by Part B are not post-acute).

diarrhea, emesis, fever, nausea, neutropenia, pain, pneumonia, or sepsis. Unplanned inpatient stays are based on the Yale readmissions measure. The potentially preventable diagnosis codes (including the use of secondary diagnosis codes) is based the Potentially Avoidable Admissions and Emergency Department Visits Among Patients Receiving Outpatient Chemotherapy measure from the on the Exempt Cancer Hospital Quality Reporting system under the CMS Prospective Payment System (ID 00021, Reference number 05230-C-PCHQR).

Number of days admitted to hospital with a potentially preventable diagnosis

This measure is the number of days in the hospital for unplanned inpatient stays that include any claims with a primary diagnosis code of anemia, dehydration, diarrhea, emesis, fever, nausea, neutropenia, pain, pneumonia, or sepsis (see Appendix Table D.16 for ICD-10-CM codes); or that include any claims with a primary diagnosis of an MCCM qualifying diagnosis and another diagnosis that includes of anemia, dehydration, diarrhea, emesis, fever, nausea, neutropenia, pain, pneumonia, or sepsis. See details about the related hospital admission outcome measures above.

Number of outpatient emergency department visits and observation stays with a potentially preventable diagnosis

This measure is the sum of the number of Medicare-paid outpatient emergency department visits and the number of observation stays that include any claims with a primary diagnosis code of anemia, dehydration, diarrhea, emesis, fever, nausea, neutropenia, pain, pneumonia, or sepsis (see Appendix Table D.16 for ICD-10-CM codes); or that include any claims with a primary diagnosis of an MCCM qualifying diagnosis and another diagnosis that includes of anemia, dehydration, diarrhea, emesis, fever, nausea, neutropenia, pain, pneumonia, or sepsis. See details about the related hospital admission outcome measures above.

3.3. Hospice-related measures

Used the Medicare hospice benefit

This measure is an indicator of whether the beneficiary used the Medicare hospice benefit at any point during the study period. We consider a beneficiary to have used the Medicare hospice benefit if they have one or more hospice claims where the demonstration identification number was not equal to 73, which would indicate participation in MCCM. This definition was adapted from National Quality Forum measure 0215.

Length of time from enrollment (or pseudo-enrollment) to entering hospice

This measure is the number of days between a beneficiary's enrollment (or pseudo-enrollment) and the from date of the next following claim for hospice services.[149]

[149] For certain planned time-to-event analyses, such as Cox proportional hazard regression models, we recoded missing data to the length of observed follow-up, using it in conjunction with the previous measure (whether, yes or no, the beneficiary used the hospice benefit).

Number of days in hospice

This measure is the total number of Medicare-paid days for hospice care received by the beneficiary. The number of days in hospice is defined as the sum of days across all of a beneficiary's hospice claims whose admission date was in the period. (The measure is set to zero if a beneficiary did not use the hospice benefit during the study period.)

Admitted to hospice less than three days before death

This measure is an indicator of whether the beneficiary enrolled in the Medicare hospice benefit and was admitted to hospice fewer than three days prior to their death. (The measure was set to missing for beneficiaries who did not die in the study period.)

3.4. Quality measures

Received an aggressive life-prolonging treatment in the last 30 days of life

This measure indicates whether a beneficiary received treatments or diagnostic testing (after enrollment or pseudo-enrollment) that are generally believed to be inappropriate for beneficiaries nearing the end of life and are therefore indicative of low-quality care in the last 30 days of life. The measure includes very aggressive interventions, such as mechanical ventilation (CPT 94003), hemodialysis (CPT 90935-90940), enteral or parenteral nutrition (CPT 43761; HCPCS B40-B42, B50-B52, B90, B99), and cardiopulmonary resuscitation (CPT 92950) (Wasp et al. 2020; De Schreye et al. 2017, 2018). In addition, at the end of their lives, beneficiaries with cancer might receive infusion or oral chemotherapy (RC 0331-0335; ICD-9-CM 9925; CPT 96401-96450, 96521-96542; HCPCS J85-J99, Q0083-Q0085) (Wasp et al. 2020; De Schreye et al. 2017; Earle et al. 2005). Beneficiaries with chronic obstructive pulmonary disease might receive endotracheal intubation or tracheotomy (CPT 31500, 31605), lung volume reduction surgery (CPT 32491), coronary or abdominal surgery (CPT 229x, 441x-442x, 451x, 492x-493x, 929x-935x; HCPCS G0269), or spirometry (CPT 940x, 94150, 94200, 94375, 94727). The measure also includes a wide range of major surgeries, such as thoracic, abdominal, or orthopedic surgeries. However, the measure also includes apparently trivial diagnostic procedures such as phlebotomy for blood tests (CPT 99195), or electrocardiography (CPT 930x). However, even these superficially minor procedures are inappropriate because, in terminally ill persons, they are likely to uncover significant abnormalities such as anemia, kidney failure, or electrolyte abnormalities, that will prompt hospitalization and lead to a cascade of aggressive, inappropriate treatments (De Schreye et al. 2017, 2018). The measure indicates whether the beneficiary received one or more of the above-mentioned treatments or tests from after enrollment (or pseudo-enrollment) in the last 30 days of life.

Number of inpatient hospitalizations in the last 30 days of life with an aggressive life-prolonging procedure, surgery, or diagnostic testing

This measure is the number of unplanned inpatient stays with any aggressive life-prolonging procedure, surgery, or diagnostic testing. For details on the definition of aggressive life-prolonging procedure, surgery, or diagnostic testing, see above.

Number of days admitted to hospital in the last 30 days of life for a stay with an aggressive life-prolonging procedure, surgery, or diagnostic testing

This measure is the number of days in the hospital for inpatient stays with any aggressive life-prolonging procedure, surgery, or diagnostic testing. For details on the definition of aggressive life-prolonging procedure, surgery, or diagnostic testing, see above.

Number of outpatient emergency department visits and observation stays with an aggressive life-prolonging procedure, surgery, or diagnostic testing

This measure is the sum of the number of Medicare-paid outpatient emergency department visits and the number of observation stays that include any claims with any aggressive life-prolonging procedure, surgery, or diagnostic testing. For details on the definition of aggressive life-prolonging procedure, surgery, or diagnostic testing, see above in this section.

Number of days at home

This is a measure of the number of days the beneficiary spent at home from the time of enrollment (or pseudo-enrollment) to the time of death or the study period end. We define this measure as the number of days between enrollment and death for a beneficiary, less days spent in hospitals, inpatient hospice, inpatient rehabilitation facilities, long-term care hospitals, and skilled nursing facilities. The measure was adapted from Lee et al. (2019) and Medicare Payment Advisory Commission (2015).

More than one emergency department visit in last 30 days of life

This measure indicates whether a decedent had more than one emergency department visits in the last 30 days of life. Emergency department visits were identified the same way as we described above. This measure is based on National Quality Forum measure 0211. (The measure was set to missing for beneficiaries who did not die in the study period.)

More than one hospitalization in last 30 days of life

This measure indicates whether a decedent had more than one inpatient admission in the last 30 days of life. Inpatient admissions were identified the same way as we described above. This measure is based on National Quality Forum measure 0212. (The measure was set to missing for beneficiaries who did not die in the study period.)

Any intensive care unit admission in last 30 days of life

This measure indicates whether a decedent had any intensive care unit admissions in the last 30 days of life. Intensive care unit admissions were identified the same way as we described above. This measure is based on National Quality Forum measure 0213. (The measure was set to missing for beneficiaries who did not die in the study period.)

Death in an inpatient facility

This measure indicates whether a beneficiary died in an inpatient facility. It is defined as having one or more inpatient facility (hospital, skilled nursing facility, rehabilitation hospital, or long-term acute care

hospital) claims in which discharge status is "expired" (discharge status code 20). (The measure was set to missing for beneficiaries who did not die in the study period.)

Survival time: length of time from enrollment (or pseudo-enrollment) until death

This is a measure of how long beneficiaries lived were alive after enrollment (or pseudo-enrollment). It is defined as the number of days between a beneficiary's enrollment (or pseudo-enrollment) date and the death date. It is set to missing for beneficiaries who did not die during the study period.

4. Detailed Information on health care measures

This section includes 17 tables to supplement the variable definitions presented earlier in this Appendix.

4.1. Eligibility measures

Table D.1. Diagnosis codes indicating each of the four MCCM-eligible conditions

Disease		Code system	Codes
Congestive heart failure		ICD-9-CM	4280, 4281, 4289, 40201, 40211, 40291, 40401, 40411, 40491, 42820, 42821, 42822, 42823, 42830, 42831, 42832, 42833, 42840, 42841, 42842, 42843
		ICD-10-CM	I110, I130, I501, I502, I5020, I5021, I5022, I5023, I503, I5030, I5031, I5032, I5033, I504, I5040, I5041, I5042, I5043, I509
Chronic obstructive pulmonary disease		ICD-9-CM	4920, 4928, 4940, 4941, 49120, 49121, 49122, 49320, 49321
		ICD-10-CM	J430, J431, J432, J438, J439, J440, J441, J449, J470, J471, J479
HIV/AIDS		ICD-9-CM	042
		ICD-10-CM	B20
Cancer	Breast	ICD-9-CM	1740, 1741, 1742, 1743, 1744, 1745, 1746, 1748, 1749, 1750, 1759
		ICD-10-CM	C50011, C50012, C50019, C50021, C50022, C50029, C50111, C50112, C50119, C50121, C50122, C50129, C50211, C50212, C50219, C50221, C50222, C50229,C50311, C50312, C50319, C50321, C50322, C50329, C50411, C50412, C50419, C50421, C50422, C50429, C50511, C50512, C50519, C50522, C50529, C50611, C50612, C50619, C50621, C50622, C50629, C50811, C50812, C50819, C50821, C50822, C50829, C50911, C50912, C50919, C50921, C50922, C50929, C7981, C946
Cancer	Colorectal	ICD-9-CM	1520, 1521, 1522, 1530, 1531, 1532, 1533, 1534, 1535, 1536, 1537, 1538, 1539, 1540, 1541, 1548, 20901, 20902, 20903, 20910, 20911, 20912, 20913, 20914, 20915, 20916, 20917
		ICD-10-CM	C170, C171, C172, C180, C181, C182, C183, C184, C185, C186, C187, C188, C189, C19, C20, C218, C785, C7A010, C7A011, C7A012, C7A020, C7A021, C7A022, C7A023, C7A024, C7A025, C7A026, C7A029, C7A094, C7A095, C7A096, C883
Cancer	Lung	ICD-9-CM	1622, 1622, 1623, 1623, 1624, 1624, 1625, 1628, 1629, 1764
		ICD-10-CM	C3400, C3401, C3402, C3410, C3411, C3412, C342, C3430, C3431, C3432, C3480, C3481, C3482, C3490, C3491, C3492, C4650, C4651, C4652, C7800, C7801, C7802, C7A090

Disease		Code system	Codes
Cancer	Other	ICD-9-CM	1400, 1401, 1403, 1404, 1405, 1406, 1408, 1409, 179, 181, 193, 1410, 1411, 1412, 1413, 1414, 1415, 1416, 1418, 1419, 1420, 1421, 1422, 1428, 1429, 1430, 1431, 1438, 1439, 1440, 1441, 1448, 1449, 1450, 1451, 1452, 1453, 1454, 1455, 1456, 1458, 1459, 1460, 1461, 1462, 1463, 1464, 1465, 1466, 1467, 1468, 1469, 1470, 1471, 1472, 1473, 1478, 1479, 1480, 1481, 1482, 1483, 1488, 1489, 1490, 1491, 1498, 1499, 1500, 1501, 1502, 1503, 1504, 1505, 1508, 1509, 1510, 1511, 1512, 1513, 1514, 1515, 1516, 1518, 1519, 1523, 1528, 1529, 1542, 1543, 1550, 1551, 1552, 1560, 1561, 1562, 1568, 1569, 1570, 1571, 1572, 1573, 1574, 1578, 1579, 1580, 1588, 1589, 1591, 1598, 1599, 1600, 1601, 1602, 1603, 1604, 1605, 1608, 1609, 1610, 1611, 1612, 1613, 1618, 1619, 1620, 1630, 1631, 1638, 1639, 1639, 1640, 1640, 1641, 1641, 1642, 1642, 1643, 1643, 1648, 1648, 1649, 1649, 1650, 1650, 1658, 1658, 1659, 1700, 1701, 1702, 1703, 1704, 1705, 1706, 1707, 1708, 1709, 1710, 1712, 1713, 1714, 1715, 1716, 1717, 1718, 1719, 1720, 1721, 1722, 1723, 1724, 1725, 1726, 1727, 1728, 1729, 17301, 17302, 17309, 1760, 1761, 1762, 1763, 1765, 1768, 1769, 1800, 1801, 1808, 1809, 1820, 1821, 1828, 1830, 1832, 1833, 1834, 1835, 1838, 1839, 1840, 1841, 1842, 1843, 1844, 1848, 1849, 1860, 1869, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906,1907, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1928, 1929, 1930, 1940, 1941, 1943, 1944, 1945, 1946, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1958, 1982, 2733, 20000, 20001, 20002, 20003, 20004, 20005, 20006, 20007, 20008, 20010, 20011, 20012, 20013, 20014, 20015, 20016, 20017, 20018, 20020, 20021, 20022, 20023, 20024, 20025, 20026, 20027, 20028, 20030, 20031, 20032, 20033, 20034, 20035, 20036, 20037, 20038, 20040, 20041, 20042, 20043, 20044, 20045, 20046, 20047, 20048, 20050, 20051, 20052, 20053, 20054, 20055, 20056, 20057, 20058, 20060, 20061, 20062, 20063, 20064, 20065, 20066, 20067, 20068, 20070, 20071, 20072, 20073, 20074, 20075, 20076, 20077, 20078, 20080, 20081, 20082, 20083, 20084, 20085, 20086, 20087, 20088, 20100, 20101, 20102, 20103, 20104, 20105, 20106, 20107, 20108, 20110, 20111, 20112, 20113, 20114, 20115, 20116, 20117, 20118, 20120, 20121, 20122, 20123, 20124, 20125, 20126, 20127, 20128, 20140, 20141, 20142, 20143, 20144, 20145, 20146, 20147, 20148, 20150, 20151, 20152, 20153, 20154, 20155, 20156, 20157, 20158, 20160, 20161, 20162, 20163, 20164, 20165, 20166, 20167, 20168, 20170, 20171, 20172, 20173, 20174, 20175, 20176, 20177, 20178, 20190, 20191, 20192, 20193, 20194, 20195, 20196, 20197, 20198, 20200, 20201, 20202, 20203, 20204, 20205, 20206, 20207, 20208, 20210, 20211, 20212, 20213, 20214, 20215, 20216, 20217, 20218, 20220, 20221, 20222, 20223, 20224, 20225, 20226, 20227, 20228, 20230, 20231, 20232, 20233, 20234, 20235, 20236, 20237, 20238, 20240, 20241, 20242, 20243, 20244, 20245, 20246, 20247, 20248, 20250, 20251, 20252, 20253, 20254, 20255, 20256, 20257, 20258, 20260, 20261, 20262, 20263, 20264, 20265, 20266, 20267, 20268, 20270, 20271, 20272, 20273, 20274, 20275, 20276, 20277, 20278, 20280, 20281, 20282, 20283, 20284, 20285, 20286, 20287, 20288, 20290, 20291, 20292, 20293, 20294, 20295, 20296, 20297, 20298, 20300, 20301, 20302, 20310, 20311, 20312, 20380, 20381, 20382, 20400, 20401, 20402, 20410,

Disease		Code system	Codes
Cancer (cont.)	Other (cont.)	ICD-9-CM (cont.)	20411, 20412, 20420, 20421, 20422, 20480, 20481, 20482, 20490, 20491, 20492, 20500, 20501, 20502, 20510, 20511, 20512, 20520, 20521, 20522, 20530, 20531, 20532, 20580, 20581, 20582, 20590, 20591, 20592, 20600, 20601, 20602, 20610, 20611, 20612, 20620, 20621, 20622, 20680, 20681, 20682, 20690, 20691, 20692, 20700, 20701, 20702, 20720, 20721, 20722, 20780, 20781, 20782, 20800, 20801, 20802, 20810, 20811, 20812, 20820, 20821, 20822, 20880, 20881, 20882, 20890, 20891, 20892, 20900, 20920, 20921, 20922, 20923, 20924, 20925, 20926, 20927, 20929, 20930, 20931, 20932, 20933, 20934, 20935, 20936, 20970, 20971, 20972, 20973, 20974, 20979, 23879, 27789
Cancer	Other	ICD-10-CM	C4400, C4401, C4402, C4409, C01, C020, C021, C022, C023, C024, C028, C029, C030, C031, C039, C040, C041, C048, C049, C050, C051, C052, C058, C059, C060, C061, C062, C0680, C0689, C069, C07, C080, C081, C089, C090, C091, C098, C099, C100, C101, C102, C103, C104, C108, C109, C110, C111, C112, C113, C118, C119, C12, C130, C131, C132, C138, C139, C140, C142, C148, C153, C154, C155, C158, C159, C160, C161, C162, C163, C164, C165, C166, C168, C169, C173, C178, C179, C210, C211, C212, C220, C221, C222, C223, C224, C227, C228, C229, C23, C240, C241, C248, C249, C250, C251, C252, C253, C254, C257, C258, C259, C260, C261, C269, C300, C301, C310, C311, C312, C313, C318, C319, C320, C321, C322, C323, C328, C329, C33, C37, C380, C381, C382, C383, C384, C388, C390, C399, C4000, C4001, C4002, C4010, C4011, C4012, C4020, C4021, C4022, C4030, C4031, C4032, C4080, C4081, C4082, C4090, C4091, C4092, C410, C411, C412, C413, C414, C419, C430, C4310, C4311, C4312, C4320, C4321, C4322, C4330, C4331, C4339, C434, C4351, C4352, C4359, C4360, C4361, C4362, C4370, C4371, C4372, C438, C439, C450, C451, C452, C457, C459, C460, C461, C462, C463, C464, C467, C469, C470, C4710, C4711, C4712, C4720, C4721, C4722, C473, C474, C475, C476, C478, C480, C481, C482, C488, C490, C4910, C4911, C4912, C4920, C4921, C4922, C493, C494, C495, C496, C498, C499, C510, C511, C512, C518, C519, C530, C531, C538, C539, C540, C541, C542, C543, C548, C549, C55, C561, C562, C569, C5700, C5701, C5702, C5710, C5711, C5712, C5720, C5721, C5722, C573, C574, C577, C578, C579, C58, C600, C601, C602, C608, C609, C6200, C6201, C6202, C6210, C6211, C6212, C6290, C6291, C6292, C6300, C6301, C6302, C6310, C6311, C6312, C632, C637, C638, C639, C641, C642, C649, C651, C659, C661, C669, C670, C671, C672, C673, C674, C675, C676, C677, C678, C679, C680, C681, C688, C689, C6900, C6901, C6902, C6910, C6911, C6912, C6920, C6921, C6922, C6930, C6931, C6932, C6940, C6941, C6942, C6950, C6951, C6952, C6960, C6961, C6962, C6980, C6981, C6982, C6990, C6991, C6992, C700, C701, C709, C710, C711, C712, C713, C714, C715, C716, C717, C718, C719, C720, C721, C7220, C7221, C7222, C7230, C7231, C7232, C7240, C7241, C7242, C7250, C7259, C729, C73, C7400, C7401, C7402, C7410, C7411, C7412, C7490, C7491, C7492, C750, C751, C752, C753, C754, C755, C758, C759, C760, C761, C762, C763, C7640, C7641, C7642, C7650, C7651, C7652, C768, C770, C771, C772, C773, C774, C775, C778, C779, C781, C782, C7830, C7839, C784, C786, C787, C7880, C7889,

Disease		Code system	Codes
Cancer (cont.)			C7900, C7901, C7902, C7910, C7911, C7919, C792, C7931, C7932, C7940, C7949, C7951, C7952, C7960, C7961, C7962, C7970, C7971, C7972, C7982, C7989, C799, C7A00, C7A019, C7A091, C7A092, C7A093, C7A098, C7A1, C7A8, C7B00, C7B01, C7B02, C7B03, C7B04, C7B09, C7B1, C7B8, C800, C801, C802, C8100, C8101, C8102, C8103, C8104, C8105, C8106, C8107, C8108, C8109, C8110, C8111, C8112, C8113, C8114, C8115, C8116, C8117, C8118, C8119, C8120, C8121, C8122, C8123, C8124, C8125, C8126, C8127, C8128, C8129, C8130, C8131, C8132, C8133, C8134, C8135, C8136, C8137, C8138, C8139, C8140, C8141, C8142, C8143, C8144, C8145, C8146, C8147, C8148, C8149, C8170, C8171, C8172, C8173, C8174, C8175, C8176, C8177, C8178, C8179, C8190, C8191, C8192, C8193, C8194, C8195, C8196, C8197, C8198, C8199, C8200, C8201, C8202, C8203, C8204, C8205, C8206, C8207, C8208, C8209, C8210, C8211, C8212, C8213, C8214, C8215, C8216, C8217, C8218, C8219, C8220, C8221, C8222, C8223, C8224, C8225, C8226, C8227, C8228, C8229, C8230, C8231, C8232, C8233, C8234, C8235, C8236, C8237, C8238, C8239, C8240, C8241, C8242, C8243, C8244, C8245, C8246, C8247, C8248, C8249, C8250, C8251, C8252, C8253, C8254, C8255, C8256, C8257, C8258, C8259, C8260, C8261, C8262, C8264, C8265, C8266, C8267, C8268, C8269, C8280, C8281, C8282, C8283, C8284, C8285, C8286, C8287, C8288, C8289, C8290, C8291, C8292, C8293, C8294, C8295, C8296, C8297, C8298, C8299, C8300, C8301, C8302, C8303, C8304, C8305, C8306, C8307, C8308, C8309, C8310, C8311, C8312, C8313, C8314, C8315, C8316, C8317, C8318, C8319, C8330, C8331, C8332, C8333, C8334, C8335, C8336, C8337, C8338, C8339, C8350, C8351, C8352, C8353, C8354, C8355, C8356, C8357, C8358, C8359, C8370, C8371, C8372, C8373, C8374, C8375, C8376, C8377, C8378, C8380, C8381, C8382, C8383, C8384, C8385, C8386, C8387, C8388, C8389, C8390, C8391, C8392, C8393, C8394, C8395, C8396, C8397, C8398, C8399, C8400, C8401, C8402, C8403, C8405, C8406, C8407, C8408, C8409, C8410, C8411, C8412, C8413, C8414, C8415, C8416, C8417, C8418, C8419, C8440, C8441, C8442, C8443, C8444, C8445, C8446, C8447, C8448, C8449, C8460, C8461, C8462, C8463, C8464, C8465, C8466, C8467, C8468, C8469, C8470, C8471, C8472, C8473, C8474, C8475, C8476, C8477, C8478, C8479, C8490, C8491, C8492, C8493, C8494, C8495, C8496, C8497, C8498, C8499, C84A0, C84A1, C84A2, C84A3, C84A4, C84A5, C84A6, C84A7, C84A8, C84A9, C84Z0, C84Z1, C84Z2, C84Z3, C84Z4, C84Z5, C84Z6, C84Z7, C84Z8, C84Z9, C8510, C8511, C8512, C8513, C8514, C8515, C8516, C8517, C8518, C8519, C8520, C8521, C8522, C8523, C8524, C8525, C8526, C8527, C8528, C8529, C8580, C8581, C8582, C8583, C8584, C8585, C8586, C8587, C8588, C8589, C8590, C8591, C8592, C8593, C8594, C8595, C8596, C8597, C8598, C8599, C860, C861, C862, C863, C864, C865, C866, C880, C882, C884, C888, C889, C9000, C9001, C9002, C9010, C9011, C9012, C9021, C9022, C9030, C9031, C9032, C9100, C9101, C9102, C9110, C9110, C9111, C9112, C9130, C9131, C9132, C9140, C9141, C9142, C9150, C9151, C9152, C9160, C9161, C9162, C9190, C9191, C9192, C91A0, C91A1, C91A2, C91Z0, C91Z1,

Disease		Code system	Codes
Cancer (*cont.*)			C91Z2, C9200, C9201, C9202, C9210, C9211, C9212, C9220, C9221, C9222, C9230, C9231, C9232, C9240, C9241, C9242, C9250, C9251, C9252, C9260, C9261, C9262, C9290, C9291, C9292, C92A0, C92A1, C92A2, C92Z0, C92Z1, C92Z2, C9300, C9301, C9302, C9310, C9311, C9312, C9331, C9332, C9390, C9391, C9392, C93Z0, C93Z1, C93Z2, C9400, C9401, C9402, C9420, C9421, C9422, C9430, C9431, C9432, C9440, C9441, C9442, C9480, C9481, C9482, C9500, C9501, C9502, C9510, C9511, C9512, C9590, C9591, C9592, C960, C962, C9620, C9621, C9622, C9629, C964, C965, C966, C96A, C96Z
Cancer	Prostate	ICD-9-CM	185
		ICD-10-CM	C61

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification; ICD-10-CM = International Classification of Diseases, Tenth Revision, Clinical Modification.

4.2. Provider types

Table D.2. Provider type definitions based on Medicare specialty code

Provider type	Medicare specialty codes
Primary care providers	01 (General practice), 08 (Family practice), 11 (Internal medicine), 16 (Obstetrics/gynecology), 37 (Pediatric medicine), and 38 (Geriatric medicine).
Nurse practitioners, physician assistants, and clinical nurse specialists	42 (Certified nurse midwife), 43 (Certified registered nurse anesthetists (eff. 1/87) (Anesthesiologist assistants were removed from this specialty 4/1/03)), 50 (Nurse practitioner), 89 (Certified clinical nurse specialist), and 97 (Physician assistant).
Specialists	02 (General surgery), 03 (Allergy/immunology), 04 (Otolaryngology), 05 (Anesthesiology), 06 (Cardiology), 07 (Dermatology), 09 (Interventional Pain Management (eff. 4/1/03)), 10 (Gastroenterology),12 (Osteopathic manipulative therapy), 13 (Neurology), 14 (Neurosurgery), 17 (Hospice and palliative care), 18 (Ophthalmology), 19 (Oral surgery (dentists only)), 20 (Orthopedic surgery), 21 (Cardiac electrophysiology), 22 (Pathology), 23 (Sports medicine), 24 (Plastic and reconstructive surgery), 25 (Physical medicine and rehabilitation), 26 (Psychiatry), 27 (Geriatric psychiatry colorectal surgery), 28 (Colorectal surgery (formerly proctology)), 29 (Pulmonary disease), 30 (Diagnostic radiology), 33 (Thoracic surgery), 34 (Urology), 35 (Chiropractic), 36 (Nuclear medicine), 39 (Nephrology), 40 (Hand surgery), 44 (Infectious disease), 46 (Endocrinology), 48 (Podiatry), 66 (Rheumatology (eff 5/92)), 70 (Multispecialty clinic or group practice), 72 (Pain management (eff. 1/1/02)), 76 (Peripheral vascular disease), 77 (Vascular surgery), 78 (Cardiac surgery), 79 (Addiction medicine), 81 (Critical care (intensivists)), 82 (Hematology), 83 (Hematology/oncology), 84 (Preventive medicine), 85 (Maxillofacial surgery), 86 (Neuropsychiatry), 90 (Medical oncology), 91 (Surgical oncology), 92 (Radiation oncology), 93 (Emergency medicine), 94 (Interventional radiology), 98 (Gynecologist/oncologist), 99 (Unknown physician specialty), C0 (Sleep medicine), C3 (Interventional cardiology), C5 (Dentist (eff. 7/2016)), C6 (hospitalist), C7 (advanced heart failure and transplant cardiology), C8 (medical toxicology), C9 (hematopoietic cell transplantation and cellular therapy), D3 (Medical genetics and genomics), D4 (Undersea and hyperbaric medicine), D5 (Opioid treatment program), D7 (Micrographic dermatologic surgery (effective October 1, 2020)) and D8 (Adult congenital heart disease (effective October 1, 2020)).

4.3. Prior health care use

Table D.3. Codes used for identifying ambulatory visits

Type	Code system	Codes
Excluded Place of Service Codes for ambulatory visit claims	Place of service	20 (Urgent care), 21 (Inpatient Hospital), 23 (Emergency room), 51 (Inpatient Psychiatric Facility), 55 (Residential Substance Abuse Treatment Facility), 56 (Psychiatric Residential Treatment Center), or 61 (Comprehensive Inpatient Rehabilitation Facility)
Evaluation and management procedure codes	CPT	99201-99205, 99211-99215, 99324-99328, 99334-99337, 99339-99340, 99341-99345, 99347-99350, 99354-99355, 99358-99359, 99415-99416, 99421-99423, 99381-99387, 99391-99397, 98966-98968, 99441-99443, 98969, 99439, 99444, 99453-99454, 99457, 99458, 99461, 99473-99474, 99483, 99487, 99489, 99490, 99491, 99492-99493, 99494, 99495-99496, 99484, 99497, 99498, 99091, 90785, 90791-90792, 90832, 90834, 90837, 90833, 90836, 90838, 90839, 90840, 90845-90847, 90849, 90853, 96150-96151, 96152-96155, 96156, 96158-96159, 96160-96161, 96164-96165, 96167-96168, 97151-97158, G0076-G0087, G2010, G2011, G2012, G2058, G2061, G2062, G2063, G0402, G0438-G0439, G0502-G0503, G0504, G0505, G0506, G0507, G0513-G0514, G9978-G9986, G9987, G0463, G0466-G0467, G0468, G0469-G0470, G0071, G0511, G0512, G2212, G2214, G2250-G2252

CPT = Current Procedural Terminology.

Table D.4. Identifying Federally Qualified Health Center, rural health clinic, or critical access hospital claims

Place of service	Definition
Federally Qualified Health Center claim	Claim type code is 7 (clinic or hospital-based renal dialysis facility) and claim service classification type code is 3 (free-standing provider based Federally Qualified Health Center) or 7 (Federally Qualified Health Center)
Rural health clinic claim	Claim type code is 7 (clinic or hospital-based renal dialysis facility) and claim service classification type code is 1 (rural health clinic)
Critical access hospital claim	3rd and 4th digit of CMS Certification number (CCN) = "13" and one of the following: claim type code 1 and claim service classification, claim type code 1 and claim service classification 4, or claim type code 8 and claim service classification 5. For critical access hospital claims, we also included revenue center codes 0960, 0969, 0982, 0983, 0988, 0989, 0210, 0219, 0280, 0289, 0410, 0419, 0460, 0470, 0471, 0479, 0480, 0489, 0530, 0750, 0759, 0770, 0779, 0780, 0789, 0961, and 0962.

Table D.5. Durable medical equipment codes, by type

Type	Code system	Codes
Oxygen equipment	HCPCS	E0424 to E0455, E0467, E0550, E0560, E1352 to E1358, E1390 to E1392, or E1405 to E1406
Home hospital beds	HCPCS	E0250 to E0373
Walkers or canes	HCPCS	E0100 to E0105 or E0130 to E0159
Wheelchairs	HCPCS	E1130 to E1161 or K0001 to K0195

HCPCS = Healthcare Common Procedure Coding System.

4.4. Health care at enrollment and individual hierarchical condition category condition variables

Table D.6. List of the hierarchical condition category indicators

Category	Description
1	HIV/AIDS
2	Septicemia, Sepsis, Systemic Inflammatory Response Syndrome/Shock
6	Opportunistic Infections
8	Metastatic Cancer and Acute Leukemia
9	Lung and Other Severe Cancers
10	Lymphoma and Other Cancers
11	Colorectal, Bladder, and Other Cancers
12	Breast, Prostate, and Other Cancers and Tumors
17	Diabetes with Acute Complications
18	Diabetes with Chronic Complications
19	Diabetes without Complication
21	Protein-Calorie Malnutrition
22	Morbid Obesity
23	Other Significant Endocrine and Metabolic Disorders
27	End-Stage Liver Disease
28	Cirrhosis of Liver
29	Chronic Hepatitis
33	Intestinal Obstruction/Perforation
34	Chronic Pancreatitis
35	Inflammatory Bowel Disease
39	Bone/Joint/Muscle Infections/Necrosis
40	Rheumatoid Arthritis and Inflammatory Connective Tissue Disease
46	Severe Hematological Disorders
47	Disorders of Immunity
48	Coagulation Defects and Other Specified Hematological Disorders
51	Dementia With Complications
52	Dementia Without Complication
54	Substance Use with Psychotic Complications
55	Substance Use Disorder, Moderate/Severe, or Substance Use with Complications
57	Schizophrenia
58	Reactive and Unspecified Psychosis
70	Quadriplegia
71	Paraplegia
72	Spinal Cord Disorders/Injuries
73	Amyotrophic Lateral Sclerosis and Other Motor Neuron Disease
74	Cerebral Palsy

Category	Description
75	Myasthenia Gravis/Myoneural Disorders and Guillain-Barre Syndrome/Inflammatory and Toxic Neuropathy
76	Muscular Dystrophy
77	Multiple Sclerosis
78	Parkinson's and Huntington's Diseases
79	Seizure Disorders and Convulsions
80	Coma, Brain Compression/Anoxic Damage
82	Respirator Dependence/Tracheostomy Status
83	Respiratory Arrest
84	Cardio-Respiratory Failure and Shock
85	Congestive Heart Failure
86	Acute Myocardial Infarction
87	Unstable Angina and Other Acute Ischemic Heart Disease
88	Angina Pectoris
96	Specified Heart Arrhythmias
99	Intracranial Hemorrhage
100	Ischemic or Unspecified Stroke
103	Hemiplegia/Hemiparesis
104	Monoplegia, Other Paralytic Syndromes
106	Atherosclerosis of the Extremities with Ulceration or Gangrene
107	Vascular Disease with Complications
108	Vascular Disease
110	Cystic Fibrosis
111	Chronic Obstructive Pulmonary Disease
112	Fibrosis of Lung and Other Chronic Lung Disorders
114	Aspiration and Specified Bacterial Pneumonias
115	Pneumococcal Pneumonia, Empyema, Lung Abscess
122	Proliferative Diabetic Retinopathy and Vitreous Hemorrhage
124	Exudative Macular Degeneration
134	Dialysis Status
135	Acute Renal Failure
136	Chronic Kidney Disease, Stage 5
137	Chronic Kidney Disease, Severe (Stage 4)
138	Chronic Kidney Disease, Moderate (Stage 3)
139	Chronic Kidney Disease, Mild or Unspecified (Stages 1-2 or Unspecified)
140	Unspecified Renal Failure
141	Nephritis
157	Pressure Ulcer of Skin with Necrosis Through to Muscle, Tendon, or Bone
158	Pressure Ulcer of Skin with Full Thickness Skin Loss
159	Pressure Ulcer of Skin with Partial Thickness Skin Loss

Category	Description
161	Chronic Ulcer of Skin, Except Pressure
162	Severe Skin Burn or Condition
166	Severe Head Injury
167	Major Head Injury
169	Vertebral Fractures without Spinal Cord Injury
170	Hip Fracture/Dislocation
173	Traumatic Amputations and Complications
176	Complications of Specified Implanted Device or Graft
186	Major Organ Transplant or Replacement Status
188	Artificial Openings for Feeding or Elimination
189	Amputation Status, Lower Limb/Amputation Complications

Note: These hierarchical condition category indicators serve to consolidate beneficiaries into hierarchical condition categories based on their ICD-9-CM and ICD-10-CM diagnosis codes at the beneficiaries' enrollment (or pseudo-enrollment) date.

4.5. Gagne comorbidity index

Table D.7. Diagnosis codes for each condition from the Gagne comorbidity index

Gagne condition	Code system	Code
Alcohol	ICD-9-CM	2911, 2912, 2915, 2919, 29181, 29182, 29189, 30390, 30391, 30392, 30393, 30500, 30501, 30502, 30503, V113
	ICD-10-CM	F1010, F1011, F10120, F10129, F10150, F10159, F10180, F10181, F10182, F10188, F1019, F1020, F1021, F10239, F10250, F10259, F1026, F1027, F10280, F10281, F10282, F10288, F1029, F1094, F10950, F10959, F1096, F1097, F10980, F10982, F1099, F10130, F10131, F10132, F10139, F10930, F10931, F10932, F10939
Any tumor (includes leukemia and lymphoma)	ICD-9-CM	1400, 1401, 1403, 1404, 1405, 1406, 1408, 1409, 151, 155, 179, 181, 185, 193, 1410, 1411, 1412, 1413, 1414, 1415, 1416, 1419, 1420, 1421, 1422, 1428, 1430, 1431, 1438, 1440, 1441, 1448, 1449, 1450, 1451, 1452, 1453, 1454, 1455, 1456, 1458, 1459, 1460, 1461, 1462, 1463, 1464, 1465, 1466, 1467, 1468, 1469, 1470, 1471, 1472, 1473, 1478, 1479, 1480, 1481, 1482, 1483, 1488, 1489, 1490, 1491, 1498, 1500, 1501, 1502, 1508, 1509, 1510, 1511, 1512, 1513, 1514, 1515, 1516, 1518, 1519, 1520, 1521, 1522, 1523, 1528, 1529, 1530, 1531, 1532, 1533, 1534, 1535, 1536, 1537, 1538, 1539, 1540, 1541, 1542, 1543, 1548, 1550, 1551, 1552, 1560, 1561, 1562, 1568, 1569, 1570, 1571, 1572, 1573, 1574, 1578, 1579, 1580, 1588, 1589, 1590, 1591, 1598, 1600, 1601, 1602, 1603, 1604, 1605, 1608, 1609, 1610, 1611, 1612, 1613, 1618, 1619, 1620, 1622, 1623, 1624, 1625, 1628, 1629, 1630, 1639, 1640, 1640, 1641, 1642, 1643, 1648, 1649, 1650, 1658, 1700, 1701, 1702, 1703, 1704, 1705, 1706, 1707, 1708, 1709, 1710, 1712, 1713, 1714, 1715, 1716, 1717, 1718, 1719, 1740, 1741, 1742, 1743, 1744, 1745, 1746, 1748, 1749, 1750, 1759, 1760, 1761, 1762, 1763, 1764, 1765, 1768, 1769, 1800, 1801, 1808, 1809, 1820, 1821, 1828, 1830, 1832, 1833, 1834, 1835, 1838, 1841, 1842, 1843, 1844, 1848, 1849, 1860, 1869, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1928, 1940, 1941, 1943, 1944, 1945, 1946, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1958, 2001, 2002, 2003, 2004, 2005, 2006, 2008, 2730, 2733, 20000, 20001, 20001, 20002, 20002, 20003, 20003, 20004, 20004, 20005, 20005, 20006, 20006, 20007, 20007, 20008, 20008, 20011, 20012, 20013, 20014, 20015, 20016, 20017, 20018, 20021, 20022, 20023, 20024, 20025, 20026, 20027, 20028, 20031, 20032, 20033, 20034, 20035, 20036, 20037, 20038, 20041, 20042, 20043, 20044, 20045, 20046, 20047, 20048, 20051, 20052, 20053, 20054, 20055, 20056, 20057, 20058, 20061, 20062, 20063, 20064, 20065, 20066, 20067, 20068, 20070, 20071, 20071, 20072, 20072, 20073, 20073, 20074, 20074, 20075, 20075, 20076, 20076, 20077, 20077, 20078, 20078, 20081, 20082, 20083, 20084, 20085, 20086, 20087, 20088, 20100, 20101, 20102, 20103, 20104, 20105, 20106, 20107, 20108, 20110, 20111, 20112, 20113, 20114, 20115, 20116, 20117, 20118, 20120, 20121, 20122, 20123, 20124, 20125, 20126, 20127, 20128, 20140, 20141, 20142, 20143,

Gagne condition	Code system	Code
Any tumor (includes leukemia and lymphoma) (cont.)	ICD-9-CM (cont.)	20144, 20145, 20146, 20147, 20148, 20150, 20151, 20152, 20153, 20154, 20155, 20156, 20157, 20158, 20160, 20161, 20162, 20163, 20164, 20165, 20166, 20167, 20168, 20170, 20171, 20172, 20173, 20174, 20175, 20176, 20177, 20178, 20190, 20191, 20192, 20193, 20194, 20195, 20196, 20197, 20198, 20200, 20201, 20202, 20203, 20204, 20205, 20206, 20207, 20208, 20210, 20211, 20212, 20213, 20214, 20215, 20216, 20217, 20218, 20220, 20221, 20222, 20223, 20224, 20225, 20226, 20227, 20228, 20230, 20231, 20232, 20233, 20234, 20235, 20236, 20237, 20238, 20240, 20241, 20242, 20243, 20244, 20245, 20246, 20247, 20248, 20250, 20251, 20252, 20253, 20254, 20255, 20256, 20257, 20258, 20260, 20261, 20262, 20263, 20264, 20265, 20266, 20267, 20268, 20270, 20271, 20272, 20273, 20274, 20275, 20276, 20277, 20278, 20280, 20281, 20282, 20283, 20284, 20285, 20286, 20287, 20288, 20290, 20291, 20292, 20293, 20294, 20295, 20296, 20297, 20298, 20300, 20301, 20302, 20310, 20311, 20312, 20380, 20381, 20382, 20400, 20401, 20402, 20410, 20411, 20412, 20420, 20421, 20422, 20480, 20481, 20482, 20490, 20491, 20492, 20500, 20501, 20502, 20510, 20511, 20512, 20520, 20521, 20522, 20530, 20531, 20532, 20580, 20581, 20582, 20590, 20591, 20592, 20600, 20601, 20602, 20610, 20611, 20612, 20620, 20621, 20622, 20680, 20681, 20682, 20690, 20691, 20692, 20700, 20701, 20702, 20720, 20721, 20722, 20780, 20781, 20782, 20800, 20801, 20802, 20810, 20811, 20812, 20820, 20821, 20822, 20880, 20881, 20882, 20890, 20891, 20892, V1046
	ICD-10-CM	C55, C58, C61, C6202, C73, C880, D890
Cardiac arrhythmias	ICD-9-CM	4262, 4263, 4264, 4266, 4267, 4270, 4272, 4279, 7850, 42610, 42611, 42613, 42650, 42651, 42652, 42653, 42681, 42682, 42689, 42731, 42760, V450, V533
	ICD-10-CM	I440, I441, I4430, I4439, I444, I445, I4460, I4469, I447, I450, I4510, I4519, I452, I454, I455, I456, I471, I479, I480, I481, I482, I4891, I492, I4940, I499, R000
Congestive heart failure	ICD-9-CM	4250, 4252, 4253, 4254, 4255, 4257, 4258, 4259, 4280, 4281, 4289, 4293, 40201, 40211, 40291, 42511, 42518, 42820, 42821, 42822, 42823, 42830, 42831, 42832, 42833, 42840, 42841, 42842, 42843
	ICD-10-CM	I110, I517
Coagulopathy	ICD-9-CM	2860, 2861, 2862, 2863, 2864, 2866, 2867, 2869, 2871, 2875, 28652, 28653, 28659, 28730, 28731, 28732, 28733, 28739, 28741, 28749
	ICD-10-CM	D65, D66, D67, D681, D6832, D684, D688, D689, D691, D696
Complicated diabetes	ICD-9-CM	25040, 25042, 25050, 25052, 25060, 25062, 25070, 25072, 25090, 25092
	ICD-10-CM	E1021, E1022, E1029, E10311, E10319, E103211, E103212, E103213, E103219, E103291, E103292, E103293, E103299, E103311, E103312, E103313, E103319, E103391, E103392, E103393, E103399, E103411, E103412, E103413, E103419, E103491, E103492, E103493, E103499, E103511, E103512, E103513, E103519, E103521, E103522, E103523, E103529, E103531, E103532, E103533, E103539, E103541, E103542, E103543, E103549, E103551, E103552, E103553, E103559, E103591, E103592, E103593, E103599, E1036, E1037X1, E1037X2, E1037X3, E1037X9,

Gagne condition	Code system	Code
	ICD-10-CM (cont.)	E1039, E1040, E1041, E1042, E1043, E1044, E1049, E1051, E1052, E1059, E10610, E1065, E108, E1121, E1122, E1129, E11311, E11311, E11319, E11319, E113211, E113212, E113213, E113219, E113291, E113292, E113293, E113299, E113311, E113312, E113313, E113319, E113391, E113392, E113393, E113399, E113411, E113412, E113413, E113419, E113491, E113492, E113493, E113499, E113511, E113512, E113513, E113519, E113521, E113522, E113523, E113529, E113531, E113532, E113533, E113539, E113541, E113542, E113543, E113549, E113551, E113552, E113553, E113559, E113591, E113592, E113593, E113599, E1136, E1136, E1137X1, E1137X2, E1137X3, E1137X9, E1139, E1139, E1140, E1141, E1142, E1143, E1144, E1149, E1151, E1152, E1159, E11610, E1165, E1165, E118, E1321, E1322, E1329, E13311, E13319, E133211, E133212, E133213, E133219, E133291, E133292, E133293, E133299, E133311, E133312, E133313, E133319, E133391, E133392, E133393, E133399, E133411, E133412, E133413, E133419, E133491, E133492, E133493, E133499, E133511, E133512, E133513, E133519, E133521, E133522, E133523, E133529, E133531, E133532, E133533, E133539, E133541, E133542, E133543, E133549, E133551, E133552, E133553, E133559, E133591, E133592, E133593, E133599, E1336, E1337X1, E1337X2, E1337X3, E1337X9, E1339, E1340, E1341, E1342, E1343, E1344, E1349, E1351, E1352, E1359, E13610, E138
Chronic obstructive pulmonary disease	ICD-9-CM	496, 4150, 4168, 4169, 4910, 4911, 4918, 4919, 4920, 4928, 4940, 4941, 49120, 49121, 49122, 49300, 49301, 49302, 49310, 49311, 49312, 49320, 49321, 49322, 49381, 49382, 49390, 49391, 49392
	ICD-10-CM	I2601, I2602, I2609, I2722, I2723, I2781, I2789, I279, J449
Deficiency anemias	ICD-9-CM	2801, 2808, 2809, 2810, 2811, 2812, 2813, 2814, 2818, 2819, 2859
	ICD-10-CM	D501, D508, D509, D510, D511, D512, D513, D518, D519, D520, D521, D528, D529, D530, D531, D532, D538, D539, D649, D680
Dementia	ICD-9-CM	2900, 2903, 2908, 2909, 3310, 3312, 29010, 29011, 29012, 29013, 29020, 29021, 29040, 29041, 29042, 29043, 33111, 33119
	ICD-10-CM	G300, G301, G308, G309, G311
Fluid and electrolyte disorders	ICD-9-CM	2760, 2761, 2762, 2763, 2764, 2767, 2768, 2769, 27650, 27651, 27652, 27659, 27661, 27669
	ICD-10-CM	E870, E871, E872, E873, E874, E875, E876, E878
Hemiplegia	ICD-9-CM	3441, 3442, 3445, 3449, 34200, 34201, 34202, 34210, 34211, 34212, 34280, 34281, 34282, 34290, 34291, 34292, 34400, 34401, 34402, 34403, 34404, 34409, 34430, 34431, 34432, 34440, 34441, 34442, 34460, 34461, 34481, 34489
	ICD-10-CM	G8100, G8101, G8102, G8103, G8104, G8110, G8111, G8112, G8113, G8114, G8190, G8191, G8192, G8193, G8194, G8220, G8221, G8222, G8250, G8251, G8252, G8253, G8254, G830, G8310, G8311, G8312, G8313, G8314, G8320, G8321, G8322, G8323, G8324, G8330, G8331, G8332, G8333, G8334, G834, G835, G8381, G8382, G8383, G8384, G8389, G839
HIV/AIDS	ICD-9-CM	042
	ICD-10-CM	B20

Gagne condition	Code system	Code
Hypertension (both complicated/uncomplicated)	ICD-9-CM	4011, 4019, 40210, 40290, 40410, 40490, 40511, 40519, 40591, 40599
	ICD-10-CM	I10, I119, I1310, I1311, I150, I151, I152, I158, I159, I160, I161, I169, I2720, I2721, I2724, I2729, N262
Liver disease	ICD-9-CM	4560, 4561, 5710, 5712, 5713, 5715, 5716, 5718, 5719, 5723, 5728, 7032, 7033, 45620, 45621, 57140, 57141, 57142, 57149, V427
	ICD-10-CM	B180, B181, D682, I8500, I8501, I8510, I8511, K700, K702, K7030, K7031, K7040, K7041, K709, K7210, K7211, K7290, K7291, K730, K731, K732, K738, K739, K740, K741, K742, K743, K744, K745, K7460, K7469, K754, K7581, K760, K766, K7689, K769, Z4823, Z944, K7400, K7401, K7402
Metastatic cancer	ICD-9-CM	1960, 1961, 1962, 1963, 1965, 1966, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1986, 1987, 1990, 1991, 1992, 19881, 19882, 19889
	ICD-10-CM	C770, C771, C772, C773, C774, C775, C778, C779, C7800, C7801, C7802, C781, C782, C7830, C7839, C784, C785, C786, C787, C7880, C7889, C7900, C7901, C7902, C791, C7910, C7911, C7919, C792, C7931, C7932, C7940, C7949, C7951, C7952, C7960, C7961, C7962, C7970, C7971, C7972, C7981, C7982, C7989, C799, C800, C801, C802
Peripheral vascular disorder	ICD-9-CM	4400, 4401, 4404, 4408, 4409, 4412, 4414, 4417, 4419, 4431, 4439, 4471, 5571, 5579, 44020, 44021, 44022, 44023, 44024, 44029, 44030, 44031, 44032, 44321, 44322, 44323, 44324, 44329, 44381, 44382, 44389, V434
Peripheral vascular disorder	ICD-10-CM	I700, I701, I708, I7090, I7091, I7092, I712, I714, I716, I719, I731, I739, I771, I790, K551, K558, K559, Z95820, Z95828
Psychosis	ICD-9-CM	2967, 2970, 2973, 2979, 2980, 2981, 2982, 2983, 2984, 2988, 2989, 29500, 29501, 29502, 29503, 29504, 29505, 29510, 29511, 29512, 29513, 29514, 29515, 29520, 29521, 29522, 29523, 29524, 29525, 29530, 29531, 29532, 29533, 29534, 29535, 29540, 29541, 29542, 29543, 29544, 29545, 29550, 29551, 29552, 29553, 29554, 29555, 29560, 29561, 29562, 29563, 29564, 29565, 29570, 29571, 29572, 29573, 29574, 29575, 29580, 29581, 29582, 29583, 29584, 29585, 29590, 29591, 29592, 29593, 29594, 29595, 29600, 29601, 29602, 29603, 29604, 29605, 29606, 29610, 29611, 29612, 29613, 29614, 29615, 29616, 29620, 29621, 29622, 29623, 29624, 29625, 29626, 29630, 29631, 29632, 29633, 29634, 29635, 29636, 29640, 29641, 29642, 29643, 29644, 29645, 29646, 29650, 29651, 29652, 29653, 29654, 29655, 29656, 29660, 29661, 29662, 29663, 29664, 29665, 29666, 29680, 29680, 29681, 29682, 29689, 29690, 29699
	ICD-10-CM	F200, F201, F202, F203, F205, F2081, F2089, F209, F22, F23, F24, F250, F251, F258, F259, F3010, F3011, F3012, F3013, F302, F303, F304, F308, F309, F310, F3110, F3111, F3112, F3113, F312, F3130, F3131, F3132, F314, F315, F3160, F3161, F3162, F3163, F3164, F3173, F3174, F3175, F3176, F3177, F3178, F3181, F3189, F319, F320, F321, F322, F323, F324, F325, F3289, F329, F330, F331, F332, F333, F3340, F3341, F3342, F338, F339, F3481, F3489, F349, Z658
Pulmonary circulation disorders	ICD-9-CM	4160, 4161, 4162, 4168, 4169, 4179
	ICD-10-CM	I289

Gagne condition	Code system	Code
Renal failure	ICD-9-CM	586, 5851, 5852, 5853, 5854, 5855, 5856, 5859, 40311, 40391, 40412, 40492, V420, V4511, V4512, V560, V568, N1830, N1831, N1832
	ICD-10-CM	F39, I120, N19, Z4822, Z4931, Z4932, Z940
Weight loss	ICD-9-CM	260, 261, 262, 2630, 2631, 2632, 2638, 2639
	ICD-10-CM	E40, E41, E42, E43

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification; ICD-10-CM = International Classification of Diseases, Tenth Revision, Clinical Modification.

4.5. Disease-specific measures

4.5.1. Congestive heart failure

Table D.8. Diagnosis codes for measures specific to beneficiaries with congestive heart failure

Measure	Code system	Codes
Any hospitalization with inotropes or cardiac procedure (intra-aortic balloon pump, ventricular assist device, or heart transplantation)	ICD-9-CM	99683, V421
	ICD-10-CM	T8621, Z941
Prior insertion of an automatic implantable cardioverter defibrillator	ICD-9-CM	V4502
	ICD-10-CM	Z95810
Any coronary artery bypass surgery in the 2 years before enrollment	ICD-9-PCS	3610, 3611, 3612, 3613, 3614, 3615, 3616, 3617, 3619
	ICD-10-PCS	0210083, 0210088, 0210089, 0210093, 0210098, 0210099, 0210344, 0210444, 0210483, 0210488, 0210489, 0210493, 0210498, 0210499, 021008C, 021008F, 021008W, 021009C, 021009F, 021009W, 02100A3, 02100A8, 02100A9, 02100AC, 02100AF, 02100AW, 02100J3, 02100J8, 02100J9, 02100JC, 02100JF, 02100JW, 02100K3, 02100K8, 02100K9, 02100KC, 02100KF, 02100KW, 02100Z3, 02100Z8, 02100Z9, 02100ZC, 02100ZF, 02103D4, 021048C, 021048F, 021048W, 021049C, 021049F, 021049W, 02104A3, 02104A8, 02104A9, 02104AC, 02104AF, 02104AW, 02104D4, 02104J3, 02104J8, 02104J9, 02104JC, 02104JF, 02104JW, 02104K3, 02104K8, 02104K9, 02104KC, 02104KF, 02104KW, 02104Z3, 02104Z8, 02104Z9, 02104ZC, 02104ZF
Any percutaneous intervention in the 2 years before enrollment	ICD-9-PCS	0066, 390, 391, 3606, 3607
	ICD-10-PCS	0270046, 0270056, 0270066, 0270076, 0270346, 0270356, 0270366, 0270376, 0270446, 0270456, 0270466, 0270476, 0610075, 0610076, 0610095, 0610096, 0610475, 0610476, 0610495, 0610496, 02700E6, 02703E6, 02704E6, 027004Z, 027005Z, 027006Z, 027007Z, 02700D6, 02700DZ, 02700EZ, 02700F6, 02700FZ, 02700G6, 02700GZ, 02700T6, 02700TZ, 02700Z6, 02700ZZ, 027034Z, 027035Z, 027036Z, 027037Z, 02703D6, 02703DZ, 02703EZ, 02703F6, 02703FZ, 02703G6, 02703GZ, 02703T6, 02703TZ, 02703Z6, 02703ZZ, 027044Z, 027045Z, 027046Z, 027047Z, 02704D6, 02704DZ, 02704EZ, 02704F6, 02704FZ, 02704G6, 02704GZ, 02704T6, 02704TZ, 02704Z6, 02704ZZ, 061007P, 061007Q, 061007R, 061007Y, 061009P, 061009Q, 061009R, 061009Y, 06100A5, 06100A6, 06100AP, 06100AQ, 06100AR, 06100AY, 06100J5, 06100J6, 06100JP, 06100JQ, 06100JR, 06100JY, 06100K5, 06100K6, 06100KP, 06100KQ, 06100KR, 06100KY, 06100Z5, 06100Z6, 06100ZP, 06100ZQ, 06100ZR, 06100ZY, 061047P, 061047Q, 061047R, 061047Y, 061049P, 061049Q, 061049R, 061049Y, 06104A5, 06104A6, 06104AP, 06104AQ, 06104AR, 06104AY, 06104J5, 06104J6, 06104JP, 06104JQ, 06104JR, 06104JY, 06104K5, 06104K6, 06104KP, 06104KQ, 06104KR, 06104KY, 06104Z5, 06104Z6, 06104ZP, 06104ZQ, 06104ZR, 06104ZY

Measure	Code system	Codes
Prior insertion of an automatic implantable cardioverter defibrillator in the 2 years before enrollment	CPT	33216, 33217, 33225, 33230, 33231, 33240
	ICD-9-PCS	0051, 0052, 0054, 3794, 3795, 3796, 3797, 3798
	ICD-10-PCS	02H43KZ, 02H43MZ, 02H44KZ, 02H60KZ, 02H63KZ, 02H63KZ, 02H64KZ, 02H70KZ, 02H73KZ, 02H74KZ, 02HK0KZ, 02HK3KZ, 02HK4KZ, 02HL0KZ, 02HL3KZ, 02HL4KZ, 02HN0KZ, 02HN4KZ, 0JH608Z, 0JH609Z, 0JH639Z, 0JH809Z, 0JH839Z, OJH638Z, OJH838Z
Any hospitalization with inotropes or cardiac procedure (intra-aortic balloon pump, ventricular assist device, or heart transplantation)	CPT	33945, 33975, 33976, 33977, 33978, 33979, 33980, 33981, 33982, 33983, 33990, 33991, 33992
	HCPCS	J1250, J1250, J1265, J2260
	ICD-10-PCS	5A02210
	ICD-9-PCS	3761
Participated in outpatient cardiac rehabilitation program	CPT	93797, 93798

CPT = Current Procedural Terminology; HCPCS = Healthcare Common Procedure Coding System; ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification; ICD-10-CM = International Classification of Diseases, Tenth Revision, Clinical Modification.

4.5.2. Chronic obstructive pulmonary disease

Table D.9. Diagnosis codes for measures specific to beneficiaries with chronic obstructive pulmonary disease

Measure	Code system	Codes
Lung cancer or thoracic malignancies	ICD-9-CM	1622, 1623, 1624, 1625, 1628, 1629, 1639, 1640, 1641, 1642, 1643, 1648, 1649, 1650, 1658, 1659
	ICD-10-CM	C3400, C3401, C3402, C3410, C3411, C3412, C342, C3430, C3431, C3432, C3480, C3481, C3482, C3490, C3491, C3492, C37, C380, C381, C382, C383, C384, C388, C390, C399
Nutritional abnormalities	ICD-9-CM	260, 261, 262, 267, 2630, 2631, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2661, 2662, 2669, 2680, 2681, 2689, 2690, 2691, 2692, 2693, 2698, 2699, 2782, 2783, 2784, 2788, 7830, 7831, 7833, 7835, 7836, 7837, 7839, 78321, 78321, 78322, V121
	ICD-10-CM	E40, E41, E42, E43, E44, E440, E441, E46, E50, E500, E501, E502, E503, E504, E505, E506, E507, E508, E509, E51, E5111, E5112, E512, E518, E519, E52, E53, E530, E531, E538, E539, E54, E55, E550, E559, E56, E560, E561, E568, E569, E58, E59, E60, E61, E610, E611, E612, E613, E614, E615, E616, E617, E618, E619, E62, E630, E631, E638, E639, E640, E641, E642, E643, E648, E649, E65, R627, R630, R631, R632, R633, R634, R635, R636, R638, Z8639
Skeletal muscle dysfunction	ICD-9-CM	7282, 7283, 7289, 72883, 72884, 72885, 72887, 72888, 72889
	ICD-10-CM	M62, M6200, M62011, M62012, M62019, M62021, M62022, M62029, M62031, M62032, M62039, M62041, M62042, M62049, M62051, M62052, M62059, M62061, M62062, M62069, M62071, M62072, M62079, M6208, M6210, M62111, M62112, M62119, M62121, M62122, M62129, M62131, M62132, M62139, M62141, M62142, M62149, M62151, M62152, M62159, M62161, M62162, M62169, M62171, M62172, M62179, M6218, M6220, M62211, M62212, M62219, M62221, M62222, M62229, M62231, M62232, M62239, M62241, M62242, M62249, M62251, M62252, M62259, M62261, M62262, M62269, M62271, M62272, M62279, M6228, M623, M6240, M62411, M62412, M62419, M62421, M62422, M62429, M62431, M62432, M62439, M62441, M62442, M62449, M62451, M62452, M62459, M62461, M62462, M62469, M62471, M62472, M62479, M6248, M6249, M6250, M62511, M62512, M62519, M62521, M62522, M62529, M62531, M62532, M62539, M62541, M62542, M62549, M62551,
Skeletal muscle dysfunction	ICD-10-CM	M62552, M62559, M62561, M62562, M62569, M62571, M62572, M62579, M6258, M6259, M6281, M6282, M62830, M62831, M62838, M6284, M6289, M629, M63, M6380, M63811, M63812, M63819, M63821, M63822, M63829, M63831, M63832, M63839, M63841, M63842, M63849, M63851, M63852, M63859, M63861, M63862, M63869, M63871, M63872, M63879, M6388, M6389

Measure	Code system	Codes
Osteoporosis	ICD-9-CM	73300, 73301, 73302, 73303, 73309, V1781
	ICD-10-CM	M80, M8000XA, M8000XD, M8000XG, M8000XK, M8000XP, M8000XS, M80011A, M80011D, M80011G, M80011K, M80011P, M80011S, M80012A, M80012D, M80012G, M80012K, M80012P, M80012S, M80019A, M80019D, M80019G, M80019K, M80019P, M80019S, M80021A, M80021D, M80021G, M80021K, M80021P, M80021S, M80022A, M80022D, M80022G, M80022K, M80022P, M80022S, M80029A, M80029D, M80029G, M80029K, M80029P, M80029S, M80031A, M80031D, M80031G, M80031K, M80031P, M80031S, M80032A, M80032D, M80032G, M80032K, M80032P, M80032S, M80039A, M80039D, M80039G, M80039K, M80039P, M80039S, M80041A, M80041D, M80041G, M80041K, M80041P, M80041S, M80042A, M80042D, M80042G, M80042K, M80042P, M80042S, M80049A, M80049D, M80049G, M80049K, M80049P, M80049S, M80051A, M80051D, M80051G, M80051K, M80051P, M80051S, M80052A, M80052D, M80052G, M80052K, M80052P, M80052S, M80059A, M80059D, M80059G, M80059K, M80059P, M80059S, M80061A, M80061D, M80061G, M80061K, M80061P, M80061S, M80062A, M80062D, M80062G, M80062K, M80062P, M80062S, M80069A, M80069D, M80069G, M80069K, M80069P, M80069S, M80071A, M80071D, M80071G, M80071K, M80071P, M80071S, M80072D, M80072K, M80072P, M80072S, M80079A, M80079D, M80079G, M80079K, M80079P, M80079S, M8008XA, M8008XD, M8008XG, M8008XK, M8008XP, M8008XS, M8080XA, M8080XD, M8080XG, M8080XK, M8080XP, M8080XS, M80811A, M80811D, M80811G, M80811K, M80811P, M80811S, M80812A, M80812D, M80812G, M80812K, M80812P, M80812S, M80819A, M80819D, M80819G, M80819K, M80819P, M80819S, M80821A, M80821D, M80821G, M80821K, M80821P, M80821S, M80822A, M80822D, M80822G, M80822K, M80822P, M80822S, M80829A, M80829D, M80829G, M80829K, M80829P, M80829S, M80831A, M80831D, M80831G, M80831K, M80831P, M80831S, M80832A, M80832D, M80832G, M80832K, M80832P, M80832S, M80839A, M80839D, M80839G, M80839K, M80839P, M80839S, M80841A, M80841D, M80841G, M80841K, M80841P, M80841S, M80842A, M80842D, M80842G, M80842K, M80842P, M80842S, M80849A, M80849D, M80849G, M80849K, M80849P, M80849S, M80851A, M80851D, M80851G, M80851K, M80851P, M80851S, M80852A, M80852D, M80852G, M80852K, M80852P, M80852S, M80859A, M80859D, M80859G, M80859K, M80859P, M80859S, M80861A, M80861D, M80861G, M80861K, M80861P, M80861S, M80862A, M80862D, M80862G, M80862K, M80862P, M80862S, M80869A, M80869D, M80869G, M80869K, M80869P, M80869S, M80871A, M80871D, M80871G, M80871K, M80871P, M80871S, M80872A, M80872D, M80872G, M80872K, M80872P, M80872S, M80879A, M80879D, M80879G, M80879K, M80879P, M80879S, M8088XA, M8088XD, M8088XG, M8088XK, M8088XP, M8088XS, M81, M810, M816, M818, Z8262, M800AXA, M800AXD, M800AXG, M800AXK, M800AXP, M800AXS, M808AXA, M808AXD, M808AXG, M808AXK, M808AXP, M808AXS

Measure	Code system	Codes
Bone fracture	ICD-9-CM	80016, 80019, 80020, 80021, 80022, 80023, 80024, 80025, 80026, 80029, 80030, 80031, 80032, 80033, 80034, 80035, 80036, 80039, 80040, 80041, 80042, 80043, 80044, 80045, 80046, 80049, 80050, 80051, 80052, 80053, 80054, 80055, 80056, 80059, 80060, 80061, 80062, 80063, 80064, 80065, 80066, 80069, 80070, 80071, 80072, 80073, 80074, 80075, 80076, 80079, 80080, 80081, 80082, 80083, 80084, 80085, 80086, 80089, 80090, 80091, 80092, 80093, 80094, 80095, 80096, 80099, 80100, 80101, 80102, 80103, 80104, 80105, 80106, 80109, 80110, 80111, 80112, 80113, 80114, 80115, 80116, 80119, 80120, 80121, 80122, 80123, 80124, 80125, 80126, 80129, 80130, 80131, 80132, 80133, 80134, 80135, 80136, 80139, 80140, 80141, 80142, 80143, 80144, 80145, 80146, 80149, 80150, 80151, 80152, 80153, 80154, 80155, 80156, 80159, 80160, 80161, 80162, 80163, 80164, 80165, 80166, 80169, 80170, 80171, 80172, 80173, 80174, 80175, 80176, 80179, 80180, 80181, 80182, 80183, 80184, 80185, 80186, 80189, 80190, 80191, 80192, 80193, 80194, 80195, 80196, 80199, 80220, 80221, 80222, 80223, 80224, 80225, 80226, 80227, 80228, 80229, 80230, 80231, 80232, 80233, 80234, 80235, 80236, 80237, 80238, 80239, 80300, 80301, 80302, 80303, 80304, 80305, 80306, 80309, 80310, 80311, 80312, 80313, 80314, 80315, 80316, 80319, 80320, 80321, 80322, 80323, 80324, 80325, 80326, 80329, 80330, 80331, 80332, 80333, 80334, 80335, 80336, 80339, 80340, 80341, 80342, 80343, 80344, 80345, 80346, 80349, 80350, 80351, 80352, 80353, 80354, 80355, 80356, 80359, 80360, 80361, 80362, 80363, 80364, 80365, 80366, 80369, 80370, 80371, 80372, 80373, 80374, 80375, 80376, 80379, 80380, 80381, 80382, 80383, 80384, 80385, 80386, 80389, 80390, 80391, 80392, 80393, 80394, 80395, 80396, 80399, 80400, 80401, 80402, 80403, 80404, 80405, 80406, 80409, 80410, 80411, 80412, 80413, 80414, 80415, 80416, 80419, 80420, 80421, 80422, 80423, 80424, 80425, 80426, 80429, 80430, 80431, 80432, 80433, 80434, 80435, 80436, 80439, 80440, 80441, 80442, 80443, 80444, 80445, 80446, 80449, 80450, 80451, 80452, 80453, 80454, 80455, 80456, 80459, 80460, 80461, 80462, 80463, 80464, 80465, 80466, 80469, 80470, 80471, 80472, 80473, 80474, 80475, 80476, 80479, 80480, 80481, 80482, 80483, 80484, 80485, 80486, 80489, 80490, 80491, 80492, 80493, 80494, 80495, 80496, 80499, 80500, 80501, 80502, 80503, 80504, 80505, 80506, 80507, 80508, 80510, 80511, 80512, 80513, 80514, 80515, 80516, 80517, 80518, 80600, 80601, 80602, 80603, 80604, 80605, 80606, 80607, 80608, 80609, 80610, 80611, 80612, 80613, 80614, 80615, 80616, 80617, 80618, 80619, 80620, 80621, 80622, 80623, 80624, 80625, 80626, 80627, 80628, 80629, 80630, 80631, 80632, 80633, 80634, 80635, 80636, 80637, 80638, 80639, 80660, 80661, 80662, 80669, 80670, 80671, 80672, 80679, 80700, 80701, 80702, 80703, 80704, 80705, 80706, 80707, 80708, 80709, 80710, 80711, 80712, 80713, 80714, 80715, 80716, 80717, 80718, 80719, 80841, 80842, 80843, 80844, 80849, 80851, 80852, 80853, 80854, 80859, 81000, 81001, 81002, 81003, 81010, 81011, 81012, 81013, 81100, 81101, 81102, 81103, 81109, 81110, 81111, 81112, 81113, 81119, 81200, 81201, 81202, 81203, 81209, 81210, 81211, 81212, 81213, 81219, 81220, 81221, 81230, 81231, 81240, 81241, 81242, 81243, 81244, 81249, 81250, 81251, 81252, 81253, 81254, 81259, 81300, 81301, 81302, 81303, 81304, 81305, 81306, 81307, 81308, 81310, 81311, 81312, 81313, 81314, 81315, 81316, 81317, 81318, 81320, 81321, 81322, 81323, 81330, 81331, 81332, 81333, 81340, 81341, 81342, 81343, 81344, 81345, 81346, 81347, 81350, 81351, 81352, 81353, 81354, 81380

Measure	Code system	Codes
	ICD-9-CM (cont.)	81381, 81382, 81383, 81390, 81391, 81392, 81393, 81400, 81401, 81402, 81403, 81404, 81405, 81406, 81407, 81408, 81409, 81410, 81411, 81412, 81413, 81414, 81415, 81416, 81417, 81418, 81419, 81500, 81501, 81502, 81503, 81504, 81509, 81510, 81511, 81512, 81513, 81514, 81519, 81600, 81601, 81602, 81603, 81610, 81611, 81612, 81613, 82000, 82001, 82002, 82003, 82009, 82010, 82011, 82012, 82013, 82019, 82020, 82021, 82022, 82030, 82031, 82032, 82100, 82101, 82110, 82111, 82120, 82121, 82122, 82123, 82129, 82130, 82131, 82132, 82133, 82139, 82300, 82301, 82302, 82310, 82311, 82312, 82320, 82321, 82322, 82330, 82331, 82332, 82340, 82341, 82342, 82380, 82381, 82382, 82390, 82391, 82392, 82520, 82521, 82522, 82523, 82524, 82525, 82529, 82530, 82531, 82532, 82533, 82534, 82535, 82539
	ICD-10-CM	S02, S020, S021, S022, S023, S024, S026, S028, S029, S12, S120, S121, S122, S123, S124, S125, S126, S128, S129, S22, S220, S222, S223, S224, S225, S229, S32, S320, S321, S322, S323, S324, S325, S326, S328, S329, S42, S420, S421, S422, S423, S424, S429, S52, S520, S521, S522, S523, S525, S526, S529, S62, S620, S621, S622, S623, S625, S626, S629, S72, S720, S721, S722, S723, S724, S728, S729, S82, S820, S821, S822, S823, S824, S825, S826, S828, S829, S92, S920, S921, S922, S923, S924, S925, S928, S929
Glaucoma	ICD-9-CM	3659, 36422, 36500, 36501, 36502, 36503, 36504, 36506, 36510, 36511, 36512, 36513, 36515, 36520, 36521, 36522, 36523, 36524, 36531, 36532, 36541, 36542, 36543, 36551, 36552, 36559, 36560, 36561, 36562, 36563, 36564, 36565, 36570, 36571, 36572, 36573, 36574, 36581, 36582, 36583, 36589
	ICD-10-CM	H40, H40001, H40002, H40003, H40009, H40011, H40012, H40013, H40019, H40021, H40022, H40023, H40029, H40031, H40032, H40033, H40039, H40041, H40042, H40043, H40049, H40051, H40052, H40053, H40059, H40061, H40062, H40063, H40069, H4010X0, H4010X1, H4010X2, H4010X3, H4010X4, H401110, H401111, H401112, H401113, H401114, H401120, H401121, H401122, H401123, H401124, H401130, H401131, H401132, H401133, H401134, H401190, H401191, H401192, H401193, H401194, H401210, H401211, H401212, H401213, H401214, H401220, H401221, H401222, H401223, H401224, H401230, H401231, H401232, H401233, H401234, H401290, H401291, H401292, H401293, H401294, H401310, H401311, H401312, H401313, H401314, H401320, H401321, H401322, H401323, H401324, H401330, H401331, H401332, H401333, H401334, H401390, H401391, H401392, H401393, H401394, H401410, H401411, H401412, H401413, H401414, H401420, H401421, H401422, H401423, H401424, H401430, H401431, H401432, H401433, H401434, H401490, H401491, H401492, H401493, H401494, H40151, H40152, H40153, H40159, H4020X0, H4020X1, H4020X2, H4020X3, H4020X4, H40211, H40212, H40213, H40219, H402210, H402211, H402212, H402213, H402214, H402220, H402221, H402222, H402223, H402224, H402230, H402231, H402232, H402233, H402234, H402290, H402291, H402292, H402293, H402294, H40231, H40232, H40233, H40239, H40241, H40242, H40243, H40249, H4030X0, H4030X1, H4030X2, H4030X3, H4030X4, H4031X0, H4031X1, H4031X2, H4031X3, H4031X4, H4032X0, H4032X1, H4032X2, H4032X3, H4032X4, H4033X0, H4033X1, H4033X2, H4033X3, H4033X4, H4040X0, H4040X1, H4040X2, H4040X3, H4040X4, H4041X0, H4041X1, H4041X2, H4041X3, H4041X4, H4042X0, H4042X1, H4042X2, H4042X3, H4042X4, H4043X0, H4043X1, H4043X2,

Measure	Code system	Codes
	ICD-10-CM (cont.)	H4043X3, H4043X4, H4050X0, H4050X1, H4050X2, H4050X3, H4050X4, H4051X0, H4051X1, H4051X2, H4051X3, H4051X4, H4052X0, H4052X1, H4052X2, H4052X3, H4052X4, H4053X0, H4053X1, H4053X2, H4053X3, H4053X4, H4060X0, H4060X1, H4060X2, H4060X3, H4060X4, H4061X0, H4061X1, H4061X2, H4061X3, H4061X4, H4062X0, H4062X1, H4062X2, H4062X3, H4062X4, H4063X0, H4063X1, H4063X2, H4063X3, H4063X4, H40811, H40812, H40813, H40819, H40821, H40822, H40823, H40829, H40831, H40832, H40833, H40839, H4089, H409
Obesity-related condition	ICD-9-CM	2781, 27800, 27801, 27802, 27803
	ICD-10-CM	E6601, E6609, E661, E662, E663, E668, E669
Chronic obstructive pulmonary disease exacerbation	ICD-9-CM	466, 480, 481, 482, 483, 484, 485, 486, 487, 490, 506, 507, 511, 512, 518, 1363, 4910, 4911, 4918, 4919, 4928, 4941, 5061, 5062, 5063, 5111, 5171, 5188, 46611, 46619, 49120, 49121, 49122, 51881, 51882
	ICD-10-CM	J438, J471

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification; ICD-10-CM = International Classification of Diseases, Tenth Revision, Clinical Modification.

Table D.10. National drug codes for measures specific to beneficiaries with chronic obstructive pulmonary disease

Measure	National drug codes
PDE-4 inhibitor	0310-0088, 0310-0095

Table D.11. Procedure codes for measures specific to beneficiaries with chronic obstructive pulmonary disease

Measure	Code system	Codes
Any hospitalization with lung volume reduction surgery, oxygen therapy, or ventilation	CPT	32124, 32141, 32440, 32442, 32445, 32480, 32482, 32484, 32486, 32488, 32491, 32500, 32501, 32503, 32504, 32540, 32655, 32657, 94002, 94003, 94004, 94005, 94656, 94657, 94660
	HCPCS	E0424, E0425, E0430, E0431, E0433, E0434, E0435, E0439, E0440, E0470, E0471, E0472, E0601, E1399, G0302, G0303, G0304, G0305, K0553, K0554, K0555
	ICD-9-PCS	0091, 0092, 0093, 315, 329, 336, 3144, 3145, 3201, 3209, 3220, 3222, 3228, 3229, 3230, 3239, 3320, 3324, 3325, 3326, 3327, 3328, 3350, 3351, 3352, 3420, 3424, 3427, 3459, 3481, 9390, 9391, 9399
	ICD-10-PCS	00BB0ZX, 00BB0ZZ, 00BB3ZX, 00BB3ZZ, 00BB4ZX, 00BB4ZZ, 0BB10ZX, 0BB10ZZ, 0BB13ZX, 0BB13ZZ, 0BB14ZX, 0BB14ZZ, 0BB17ZX, 0BB17ZZ, 0BB18ZX, 0BB18ZZ, 0BB20ZX, 0BB20ZZ, 0BB23ZX, 0BB23ZZ, 0BB24ZX, 0BB24ZZ, 0BB27ZX, 0BB27ZZ, 0BB28ZX, 0BB28ZZ, 0BB30ZX, 0BB30ZZ, 0BB33ZX, 0BB33ZZ, 0BB34ZX, 0BB34ZZ, 0BB37ZX, 0BB37ZZ, 0BB38ZX, 0BB38ZZ, 0BB40ZX, 0BB40ZZ, 0BB43ZX, 0BB43ZZ, 0BB44ZX, 0BB44ZZ, 0BB47ZX, 0BB47ZZ, 0BB48ZX, 0BB48ZZ, 0BB50ZX, 0BB50ZZ, 0BB53ZX, 0BB53ZZ, 0BB54ZX, 0BB54ZZ, 0BB57ZX, 0BB57ZZ, 0BB58ZX, 0BB58ZZ, 0BB60ZX, 0BB60ZZ, 0BB63ZX, 0BB63ZZ, 0BB64ZX, 0BB64ZZ, 0BB67ZX,

Measure	Code system	Codes
	ICD-10-PCS (cont.)	0BB67ZZ, 0BB68ZX, 0BB68ZZ, 0BB70ZX, 0BB70ZZ, 0BB73ZX, 0BB73ZZ, 0BB74ZX, 0BB74ZZ, 0BB77ZX, 0BB77ZZ, 0BB78ZX, 0BB78ZZ, 0BB80ZX, 0BB80ZZ, 0BB83ZX, 0BB83ZZ, 0BB84ZX, 0BB84ZZ, 0BB87ZX, 0BB87ZZ, 0BB88ZX, 0BB88ZZ, 0BB90ZX, 0BB90ZZ, 0BB93ZX, 0BB93ZZ, 0BB94ZX, 0BB94ZZ, 0BB97ZX, 0BB97ZZ, 0BB98ZX, 0BB98ZZ, 0BBB0ZX, 0BBB0ZZ, 0BBB3ZX, 0BBB3ZZ, 0BBB4ZX, 0BBB4ZZ, 0BBB7ZX, 0BBB7ZZ, 0BBB8ZX, 0BBB8ZZ, 0BBC0ZX, 0BBC0ZZ, 0BBC3ZX, 0BBC3ZZ, 0BBC4ZX, 0BBC4ZZ, 0BBC7ZX, 0BBC7ZZ, 0BBC8ZX, 0BBC8ZZ, 0BBD0ZX, 0BBD0ZZ, 0BBD3ZX, 0BBD3ZZ, 0BBD4ZX, 0BBD4ZZ, 0BBD7ZX, 0BBD7ZZ, 0BBD8ZX, 0BBD8ZZ, 0BBF0ZX, 0BBF0ZZ, 0BBF3ZX, 0BBF3ZZ, 0BBF4ZX, 0BBF4ZZ, 0BBF7ZX, 0BBF7ZZ, 0BBF8ZX, 0BBF8ZZ, 0BBG0ZX, 0BBG0ZZ, 0BBG3ZX, 0BBG3ZZ, 0BBG4ZX, 0BBG4ZZ, 0BBG7ZX, 0BBG7ZZ, 0BBG8ZX, 0BBG8ZZ, 0BBH0ZX, 0BBH0ZZ, 0BBH3ZX, 0BBH3ZZ, 0BBH4ZX, 0BBH4ZZ, 0BBH7ZX, 0BBH7ZZ, 0BBH8ZX, 0BBH8ZZ, 0BBJ0ZX, 0BBJ0ZZ, 0BBJ3ZX, 0BBJ3ZZ, 0BBJ4ZX, 0BBJ4ZZ, 0BBJ7ZX, 0BBJ7ZZ, 0BBJ8ZX, 0BBJ8ZZ, 0BBK0ZX, 0BBK0ZZ, 0BBK3ZX, 0BBK3ZZ, 0BBK4ZX, 0BBK4ZZ, 0BBK7ZX, 0BBK7ZZ, 0BBK8ZX, 0BBK8ZZ, 0BBL0ZX, 0BBL0ZZ, 0BBL3ZX, 0BBL3ZZ, 0BBL4ZX, 0BBL4ZZ, 0BBL7ZX, 0BBL7ZZ, 0BBL8ZX, 0BBL8ZZ, 0BBM0ZX, 0BBM0ZZ, 0BBM3ZX, 0BBM3ZZ, 0BBM4ZX, 0BBM4ZZ, 0BBM7ZX, 0BBM7ZZ, 0BBM8ZX, 0BBM8ZZ, 0BBN0ZX, 0BBN0ZZ, 0BBN3ZX, 0BBN3ZZ, 0BBN4ZX, 0BBN4ZZ, 0BBN8ZX, 0BBN8ZZ, 0BBP0ZX, 0BBP0ZZ, 0BBP3ZX, 0BBP3ZZ, 0BBP4ZX, 0BBP4ZZ, 0BBP8ZX, 0BBP8ZZ, 0BBT0ZX, 0BBT0ZZ, 0BBT3ZX, 0BBT3ZZ, 0BBT4ZX, 0BBT4ZZ, 0BYC0Z0, 0BYC0Z1, 0BYD0Z0, 0BYD0Z1, 0BYF0Z0, 0BYF0Z1, 0BYG0Z0, 0BYG0Z1, 0BYH0Z0, 0BYH0Z1, 0BYJ0Z0, 0BYJ0Z1, 0BYK0Z0, 0BYK0Z0, 0BYK0Z1, 0BYK0Z2, 0BYL0Z0, 0BYL0Z0, 0BYL0Z1, 0BYL0Z2, 0BYM0Z0, 0BYM0Z1, 5A09357, 5A09358, 5A09359, 5A0935B, 5A0935Z
Number of respiratory therapist visits	HCPCS	G0237, G0238, G0239
	Revenue Center	0410, 0412, 0413, 0419, 0976

CPT = Current Procedural Terminology; HCPCS = Healthcare Common Procedure Coding System; ICD-9-PCS = International Classification of Diseases, Ninth Revision, Procedure Coding System; ICD-10-PCS = International Classification of Diseases, Tenth Revision, Procedure Coding System.

4.5.3. Cancer

Table D.12. Diagnosis codes for measures specific to beneficiaries with cancer

Measure	Code system	Codes
Poor prognosis solid and hematological malignancies	ICD-9-CM	151, 155, 159, 191, 200, 204, 205, 206, 208, 209, 1500, 1501, 1502, 1503, 1504, 1505, 1508, 1509, 1510, 1511, 1512, 1513, 1514, 1515, 1516, 1518, 1519, 1550, 1551, 1552, 1570, 1571, 1572, 1573, 1574, 1578, 1579, 1580, 1588, 1589, 1590, 1591, 1598, 1599, 1620, 1622, 1623, 1624, 1625, 1628, 1629, 1630, 1631, 1638, 1639, 1640, 1641, 1642, 1643, 1648, 1649, 1650, 1658, 1659, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1928, 1929, 1950, 1951, 1952, 1953, 1954, 1955, 1958, 1960, 1961, 1962, 1963, 1965, 1966, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1990, 1991, 1992, 2001, 2002, 2003, 2004, 2005, 2006, 2008, 2031, 2038, 2041, 2048, 2049, 2051, 2052, 2053, 2058, 2059, 2061, 2062, 2068, 2069, 2078, 2081, 2088, 2089, 2091, 2092, 2093, 2097, 2375, 2391, 2396, 7331, 19881, 19882, 19889, 20000, 20001, 20002, 20003, 20004, 20005, 20006, 20007, 20008, 20010, 20011, 20012, 20013, 20014, 20015, 20016, 20017, 20018, 20020, 20021, 20022, 20023, 20024, 20025, 20026, 20027, 20028, 20030, 20031, 20032, 20033, 20034, 20035, 20036, 20037, 20038, 20040, 20041, 20042, 20043, 20044, 20045, 20045, 20046, 20047, 20048, 20050, 20051, 20052, 20053, 20054, 20055, 20056, 20057, 20058, 20060, 20061, 20062, 20063, 20064, 20065, 20066, 20067, 20068, 20068, 20070, 20071, 20072, 20073, 20074, 20075, 20076, 20077, 20078, 20080, 20081, 20082, 20083, 20084, 20085, 20086, 20087, 20088, 20155, 20300, 20302, 20380, 20400, 20410, 20412, 20480, 20490, 20500, 20502, 20510, 20512, 20520, 20522, 20530, 20532, 20580, 20582, 20590, 20592, 20600, 20601, 20602, 20610, 20611, 20612, 20620, 20621, 20622, 20680, 20681, 20690, 20691, 20692, 20780, 20800, 20810, 20880, 20890, 20892, 20900, 20901, 20902, 20903, 20910, 20911, 20912, 20913, 20914, 20915, 20916, 20917, 20920, 20921, 20922, 20923, 20924, 20925, 20926, 20927, 20929, 20930, 20931, 20932, 20933, 20934, 20935, 20936, 20970, 20971, 20972, 20973, 20974, 20975, 20979, 23873, 73310, 73311, 73312, 73313, 73314, 73315, 73316, 73319, 78951, V5420, V5421, V5422, V5423, V5424, V5425, V5426, V5427, V5429, C153, C154, C155, C158, C159, C160, C161, C162, C163, C164, C165, C166, C168, C169, C220, C221, C222, C223, C224, C227, C228, C229, C250, C251, C252, C253, C254, C257, C258, C259, C260, C261, C269, C33, C3400, C3401, C3402, C3410, C3411, C3412, C342, C3430, C3431, C3432, C3480, C3481, C3482, C3490, C3491, C3492, C37, C380, C381, C382, C383, C384, C388, C390, C399, C450, C451, C452, C457, C459, C480, C481, C482, C488, C4A0, C4A10, C4A11, C4A12, C4A20, C4A21, C4A22, C4A30, C4A31, C4A39, C4A4, C4A51, C4A52, C4A59, C4A60, C4A61, C4A62, C4A70, C4A71, C4A72, C4A8, C4A9, C700, C701, C709, C710, C711, C712, C713, C714, C715, C716, C717, C718, C719, C720, C721, C7220, C7221, C7222, C7230, C7231, C7232, C7240, C7241, C7242, C7250, C7259, C729, C760, C761, C762, C763, C7640, C7641, C7642, C7650, C7651, C7652, C768, C770, C771, C772, C773, C774, C775, C778, C779, C7800, C7801,

Measure	Code system	Codes
Poor prognosis solid and hematological malignancies (cont.)	ICD-9-CM (cont.)	C7802, C781, C782, C7830, C7839, C784, C785, C786, C787, C7880, C7889, C7900, C7901, C7902, C7910, C7911, C7919, C792, C7931, C7932, C7940, C7949, C7951, C7952, C7960, C7961, C7962, C7970, C7971, C7972, C7981, C7982, C7989, C799, C7A00, C7A010, C7A011, C7A012, C7A019, C7A020, C7A021, C7A022, C7A023, C7A024, C7A025, C7A026, C7A029, C7A090, C7A091, C7A092, C7A093, C7A094, C7A095, C7A096, C7A098, C7A1, C7A8, C7B00, C7B01, C7B02, C7B03, C7B04, C7B09, C7B1, C7B8, C800, C801, C802, C8115, C8251, C8252, C8253, C8254, C8255, C8256, C8257, C8258, C8300, C8301, C8302, C8303, C8304, C8305, C8306, C8307, C8308, C8309, C8310, C8311, C8312, C8313, C8314, C8315, C8316, C8317, C8318, C8319, C8330, C8331, C8332, C8333, C8334, C8335, C8336, C8337, C8338, C8339, C8350, C8351, C8352, C8353, C8354, C8355, C8356, C8357, C8358, C8359, C8370, C8371, C8372, C8373, C8373, C8374, C8375, C8376, C8377, C8378, C8379, C8380, C8381, C8382, C8383, C8384, C8385, C8386, C8387, C8388, C8389, C8390, C8391, C8392, C8393, C8394, C8395, C8396, C8397, C8398, C8399, C8460, C8461, C8462, C8463, C8464, C8465, C8466, C8467, C8468, C8469, C8470, C8471, C8472, C8473, C8474, C8475, C8476, C8477, C8478, C8479, C8491, C8492, C8493, C8494, C8495, C8496, C8497, C8498, C84A1, C84A2, C84A3, C84A4, C84A5, C84A6, C84A7, C84A8, C84Z1, C84Z2, C84Z3, C84Z4, C84Z5, C84Z6, C84Z7, C84Z8, C8511, C8512, C8513, C8514, C8515, C8516, C8517, C8518, C8520, C8521, C8522, C8523, C8524, C8525, C8526, C8527, C8528, C8529, C8581, C8582, C8583, C8584, C8585, C8586, C8587, C8588, C8591, C8592, C8593, C8594, C8595, C8596, C8597, C8598, C860, C861, C862, C863, C865, C866, C882, C883, C884, C888, C889, C9000, C9002, C9020, C9030, C9100, C9110, C9112, C9130, C9150, C9160, C9190, C91A0,
	ICD-10-CM	C91Z0, C9200, C9202, C9210, C9212, C9220, C9222, C9230, C9232, C9240, C9242, C9250, C9252, C9260, C9262, C9290, C9292, C92A0, C92A2, C92Z0, C92Z2, C9300, C9301, C9302, C9310, C9311, C9312, C9330, C9330, C9390, C9391, C9392, C93Z0, C93Z1, C9430, C9480, C9500, C9510, C9590, C9592, D430, D431, D432, D434, D4622, D491, D496, M4840XD, M4840XG, M4841XD, M4841XG, M4842XD, M4842XG, M4843XD, M4843XG, M4844XD, M4844XG, M4845XD, M4845XG, M4846XD, M4846XG, M4847XD, M4847XG, M4848XD, M4848XG, M4850XA, M4850XD, M4850XG, M4851XA, M4851XD, M4851XG, M4852XA, M4852XD, M4852XG, M4853XA, M4853XD, M4853XG, M4854XA, M4854XD, M4854XG, M4855XA, M4855XD, M4855XG, M4856XA, M4856XD, M4856XG, M4857XA, M4857XD, M4857XG, M4858XA, M4858XD, M4858XG, M8000XA, M8000XD, M8000XG, M80011A, M80011D, M80011G, M80012A, M80012D, M80012G, M80019A, M80019D, M80019G, M80021A, M80021D, M80021G, M80022A, M80022D, M80022G, M80029A, M80029D, M80029G, M80031A, M80031D, M80031G, M80032A, M80032D, M80032G, M80039A, M80039D, M80039G, M80041A, M80041D, M80041G, M80042A, M80042D, M80042G, M80049A, M80049D, M80049G, M80051A, M80051D, M80051G, M80052A, M80052D, M80052G,

Measure	Code system	Codes
Poor prognosis solid and hematological malignancies (cont.)	ICD-10-CM (cont.)	M80059A, M80059D, M80059G, M80061A, M80061D, M80061G, M80062A, M80062D, M80062G, M80069A, M80069D, M80069G, M80071A, M80071D, M80071G, M80072D, M80079A, M80079D, M80079G, M8008XA, M8008XD, M8008XG, M8080XA, M8080XD, M8080XG, M80811A, M80811D, M80811G, M80812A, M80812D, M80812G, M80819A, M80819D, M80819G, M80821A, M80821D, M80821G, M80822A, M80822D, M80822G, M80829A, M80829D, M80829G, M80831A, M80831D, M80831G, M80832A, M80832D, M80832G, M80839A, M80839D, M80839G, M80841A, M80841D, M80841G, M80842A, M80842D, M80842G, M80849A, M80849D, M80849G, M80851A, M80851D, M80851G, M80852A, M80852D, M80852G, M80859A, M80859D, M80859G, M80861A, M80861D, M80861G, M80862A, M80862D, M80862G, M80869A, M80869D, M80869G, M80871A, M80871D, M80871G, M80872A, M80872D, M80872G, M80879A, M80879D, M80879G, M8088XA, M8088XD, M8088XG, M8430XD, M8430XG, M84311D, M84311G, M84312D, M84312G, M84319D, M84319G, M84321D, M84321G, M84322D, M84322G, M84329D, M84329G, M84331D, M84331G, M84332D, M84332G, M84333D, M84333G, M84334D, M84334G, M84339D, M84339G, M84341D, M84341G, M84342D, M84342G, M84343D, M84343G, M84344D, M84344G, M84345D, M84345G, M84346D, M84346G, M84350D, M84350G, M84351D, M84351G, M84352D, M84352G, M84353D, M84353G, M84359D, M84359G, M84361D, M84361G, M84362D, M84362G, M84363D, M84363G, M84364D, M84364G, M84369D, M84369G, M84371D, M84371G, M84372D, M84372G, M84373D, M84373G, M84374D, M84374G, M84375D, M84375G, M84376D, M84376G, M84377D, M84377G, M84378D, M84378G, M84379D, M84379G, M8438XD, M8438XG, M8440XA, M8440XD, M8440XG, M84411A, M84411D, M84411G, M84412A, M84412D, M84412G, M84419A, M84419D, M84419G, M84421A, M84421D, M84421G, M84422A, M84422D, M84422G, M84429A, M84429D, M84429G, M84431A, M84431D, M84431G, M84432A, M84432D, M84432G, M84433A, M84433D, M84433G, M84434A, M84434D, M84434G, M84439A, M84439D, M84439G, M84441A, M84441D, M84441G, M84442A, M84442D, M84442G, M84443A, M84443D, M84443G, M84444A, M84444D, M84444G, M84445A, M84445D, M84445G, M84446A, M84446D, M84446G, M84451A, M84451D, M84451G, M84452A, M84452D, M84452G, M84453A, M84453D, M84453G, M84454A, M84454D, M84454G, M84459A, M84459D, M84459G, M84461A, M84461D, M84461G, M84462A, M84462D, M84462G, M84463A, M84463D, M84463G, M84464A, M84464D, M84464G, M84469A, M84469D, M84469G, M84471A, M84471D, M84471G, M84472A, M84472D, M84472G, M84473A, M84473D, M84473G, M84474A, M84474D, M84474G, M84475A, M84475D, M84475G, M84476A, M84476D, M84476G, M84477A, M84477D, M84477G, M84478A, M84478D, M84478G, M84479A, M84479D, M84479G, M8448XA, M8448XD, M8448XG, M8450XA, M8450XD, M8450XG, M84511A, M84511D, M84511G, M84512A, M84512D, M84512G, M84519A, M84519D, M84519G, M84521A,

Measure	Code system	Codes
Poor prognosis solid and hematological malignancies (cont.)	ICD-10-CM (cont.)	M84521D, M84521G, M84522A, M84522D, M84522G, M84529A, M84529D, M84529G, M84531A, M84531D, M84531G, M84532A, M84532D, M84532G, M84533A, M84533D, M84533G, M84534A, M84534D, M84534G, M84539A, M84539D, M84539G, M84541A, M84541D, M84541G, M84542A, M84542D, M84542G, M84549A, M84549D, M84549G, M84550A, M84550D, M84550G, M84551A, M84551D, M84551G, M84552A, M84552D, M84552G, M84553A, M84553D, M84553G, M84559A, M84559D, M84559G, M84561A, M84561D, M84561G, M84562A, M84562D, M84562G, M84563A, M84563D, M84563G, M84564A, M84564D, M84564G, M84569A, M84569D, M84569G, M84571A, M84571D, M84571G, M84572A, M84572D, M84572G, M84573A, M84573D, M84573G, M84574A, M84574D, M84574G, M84575A, M84575D, M84575G, M84576A, M84576D, M84576G, M8458XA, M8458XD, M8458XG, M8460XA, M8460XD, M8460XG, M84611A, M84611D, M84611G, M84612A, M84612D, M84612G, M84619A, M84619D, M84619G, M84621A, M84621D, M84621G, M84622A, M84622D, M84622G, M84629A, M84629D, M84629G, M84631A, M84631D, M84631G, M84632A,
Poor prognosis solid and hematological malignancies (cont.)	ICD-10-CM	M84632D, M84632G, M84633A, M84633D, M84633G, M84634A, M84634D, M84634G, M84639A, M84639D, M84639G, M84641A, M84641D, M84641G, M84642A, M84642D, M84642G, M84649A, M84649D, M84649G, M84650A, M84650D, M84650G, M84651A, M84651D, M84651G, M84652A, M84652D, M84652G, M84653A, M84653D, M84653G, M84659A, M84659D, M84659G, M84661A, M84661D, M84661G, M84662A, M84662D, M84662G, M84663A, M84663D, M84663G, M84664A, M84664D, M84664G, M84669A, M84669D, M84669G, M84671A, M84671D, M84671G, M84672A, M84672D, M84672G, M84673A, M84673D, M84673G, M84674A, M84674D, M84674G, M84675A, M84675D, M84675G, M84676A, M84676D, M84676G, M8468XA, M8468XD, M8468XG, M84750A, M84750D, M84750G, M84751A, M84751D, M84751G, M84752A, M84752D, M84752G, M84753A, M84753D, M84753G, M84754A, M84754D, M84754G, M84755A, M84755D, M84755G, M84756A, M84756D, M84756G, M84757A, M84757D, M84757G, M84758A, M84758D, M84758G, M84759A, M84759D, M84759G, M9701XD, M9702XD, M9711XD, M9712XD, M9721XD, M9722XD, M9731XD, M9732XD, M9741XD, M9742XD, M978XXD, M979XXD, R180
Diagnosis codes indicating advanced stage or poor prognosis cancers	ICD-9-CM	214, 218, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1960, 1960, 1961, 1961, 1962, 1962, 1963, 1963, 1965, 1965, 1966, 1966, 1968, 1968, 1969, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1990, 1991, 1992, 2140, 2141, 2142, 2143, 2144, 2148, 2149, 2180, 2181, 2182, 2189, 2281, 2377, 2383, 2384, 2850, 2851, 2852, 2853, 2858, 2858, 2859, 9952, 19881, 19881, 19882, 19882, 19889, 19889, 22527, 22529, 23770, 23771, 23772, 23773, 23779, 23871, 23872, 23873, 23874, 23875, 23876, 23877, 23879, 28521, 28522, 28529, 28803, 78701, 99520, 99521, 99522, 99523, 99524, E9331, V5811, V5869

Measure	Code system	Codes
	ICD-10-CM	C792, D181, D251, D62, D630, D631, D638, D640, D6481, D701, T383X5A, T410X5A, T411X5A, T41205A, T41295A, T413X5A, T4145XA, T451X5A, T451X5S, T50905A, T7841XA, T8852XA, Z1501, Z5111, Z7984, Z79891

ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification; ICD-10-CM = International Classification of Diseases, Tenth Revision, Clinical Modification.

Table D.13. National drug codes for measures specific to beneficiaries with cancer

Measure	National drug codes
Drug codes indicating advanced stage or poor prognosis cancers	0002-2980, 0002-3977, 0002-4483, 00024-5824, 0002-4815, 0002-5337, 0002-6216, 0002-7501, 0002-7502, 0003-3756, 0004-1100, 0004-1101, 00069-9144, 00075-8003, 00075-8004, 0009-5091, 0009-5093, 0009-7529, 0023-3348, 0031-2249, 0031-8752, 0031-8770, 00409-0366 – 00409-0368, 00409-0369, 0054-0271, 0054-0272, 0054-0382, 0054-0383, 0054-3176, 0054-3177, 0054-3542, 0054-4179, 0054-4180, 0054-4181 – 0054-4184, 0054-4186, 0054-4496 – 0054-4499, 0054-8174 – 0054-8176, 0054-8179 – 0054-8181, 0054-8183, 0054-8496, 0065-0631, 0065-0647, 0065-0648, 0067-2056, 0067-6095, 0067-7918, 0067-7919, 0067-8106, 0067-8124, 0067-8125, 0067-8129, 0067-8137, 0067-8138, 0067-8147, 0067-8148, 0067-8200, 0069-0197, 0069-0227, 0069-0231, 0069-0291 – 0069-0294, 0069-0308, 0069-0315, 0069-0324, 0069-0342, 0069-1198, 0069-1305 – 0069-1309, 0069-1311, 0069-1318, 0069-2299, 0069-3030 – 0069-3034, 0069-4004, 0069-4015, 0069-4026, 0069-4030, 0069-4031 – 0069-4034, 0069-4037, 0069-8140, 0069-8141, 00703-5720, 00703-5730, 0074-2108, 0074-2282, 0074-2440, 0074-3346, 0074-3473, 0074-3641, 0074-3642, 0074-3663, 0074-3683, 0074-3779, 0074-9694, 0075-8004, 0078-0666, 0078-0668, 0078-0671 – 0078-0673, 0078-0681, 0078-0682, 0078-0694, 0078-0701, 0078-0708, 0078-0709, 0078-0715, 0078-0716, 0078-0771, 0078-0799, 0078-0876, 0078-0909, 0078-0916, 0078-0923, 0093-7473, 0093-7474, 0093-7536, 0093-7662, 0093-7663, 0093-7664, 0095-0087 – 0095-0089, 00955-1020 – 00955-1022, 0113-0050, 0113-0052, 0113-0186, 0113-0355, 0113-0379, 0113-0431, 0113-0437, 0113-0462, 0113-0479, 0113-0622, 0113-0837, 0113-0964, 0113-1909, 0113-7186, 0113-7264, 0113-7379, 0113-7437, 0113-7479, 0113-7506, 0113-7911, 0113-7951, 0113-8264, 0121-0489, 0121-0865, 0121-0887, 0121-0907, 0121-0945, 0121-0978, 0121-1730, 0121-1814, 0121-4776, 0135-0608, 0135-7021, 0143-9084, 0143-9085 – 0143-9093, 0143-9202 – 0143-9205, 0143-9275, 0143-9277, 0143-9368 – 0143-9372, 0143-9376, 0143-9394, 0143-9395, 0143-9504, 0143-9505, 0143-9510 – 0143-9513, 0143-9546 – 0143-9549, 0143-9552 – 0143-9555, 0143-9558, 0143-9583, 0143-9701, 0143-9702, 0187-3204, 0187-5200, 0280-1200, 0310-0482, 0310-0720, 0310-1349, 0310-1350, 0310-7720, 0338-0063, 0338-0067, 0338-0080, 0338-0086, 0363-0020, 0363-0050, 0363-0058, 0363-0064, 0363-0092, 0363-0121, 0363-0189, 0363-0190, 0363-0192, 0363-0207, 0363-0235, 0363-0236, 0363-0250, 0363-0293, 0363-0295, 0363-0329, 0363-0353, 0363-0367, 0363-0379, 0363-0409, 0363-0418, 0363-0460, 0363-0463, 0363-0481, 0363-0526, 0363-0543, 0363-0556, 0363-0599, 0363-0614, 0363-0654, 0363-0665, 0363-0672, 0363-0682, 0363-0687, 0363-0710, 0363-0714, 0363-0715, 0363-0747, 0363-0753, 0363-0756, 0363-0760, 0363-0816, 0363-0860, 0363-0862, 0363-0863, 0363-0935, 0363-0964, 0363-1170, 0363-1319, 0363-1523, 0363-1900, 0363-2177, 0363-3291, 0363-3394, 0363-3790, 0363-4115, 0363-4200, 0363-4385, 0363-4470, 0363-4801, 0363-4851, 0363-5410, 0363-5430, 0363-5480, 0363-6141, 0363-6156, 0363-6176, 0363-6177, 0363-6270, 0363-6489, 0363-6580, 0363-6850, 0363-7100, 0363-7290, 0363-7300, 0363-7400, 0363-8590, 0363-8989, 0363-9130, 0363-9140, 0363-9181, 0363-9485, 0363-9685, 0363-9766, 0363-9835, 0363-9895, 0363-9991, 0378-2511, 0378-2512, 0378-3266, 0378-4791, 0378-7131 – 0378-7133, 0378-8078, 0409-0181 – 0409-0183, 0409-0185 – 0409-0187, 0409-0201, 0409-0302, 0409-0365 – 0409-0368, 0409-1732, 0409-2504, 0409-4235, 0409-5068, 0409-7870, 0536-1010, 0536-1214, 0555-0484, 0555-0485, 0555-0606, 0555-0607, 0573-0164, 0573-0167, 0574-0930, 0574-0931, 0574-4160, 0591-5019, 0597-0137, 0597-0138, 0597-0141, 0641-0367, 0641-0376, 0641-6145, 0641-6146, 0703-4094, 0703-4239, 0703-4244, 0703-4246, 0703-4248, 0703-4714, 0703-5140, 0703-5145, 0703-5653, 0703-5656, 0703-5657, 0703-5747, 0703-5748, 0781-3079, 0781-3201, 0781-3233, 0781-3244, 0781-3255, 0781-3312, 0781-3415, 0781-3492, 0781-4003, 0781-6186, 0832-0086, 0869-0295, 0904-1228, 0904-2035, 0904-2056, 0904-3571, 0904-4274, 0904-5306, 0904-5307, 0904-5354, 0904-5551, 0904-6019, 0904-6195, 0904-6703, 0904-6731, 0904-6740, 0904-6741, 0904-6985,

Measure	National drug codes
Drug codes indicating advanced stage or poor prognosis cancers (cont.)	0904-7072, 0904-7141, 0924-0036, 0924-0056, 0955-1020 – 0955-1022, 0998-0615, 0998-0630, 10019-935 – 10019-939, 10019-942 – 10019-945, 10019-955 – 10019-957, 10019-982, 10019-984, 10157-9077, 10202-946, 10202-947, 10237-907, 11383-258, 11383-261, 11673-012, 11673-050, 11673-059, 11673-186, 11673-216, 11673-225, 11673-236, 11673-265, 11673-292, 11673-367, 11673-375, 11673-400, 11673-420, 11673-437, 11673-460, 11673-462, 11673-463, 11673-542, 11673-622, 11673-654, 11673-690, 11673-694, 11673-713, 11673-720, 11673-756, 11673-817, 11673-832, 11673-837, 11673-877, 11673-899, 11673-918, 11673-956, 11673-985, 11822-0020, 11822-0050, 11822-0186, 11822-0190, 11822-0329, 11822-0556, 11822-0599, 11822-0622, 11822-0672, 11822-0685, 11822-0727, 11822-0729, 11822-0789, 11822-0964, 11822-1119, 11822-1565, 11822-1566, 11822-2050, 11822-2119, 11822-2350, 11822-2985, 11822-3670, 11822-4894, 11822-5059, 11822-5260, 11822-5694, 11822-6415, 11822-6489, 11822-7530, 11822-8791, 11822-9485, 13411-839, 13411-841, 13411-855, 13985-744, 15014-211, 15054-0043, 15127-292, 15127-595, 15127-862, 15127-922, 15579-828, 16103-347, 16103-348, 16110-812, 16571-421, 16714-001, 16714-027, 16714-0465, 16714-0500, 16714-070, 16714-118, 16714-131, 16714-137, 16714-178, 16714-467, 16714-468, 16714-742, 16714-816, 16714-856 – 16714-859, 16714-890, 16714-909, 16714-915, 16714-930, 16729-0120, 16729-0228, 16729-023, 16729-0231, 16729-035, 16729-072, 16729-073, 16729-092, 16729-114, 16729-117, 16729-118, 16729-243, 16729-276, 16729-288, 16729-295, 16729-365, 16729-391, 16729-419, 16729-423, 16729-426, 16729-436, 16729-542, 17714-020, 17714-021, 17714-023, 17714-135, 17856-0361, 17856-0907, 17856-6985, 20276-325, 21130-004, 21130-014, 21130-020, 21130-025, 21130-030, 21130-095, 21130-154, 21130-236, 21130-283, 21130-329, 21130-379, 21130-556, 21130-630, 21130-654, 21130-735, 21130-763, 21130-808, 21130-816, 21130-860, 23155-356, 24208-295, 24208-720, 24208-795, 24208-830, 24286-1565, 24385-210, 24385-379, 24385-431, 24385-479, 24979-041, 25021-0245, 25021-215, 25021-230, 25021-234, 25021-235, 25021-239, 25021-245, 25021-462, 25021-783, 25021-788, 25021-813 – 25021-816, 25021-828, 28105-421, 29485-1007, 29485-6931, 29485-7007, 29485-7963, 30142-021, 30142-050, 30142-114, 30142-116, 30142-193, 30142-228, 30142-229, 30142-232, 30142-290, 30142-317, 30142-329, 30142-367, 30142-375, 30142-383, 30142-404, 30142-415, 30142-483, 30142-530, 30142-549, 30142-554, 30142-558, 30142-582, 30142-616, 30142-635, 30142-651, 30142-672, 30142-688, 30142-700, 30142-715, 30142-736, 30142-753, 30142-755, 30142-772, 30142-832, 30142-835, 30142-847, 30142-949, 30142-964, 33992-0292, 33992-0329, 33992-0367, 33992-0379, 33992-0404, 33992-0447, 33992-0464, 33992-0656, 36000-326, 36800-050, 36800-095, 36800-116, 36800-200, 36800-229, 36800-237, 36800-264, 36800-317, 36800-367, 36800-379, 36800-413, 36800-431, 36800-436, 36800-437, 36800-447, 36800-466, 36800-483, 36800-500, 36800-501, 36800-504, 36800-506, 36800-507, 36800-556, 36800-566, 36800-569, 36800-585, 36800-622, 36800-654, 36800-658, 36800-669, 36800-672, 36800-756, 36800-771, 36800-784, 36800-790, 36800-792, 36800-859, 36800-902, 36800-909, 36800-910, 36800-933, 36800-937, 36800-964, 36800-985, 37000-430, 37000-431, 37000-500, 37000-501, 37000-712, 37000-758, 37000-895, 37000-926, 37000-927, 37000-930, 37000-959, 37000-974, 37000-975, 37012-050, 37012-186, 37012-379, 37012-437, 37012-462, 37012-479, 37205-278, 37205-338, 37205-759, 37808-012, 37808-017, 37808-019, 37808-077, 37808-104, 37808-186, 37808-236, 37808-252, 37808-264, 37808-269, 37808-379, 37808-431, 37808-481, 37808-543, 37808-556, 37808-590, 37808-602, 37808-622, 37808-677, 37808-690, 37808-703, 37808-795, 37808-860, 37808-866, 37808-932, 37835-319, 37835-615, 41163-050, 41163-089, 41163-119, 41163-186, 41163-228, 41163-236, 41163-290, 41163-329, 41163-367, 41163-379, 41163-515, 41163-585, 41163-593, 41163-613, 41163-734, 41163-860, 41163-956, 41163-964, 41167-0014, 41167-0040, 41167-0061, 41167-0067, 41190-295, 41226-160, 41250-044, 41250-050, 41250-089, 41250-107, 41250-195, 41250-236, 41250-260, 41250-285, 41250-295, 41250-316, 41250-329, 41250-367, 41250-379, 41250-413, 41250-462,

Measure	National drug codes
Drug codes indicating advanced stage or poor prognosis cancers (cont.)	41250-479, 41250-481, 41250-526, 41250-599, 41250-614, 41250-622, 41250-659, 41250-694, 41250-696, 41250-710, 41250-738, 41250-756, 41250-848, 41250-853, 41250-893, 41250-913, 41250-951, 41250-964, 41415-046, 41520-034, 41520-050, 41520-052, 41520-208, 41520-231, 41520-264, 41520-290, 41520-295, 41520-413, 41520-431, 41520-483, 41520-514, 41520-632, 41520-778, 41520-806, 41520-835, 41520-913, 41520-936, 41520-956, 41520-996, 42195-121, 42195-127, 42195-149, 42195-151, 42195-221, 42195-270, 42195-490, 42195-721, 42291-085, 42292-051 – 42292-053, 42507-049, 42507-236, 42507-317, 42507-483, 42571-169, 42571-337, 42806-358, 42806-359, 42806-648, 42806-649, 43063-266, 43063-383, 43063-720, 43598-262, 43598-283, 43598-326, 43598-389, 43598-541, 43598-610, 43598-611, 43598-682, 43598-683, 43598-771, 43598-773, 43624-002, 43975-307, 43975-308, 44087-5000, 44567-509 – 44567-511, 44567-530, 44567-620, 44567-621, 44567-622, 45802-358, 45865-583, 45865-796, 45865-989, 45963-0765, 45963-0781, 45963-0790, 45963-608, 45963-614, 45963-619, 45963-624, 45963-733, 45963-734, 45963-765, 45963-790, 46122-356, 46122-358, 46122-359, 46122-405, 46122-419, 46122-425, 46122-427, 46122-440, 46122-441, 46122-456, 46122-572, 46122-643, 46122-651, 46122-674, 46122-678, 46122-685, 46122-695, 46122-699, 46708-565 – 46708-567, 46994-329, 46994-660, 46994-935, 47046-168, 47335-0285, 47335-049, 47335-050, 47335-323, 47335-485, 47335-895, 47335-936, 47335-939, 47682-166, 47682-167, 47682-184, 47781-914, 47781-916, 48102-045 – 48102-052, 49035-047, 49035-057, 49035-065, 49035-164, 49035-223, 49035-237, 49035-330, 49035-356, 49035-358, 49035-363, 49035-367, 49035-379, 49035-461, 49035-543, 49035-556, 49035-588, 49035-599, 49035-600, 49035-622, 49035-623, 49035-654, 49035-658, 49035-670, 49035-672, 49035-675, 49035-685, 49035-699, 49035-704, 49035-727, 49035-736, 49035-808, 49035-858, 49035-901, 49035-929, 49035-933, 49035-935, 49035-945, 49035-948, 49035-964, 49035-986, 49035-996, 49035-997, 49315-008, 49315-009, 49348-045, 49348-140, 49348-151, 49348-854, 49348-873, 49348-983, 49467-230, 49483-061, 49483-329, 49483-356, 49580-0292, 49580-0293, 49580-0314, 49580-0379, 49580-0502, 49580-0808, 49738-236, 49738-483, 49781-147, 49873-704, 49873-705, 49884-230, 49884-289, 49884-290, 49884-753, 49884-907, 49999-059, 49999-141, 50066-267, 50090-0088 – 50090-0091, 50090-0570, 50090-0571, 50090-0627, 50090-0878, 50090-1135, 50090-1638, 50090-1841, 50090-1893, 50090-1914, 50090-2313, 50090-2453, 50090-2935, 50090-3068, 50090-3300, 50090-3398, 50090-3541, 50090-3787, 50090-3788, 50090-3867, 50090-4264, 50090-4435, 50090-4539, 50090-4567, 50090-4703, 50090-5457, 50090-5546, 50090-5716, 50090-5719, 50090-5744, 50242-060 – 50242-064, 50242-077, 50242-087 – 50242-091, 50242-094, 50242-130, 50242-210, 50242-245, 50242-260, 50242-917, 50242-918, 50268-075, 50268-154, 50268-527, 50269-226, 50269-608, 50383-859, 50419-171, 50419-390 – 50419-392, 50486-616, 50488-4125, 50580-226, 50580-228, 50580-232, 50580-239, 50580-341, 50580-370, 50580-415, 50580-534, 50580-535, 50580-563, 50580-608, 50580-736, 50580-833, 50580-843, 50594-008, 50594-013, 50594-863, 50742-0428, 50742-0431, 50742-0463, 50742-181 – 50742-184, 50742-401, 50742-402, 50742-423, 50742-428, 50742-431, 50742-445 – 50742-448, 50742-463, 50742-481 – 50742-483, 50742-485, 50742-496, 50742-497, 50742-498, 50742-519 – 50742-521, 50804-060, 50804-091, 50804-236, 50804-473, 50804-483, 50804-735, 50804-825, 50804-860, 50844-018, 50844-102, 50844-200, 50844-228, 50844-235, 50844-250, 50844-253, 50844-256, 50844-264, 50844-329, 50844-539, 50844-546, 50844-611, 50844-629, 50844-656, 50844-658, 50844-728, 50844-729, 50844-756, 50844-792, 50844-932, 50844-956, 51013-104, 51013-108, 51013-129, 51013-138, 51013-142, 51013-144, 51013-167, 51013-179, 51013-181, 51013-199, 51013-419, 51013-420, 51027-0330, 51079-434, 51079-510, 51079-581, 51079-582, 51316-700, 51316-779, 51316-998, 51407-095, 51407-096, 51407-361, 51662-1218, 51662-1219, 51662-1297, 51662-1312, 51662-1343, 51662-1347, 51662-1348, 51662-1370, 51662-1374, 51662-1391, 51662-1432, 51672-2089, 51672-4062, 51672-4063, 51672-4118, 51824-056, 51824-059, 51824-069, 51824-081, 51862-362, 51879-163,

Measure	National drug codes
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Drug codes indicating advanced stage or poor prognosis cancers (cont.)	62011-0310, 62011-0335, 62011-0342, 62011-0343, 62011-0356, 62011-0392, 62011-0416, 62011-0420, 62011-2520, 62175-710, 62207-814, 62320-302, 62332-565 – 62332-567, 62372-732, 62372-743, 62559-670, 62559-680, 62559-890, 62559-930, 62559-931, 62756-008, 62756-073, 62756-102, 62756-219, 62756-238, 62756-239, 62756-321, 62756-438, 62756-533, 62756-614, 62756-746, 62756-826, 62756-827, 62756-974, 62856-389, 62856-797, 62856-798, 62935-153, 62935-223, 62935-303, 62935-453, 62935-753, 63020-040, 63020-090, 63020-113, 63020-180, 63020-198, 63029-049, 63029-050, 63029-211, 63029-505, 63029-554, 63029-656, 63187-080, 63187-167, 63187-315, 63187-383, 63187-395, 63187-498, 63187-561, 63187-669, 63187-771, 63187-866, 63304-095, 63304-096, 63304-135, 63323-101 – 63323-104, 63323-117, 63323-125, 63323-126, 63323-165, 63323-172, 63323-193, 63323-360, 63323-506, 63323-516, 63323-631, 63323-664, 63323-710, 63323-711, 63323-715, 63323-883, 63459-910, 63459-912, 63459-918, 63459-920, 63539-197, 63548-0400, 63548-0690, 63629-1159, 63629-1160, 63629-2219 – 63629-2221, 63629-2696, 63629-3742, 63629-4127, 63629-4129, 63629-7631, 63629-7718, 63629-7806, 63629-7850, 63629-8308, 63629-8797, 63629-8821, 63739-0932, 63739-0971, 63739-165, 63739-549, 63824-110, 63824-204, 63824-211, 63824-212, 63824-218, 63824-220, 63824-251, 63824-511, 63824-516, 63824-551, 63824-555, 63824-558, 63824-793, 63824-950, 63824-955, 63850-0010, 63868-016, 63868-068, 63868-087, 63868-119, 63868-128, 63868-210, 63868-260, 63868-291, 63868-325, 63868-368, 63868-370, 63868-392 – 63868-394, 63868-415, 63868-474, 63868-492, 63868-611, 63868-612, 63868-658, 63868-683, 63868-708, 63868-731, 63868-772, 63868-792, 63868-823, 63868-829, 63868-900, 63868-952, 63868-985, 63940-200, 63940-235, 63940-329, 63940-367, 63940-404, 63940-658, 63940-672, 63941-079, 63941-090, 63941-091, 63941-095, 63941-155, 63941-219, 63941-224, 63941-225, 63941-231, 63941-236, 63941-259, 63941-260, 63941-292, 63941-316, 63941-413, 63941-556, 63941-674, 63941-690, 63941-710, 63941-735, 63941-860, 63941-916, 63981-329, 63981-556, 64024-479, 64092-010, 64092-012, 64092-830, 64380-732, 64980-276, 64980-277, 64980-509, 65162-843, 65162-844, 65219-162, 65219-164, 65597-406, 65753-400, 65841-613, 65841-743, 66267-080, 66267-081, 66267-779, 66267-977, 66530-249, 66689-020, 66715-5154, 66715-5254, 66715-5354, 66715-5454, 66715-5503, 66715-5554, 66715-5654, 66715-6643, 66715-6654, 66715-6703, 66715-6743, 66715-6754, 66715-6803, 66715-6814, 66715-6843, 66715-6854, 66715-6914, 66715-6943, 66715-9706, 66715-9733, 66715-9746, 66715-9817, 66733-948, 66733-958, 66758-0050, 66758-050, 66758-0950, 66758-950, 67046-006, 67046-007, 67091-114, 67091-115, 67091-137, 67091-200, 67091-201, 67091-219, 67091-277, 67091-290, 67091-323, 67091-339, 67091-354, 67184-0511 – 67184-0515, 67234-023, 67296-0326, 67296-0876, 67296-1055, 67296-1090, 67296-1413, 67296-1426, 67296-1645, 67296-1758, 67414-226, 67414-608, 67457-124, 67457-311, 67457-317, 67457-418 – 67457-423, 67457-436, 67457-462 – 67457-464, 67457-483, 67457-484, 67457-528 – 67457-533, 67457-616 – 67457-618, 67457-662, 67457-781, 67457-845, 67510-0054, 67510-0633, 67751-147, 67751-156, 67751-166, 67751-169, 67751-213, 67877-458, 67877-459, 68001-155, 68001-265, 68001-266, 68001-282 – 68001-284, 68001-342, 68001-345, 68001-348, 68001-350, 68001-359, 68001-370 – 68001-372, 68001-416 – 68001-418, 68001-424 – 68001-426, 68001-442 – 68001-444, 68001-480, 68001-482, 68001-484, 68001-487, 68001-488, 68001-492, 68001-493, 68001-510, 68001-516, 68001-522, 68016-051, 68016-057, 68016-154, 68016-163, 68016-219, 68016-298, 68016-376, 68016-501, 68016-507, 68016-639, 68016-640, 68016-641, 68016-651, 68016-654, 68016-682, 68016-712, 68016-728, 68016-730, 68016-789, 68016-795, 68016-823, 68047-702, 68071-1682, 68071-1744, 68071-1821, 68071-2321, 68071-2418, 68071-2428, 68071-3193, 68071-3352, 68071-4127, 68071-4203, 68071-4375, 68071-5203, 68071-5281, 68083-148, 68083-149, 68083-162, 68083-163, 68083-190 – 68083-193, 68083-248 – 68083-250, 68083-269, 68083-270, 68083-278, 68083-279, 68083-292,

Measure	National drug codes
Drug codes indicating advanced stage or poor prognosis cancers (cont.)	68083-293, 68083-381, 68083-382, 68083-399 – 68083-401, 68083-473, 68083-474, 68094-018, 68094-022, 68094-024, 68163-541, 68163-710, 68163-730, 68180-801, 68196-556, 68196-829, 68196-835, 68196-916, 68196-929, 68210-0010, 68210-0020, 68210-0099, 68210-0202, 68210-0203, 68210-0210, 68210-0230, 68210-1000 – 68210-1002, 68210-1200, 68210-1280, 68210-2000, 68210-2010, 68210-2020, 68210-2100, 68210-4089, 68210-4095, 68210-4099, 68210-4127, 68210-4131, 68210-4132, 68210-4135, 68210-4145, 68210-4147, 68210-4157, 68210-4160, 68210-4179, 68210-4185, 68210-4190, 68210-6112, 68382-209, 68382-224, 68382-913 – 68382-915, 68391-050, 68391-186, 68391-200, 68391-447, 68391-863, 68462-317, 68788-6774, 68788-7142, 68788-7267, 68788-7589, 68788-7830, 68788-7994, 68788-8104, 68788-9373, 68788-9687, 68788-9688, 68788-9702, 68817-134, 68842-301, 68998-090, 68998-091, 68998-095, 68998-113, 68998-171, 68998-505, 69070-306, 69097-313, 69097-314, 69097-516, 69097-517, 69097-915, 69097-927, 69097-948, 69097-949, 69117-0003, 69168-048, 69168-247, 69168-263, 69168-346, 69168-393, 69168-410, 69168-431, 69168-762, 69168-910, 69206-995, 69238-1373 – 69238-1375, 69238-1422, 69256-040, 69256-050, 69256-293, 69256-379, 69256-837, 69256-860, 69256-916, 69306-111, 69306-112, 69306-114, 69339-151, 69339-152, 69365-003, 69365-004, 69367-187, 69396-025, 69423-965, 69448-005, 69452-205, 69452-264, 69452-322, 69517-106, 69539-019, 69539-020, 69539-090, 69539-091, 69539-092, 69543-371, 69571-005, 69607-0916, 69618-024, 69618-025, 69639-101 – 69639-105, 69676-0039, 69721-004, 69721-005, 69732-005, 69842-002, 69842-156, 69842-174, 69842-200, 69842-235, 69842-261, 69842-264, 69842-279, 69842-291, 69842-299, 69842-306, 69842-308, 69842-321, 69842-328, 69842-379, 69842-392, 69842-393, 69842-422, 69842-447, 69842-448, 69842-460 – 69842-462, 69842-470, 69842-477, 69842-496, 69842-506, 69842-537, 69842-572, 69842-620, 69842-621, 69842-624, 69842-653, 69842-654, 69842-656, 69842-658, 69842-672, 69842-682, 69842-685, 69842-719, 69842-734, 69842-735, 69842-753, 69842-758, 69842-774, 69842-798, 69842-820, 69842-825, 69842-834, 69842-836, 69842-860, 69842-870, 69842-882, 69842-905, 69842-913, 69842-916, 69842-938, 69842-939, 69842-944, 69842-951, 69842-952, 69842-956, 69842-958, 69842-981, 69842-987, 69848-014, 69968-0223, 69968-0242, 69968-0270, 69968-0459, 69968-0625, 69968-0711, 70000-0006, 70000-0023, 70000-0085, 70000-0086, 70000-0128, 70000-0136, 70000-0142, 70000-0144, 70000-0157, 70000-0174, 70000-0207, 70000-0242, 70000-0244 – 70000-0246, 70000-0388, 70000-0411, 70000-0426, 70000-0467, 70000-0474, 70000-0492, 70000-0527, 70000-0584, 70000-0585, 70000-0590, 70020-1910, 70020-1911, 70069-021 – 70069-025, 70121-1099, 70121-1218, 70121-1219,70121-1221 – 70121-1223, 70121-1238 – 70121-1240, 70121-1399, 70121-1450 – 70121-1452, 70121-1463, 70121-1572, 70382-204, 70518-0285, 70518-0410, 70518-0532, 70518-1082, 70518-1259, 70518-1289, 70518-1442, 70518-1534, 70518-1680, 70518-1836, 70518-2420, 70518-2438, 70518-2484, 70518-2605, 70518-2740, 70518-2993, 70518-2998, 70518-3019, 70518-3050, 70518-3119, 70518-3243, 70518-3263, 70529-045, 70529-053, 70529-112, 70529-118, 70534-002, 70569-151, 70677-0002, 70677-0003, 70677-0024, 70677-0081, 70692-103, 70692-111, 70692-119, 70692-136, 70692-148, 70692-783 – 70692-785, 70692-832, 70700-169, 70700-170, 70700-174 – 70700-176, 70700-186 – 70700-189, 70700-284, 70710-1530, 70710-1531, 70710-1688, 70756-815, 70756-816, 70771-1521 – 70771-1523, 70771-1626, 70860-204 – 70860-206, 70860-208, 70860-211, 70860-218, 70934-487, 70934-497, 71101-215, 71141-090, 71141-095, 71205-012, 71205-013, 71205-259, 71205-309, 71205-315, 71205-330, 71205-410, 71205-521, 71205-577, 71205-611, 71205-615, 71205-943, 71288-100, 71288-104, 71288-105, 71288-113, 71288-114, 71288-117, 71288-143, 71288-144, 71288-150, 71288-151, 71288-555, 71309-006, 71309-009, 71309-110, 71335-0077, 71335-0081, 71335-0177, 71335-0352, 71335-0435, 71335-0526, 71335-1772, 71384-512, 71384-513, 71399-0125, 71399-8026, 71399-8028, 71594-705, 71679-085, 71679-106, 71679-143,

Measure	National drug codes
Drug codes indicating advanced stage or poor prognosis cancers (cont.)	71731-6121, 71776-035, 71777-390 – 71777-392, 71872-7005, 71872-7021, 71872-7090 – 71872-7092, 71872-7128, 71872-7147, 71872-7153, 71872-7157, 71872-7164, 71872-7171, 71872-7180, 71872-7205, 71872-7222, 71872-7239, 71872-7242, 71879-001, 71905-400, 72036-019, 72036-090, 72036-091, 72036-095, 72036-113, 72036-171, 72036-402, 72064-210, 72090-006, 72090-020, 72090-021, 72189-038, 72189-254, 72205-006, 72205-007, 72205-061 – 72205-063, 72205-080 – 72205-082, 72266-120, 72266-121, 72288-050, 72288-052, 72288-089, 72288-186, 72288-310, 72288-379, 72288-437, 72288-479, 72288-964, 72476-034, 72476-113, 72476-169, 72476-295, 72476-350, 72476-860, 72476-916, 72485-101, 72485-204, 72485-205, 72485-211 – 72485-219, 72485-221 – 72485-223, 72572-120, 72572-122, 72603-103 – 72603-105, 72603-200, 72603-326, 72603-411, 72606-554, 72606-555, 72663-203, 72664-611, 72789-008, 72893-004, 72893-006, 72893-009, 72893-013 – 72893-015, 73006-111, 73006-119, 73006-120, 73006-148, 73006-350, 73057-347, 73057-348, 73057-352, 73057-358, 73097-013, 73147-3109, 73147-3111, 73282-0012, 73418-747, 73629-001, 73921-023, 76045-102, 76045-106, 76045-109, 76045-210, 76168-015, 76168-065, 76168-121, 76281-301, 76281-313, 76281-315, 76281-319, 76281-505, 76281-522, 76420-004, 76420-077, 76420-185, 76420-219, 76420-270, 76420-766, 76420-767, 76420-769, 76420-810, 76457-002, 76519-1224, 78206-147, 79043-200, 79395-011, 79481-0700, 79903-023, 79903-035, 79903-050, 79903-053, 79903-056, 79903-057, 79903-083, 80070-330, 80070-340, 80070-350, 80070-360, 80136-785, 80159-104, 80267-431, 80267-479, 80489-005, 80539-614, 81033-003, 81522-186, 81522-379, 81522-437, 81522-479, 81522-916, 81565-202, 81646-120, 90107-1270, 90107-1560, 90107-2400, 90107-2410
Hormonal therapy	0093-1125, 0143-9597, 0378-6920, 0378-6924, 0904-6948, 16714-963, 42292-057, 43598-358, 47335-401, 51407-181, 57894-150, 57894-155, 57894-195, 60505-4327, 64679-021, 64980-418, 69539-049, 0093-7536, 0904-6195, 16571-421, 16729-035, 42291-085, 43063-383, 50090-2453, 50268-075, 51991-620, 59651-236, 60429-286, 60505-2985, 60687-112, 60763-376, 62175-710, 62559-670, 63187-080, 63850-0010, 65841-743, 68001-155, 68071-1682, 68071-5203, 68382-209, 68788-6774, 69117-0003, 70518-2420, 70518-2484, 72789-008, 76420-004, 76519-1224, 0378-6921, 60505-4764, 68001-489, 68462-135

Table D.14. Procedure codes for measures specific to beneficiaries with cancer

Measure	Code system	Codes
Poor prognosis solid and hematological malignancies	HCPCS	G9066, G9069, G9075, G9087, G9088, G9094, G9098, G9103, G9107, G9111, G9834, G9842
Procedure codes indicating advanced stage or poor prognosis cancers	CPT	19301, 19302, 19303, 19304, 19305, 19306, 19307, 31652, 31653, 36640, 38300, 38305, 38500, 38505, 38510, 38520, 38525, 38530, 38531, 38570, 38572, 38573, 38589, 38700, 38720, 38724, 38740, 38745, 38746, 38747, 38760, 38765, 38770, 38780, 38790, 38792, 39402, 55812, 55842, 55862, 61517, 76950, 77011, 77014, 77261, 77262, 77263, 77280, 77285, 77290, 77293, 77295, 77299, 77300, 77301, 77305, 77306, 77307, 77310, 77315, 77316, 77317, 77318, 77321, 77326, 77327, 77328, 77331, 77332, 77333, 77334, 77336, 77338, 77370, 77371, 77372, 77373, 77385, 77386, 77387, 77399, 77401, 77402, 77403, 77404, 77406, 77407, 77408, 77409, 77411, 77412, 77413, 77414, 77416, 77417, 77421, 77422, 77423, 77424, 77425, 77427, 77431, 77432, 77435, 77469, 77470, 77499, 77520, 77522, 77523, 77525, 77600, 77605, 77610, 77615, 77620, 77750, 77761, 77762, 77763, 77767, 77768, 77776, 77777, 77778, 77785, 77786, 77787, 77789, 77790, 77799, 79005, 79101, 79200, 79300, 79403, 79440, 79445, 79999, 81162, 81163, 96401, 96402, 96405, 96406, 96409, 96411, 96413, 96415, 96416, 0182T, 0197T, 0394T, 0395T
	HCPCS	E0791, E0791, G0498, G3001, G6001, G6002, G6003, G6004, G6005, G6006, G6007, G6008, G6009, G6010, G6011, G6012, G6013, G6014, G6016, G6017, J0610, J0881, J0885, J0897, J1442, J1447, J1950, J2430, J2469, J2505, J3315, J3489, J8530, J8610, J9000, J9022, J9035, J9043, J9045, J9055, J9060, J9155, J9171, J9178, J9179, J9198, J9198, J9206, J9207, J9217, J9218, J9219, J9250, J9260, J9264, J9267, J9271, J9299, J9303, J9306, J9354, J9355, J9358, J9390, J9395, J9350, J9265, J9223, J1951, J9272, J9170, J9170, J9113, J9061, J9182, J9062

CPT = Current Procedural Terminology; HCPCS = Healthcare Common Procedure Coding System

Table D.15. National drug codes to identify hormonal therapies commonly given to beneficiaries with early-stage breast cancer

Drug	National drug codes
Tamoxifen	378, 591, 50090, 51862, 59651, 60429, 63187, 63739, 68071, 68382, 70518, 70771, 71335, and 89141
Anastrazole	93, 904, 16571, 16729, 42291, 43063, 50090, 50268, 51991, 59651, 60429, 60505, 60687, 60763, 62175, 62559, 63187, 63850, 65841, 68001, 68071, 68382, 68788, 69117, 70518, 72789, 76420, and 76519
Letrozole	78, 93, 16729, 17856, 42291, 50268, 51991, 55111, 57884, 59651, 60505, 68071, 69117, 70518, and 71335
Exemestane	9, 54, 378, 832, 44278, 47781, 50090, 51991, 59762, 65162, 68382, 69097, and 70771

4.6. Potentially preventable diagnoses

Table D.16. Diagnosis codes for potentially preventable diagnoses

Measure	Code system	Codes
Anemia	ICD-10-CM	D59.0, D59.10, D59.11, D59.12, D59.13, D59.19, D59.2, D59.9, D61.1, D61.2, D61.810, D61.811, D61.818, D61.82, D61.89, D63.0, D64.1, D64.2, D64.3, D64.81, D64.89, D64.9
Dehydration	ICD-10-CM	E86.0, E86.1, E86.9, E87.0
Diarrhea	ICD-10-CM	K52.1, K52.89, R19.7
Emesis	ICD-10-CM	K92.0, R11.10, R11.11, R11.12, R11.13, R11.14, R11.15
Fever	ICD-10-CM	R50.2, R50.81, R50.82, R50.9, R56.00, R56.01
Nausea	ICD-10-CM	R11.0, R11.2
Neutropenia	ICD-10-CM	D70.1, D70.2, D70.3, D70.8, D70.9
Pain	ICD-10-CM	G89.29, G89.3, H57.10, H57.11, H57.12, H57.13, H92.01, H92.02, H92.03, H92.09, K12.30, K12.31, K12.32, K12.39, K13.79, K62.89, M25.50, M25.511, M25.512, M25.519, M25.521, M25.522, M25.529, M25.531, M25.532, M25.539, M25.541, M25.542, M25.549, M25.551, M25.552, M25.559, M25.561, M25.562, M25.569, M25.571, M25.572, M25.579, M25.59, M53.81, M53.82, M53.83, M54.5, M54.6, M54.81, M54.89, M54.9, M79.1, M79.10, M79.11, M79.12, M79.18, M79.601, M79.602, M79.603, M79.604, M79.605, M79.606, M79.609, M79.621, M79.622, M79.629, M79.631, M79.632, M79.639, M79.641, M79.642, M79.643, M79.644, M79.645, M79.646, M79.651, M79.652, M79.659, M79.661, M79.662, M79.669, M79.671, M79.672, M79.673, M79.674, M79.675, M79.676, R07.0, R07.1, R07.2, R07.81, R07.82, R07.89, R07.9, R10.0, R10.10, R10.11, R10.12, R10.13, R10.2, R10.30, R10.31, R10.32, R10.33, R10.84, R10.9, R51, R51.0, R51.9, R52, R68.84
Pneumonia	ICD-10-CM	A01.03, A02.22, A15.0, A37.01, A37.11, A37.81, A48.1, A50.04, A54.84, A70, B01.2, B05.2, B25.0, B39.0, B39.1, B39.2, B44.0, B44.1, B77.81, J09.X1, J10.00, J10.01, J10.08, J12.0, J12.1, J12.2, J12.3, J12.81, J12.82, J12.89, J12.9, J13, J14, J15.0, J15.1, J15.20, J15.211, J15.212, J15.29, J15.3, J15.4, J15.5, J15.6, J15.7, J15.8, J15.9, J16.0, J16.8, J17, J18.0, J18.1, J18.2, J18.8, J18.9, J85.1
Sepsis	ICD-10-CM	A20.7, A26.7, A32.7, A40.0, A40.1, A40.3, A40.8, A40.9, A41.01, A41.02, A41.1, A41.2, A41.3, A41.4, A41.50, A41.51, A41.52, A41.53, A41.59, A41.81, A41.89, A41.9, A42.7, B00.7, B37.7, R65.20, R65.21, T81.12XA, T81.12XD, T81.12XS, T81.44XA, T81.44XD, T81.44XS

ICD-10-CM = International Classification of Diseases, Tenth Revision, Clinical Modification.

4.7. Quality measures

Table D.17. Procedure codes for quality measures

Measure	Code system	Codes
Aggressive Life Prolonging Procedures in the Last 30 Days of Life	CPT	*insertion of feeding tube*: 43246, 43761, 44500, 49440, 49441, 74340; *hemodialysis*: 90935 90937 90940 90945 90947 90999; *cardiopulmonary resuscitation*: 92950; *emergent endotracheal intubation*: 31500; *management of mechanical ventilation:* 94002, 94003
	ICD-10-PCS	*insertion of feeding tube*: 0DH60UZ, 0DH63UZ, 0DHA0UZ, 0DHA3UZ; *hemodialysis*: the first 4 (leftmost) characters are 5A1D; *cardiopulmonary resuscitation:* 5A1221Z; *emergent endotracheal intubation*: 0BH17EZ; *management of mechanical ventilation:* 5A1945Z
Any Surgery in Last 30 Days of Life	CPT	10004–69990
	ICD-10-PCS	1st (leftmost) character of an ICD-10-PCS code=0
Any Basic Diagnostic Tests in Last 30 Days of Life	CPT	*ECG*: 93000–93010, 93040–93042; *basic laboratory tests:* *basic chemistries–basic or comprehensive metabolic profile:* 80048, 80050, 80053; *basic hematology tests:* 85004, 85007, 85013, 85014, 85018, 85025, 85027; *urinalysis: 81000,81001, 81002, 81003, 81005, 81007, 81015;* *chest X-ray*: 71010, 71020, 71045, 71046; *non-invasive vascular diagnostic studies (e.g. Doppler studies of legs):* 93880–93998
	ICD-10-PCS	Not implemented in inpatient hospital claims since included in DRG payment and not billed separately

CPT = Current Procedural Terminology; ICD-10-PCS = International Classification of Diseases, Tenth Revision, Procedure Coding System.

Appendix E

Model Impacts: Supplemental Results

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This appendix contains additional results to support the findings presented in Chapters 6 and 7. These include full results for all the main analyses and subgroup analyses (Sections 1 and 2, respectively), sensitivity analyses (Section 3), checks to assess the robustness of the impact analysis results to alternative methodologies (Section 4), additional exploratory analyses (Section 5), and analyses with an alternative comparison group who entered directly into hospice (Section 6). Appendix C discusses our impact analysis methods.

1. Complete results from the main impact analyses with the full sample

In this section, we report regression-adjusted intervention and comparison group means and impact estimates for the full sample of MCCM enrollees and matched comparison beneficiaries, including confidence intervals and *p*-values. We discussed these results in Chapter 6. Appendix Table E.1 shows the estimated impacts on Medicare expenditures from enrollment (or pseudo-enrollment) to death (corresponding to Figure 19and Figure 20). In addition, we include estimated impacts on Medicare expenditures (with and without MCCM payments) *per day*.

Table E.1. Differences in Medicare expenditures between deceased MCCM enrollees and matched comparison beneficiaries

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Medicare expenditures (dollars per beneficiary)						
Medicare Part A and B expenditures plus MCCM payments	48,781	56,385	-7,604	-13	< .001	[-8,910, -6,298]
Medicare Part A and B expenditures	46,810	56,385	-9,576	-17	< .001	[-10,882, -8,269]
Inpatient expenditures	16,284	26,172	-9,887	-38	< .001	[-10,752, -9,023]
Hospice expenditures	8,375	4,128	+4,248	+103	< .001	[3,914, 4,581]
Other expenditures[a]	22,150	26,086	-3,936	-15%	< .001	[-4,769, -3,103]
Skilled nursing facility expenditures	2,627	3,435	-808	-24	< .001	[-1,044, -571]
Home health expenditures	2,436	2,324	+112	+5	0.10	[1, 222]
Part B drug expenditures	6,234	6,823	-588	-9	0.09	[-1,164, -12]
Durable medical equipment expenditures	862	711	+151	+21	0.009	[55, 247]
Other expenditures[b]	9,990	13,025	-3,035	-23	< .001	[-3,426, -2,644]
MCCM payments	1,971	0	+1,971	n/a	n/a	n/a
Medicare expenditures per day (dollars per beneficiary per day)						
Medicare Part A and B expenditures plus MCCM payments	379	520	-141	-27	< .001	[-155, -128]
Medicare Part A and B expenditures	362	520	-158	-30	< .001	[-172, -145]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting). We rounded numbers in this table after performing the calculations.

[a] Medicare Part A and B expenditures minus inpatient expenditures and hospice expenditures. For the sake of internal consistency, we calculated regression-adjusted means and impact estimates for Medicare Part A and B expenditures, inpatient expenditures, and hospice expenditures. Then, we manipulated the regression output to compute regression adjusted means and impacts for "other expenditures." Standard errors were calculated by seemingly unrelated estimation. Running a separate regression model to estimate impacts on "other expenditures" gives modestly different results. Specifically, a separate regression yields an estimate of -$4,140 (with standard error $497) compared to our reported estimate of -$3,936 (with standard error $506).

[b] *Other expenditures* includes all Medicare Part A and B expenditures not classified, including outpatient emergency department visits, ambulatory care visits, and other clinically necessary services.

CI = confidence interval; MCCM = Medicare Care Choices Model; n/a = not applicable.

In Appendix Table E.2, we report impact estimates on health care use for the inpatient and outpatient categories shown in Figure 21and Figure 22. We also split up the outcome measures "number of outpatient emergency department visits and observation stays" and "number of ambulatory visits with primary care providers and specialist physicians" into their respective components, which are not shown in the figures in Chapter 6.

Table E.2. Differences in health care service use between deceased MCCM enrollees and matched comparison beneficiaries

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Inpatient care (number per 1,000 beneficiaries)						
Number of inpatient admissions	1,242	1,676	-434	-26	< .001	[-478, -390]
Number of days admitted to a hospital	8,170	12,135	-3,965	-33	< .001	[-4,348, -3,582]
Number of days in hospital intensive care unit	2,560	4,147	-1,586	-38	< .001	[-1,779, -1,393]
Number of days in hospital without intensive care unit	5,610	7,981	-2,371	-30	< .001	[-2,669, -2,074]
Number of 30-day all-cause readmissions	303	429	-126	-29	< .001	[-150, -102]
Emergency care (number per 1,000 beneficiaries)						
Number of outpatient emergency department visits and observation stays	886	1,005	-119	-12	< .001	[-165, -73]
Number of outpatient emergency department visits	873	994	-121	-12	< .001	[-167, -75]
Number of observation stays	175	185	-10	-6	0.32	[-28, 7]
Number of emergency medical service ambulance transports	954	1,077	-123	-11	< .001	[-166, -79]
Ambulatory visits (number per 1,000 beneficiaries)						
Number of ambulatory visits with primary care providers and specialist physicians	12,885	14,860	-1,975	-13	< .001	[-2,318, -1,632]
Number of ambulatory visits with primary care providers	6,861	7,651	-790	-10	< .001	[-1,038, -543]
Number of ambulatory visits with specialist physicians	6,024	7,216	-1,192	-17	< .001	[-1,393, -991]
Post-acute and home health care (number per beneficiary)						
Number of post-acute care days	16.9	18.8	-1.9	-10	< .001	[-2.7, -1.1]
Number of home health visits	10.9	10.5	+0.4	+4	0.27	[-0.2, 1.0]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting).

CI = confidence interval; MCCM = Medicare Care Choices Model.

In Appendix Table E.3, we expand on the findings from Appendix Table E.2 by reporting estimated impacts on types of health care services that indicate more intensive or unnecessary service use, such as hospital stays that involved a surgery and emergency department visits with a potentially preventable diagnosis, corresponding to Table 8.

Table E.3. Differences between deceased MCCM enrollees and matched comparison beneficiaries in exploratory health care service use measures

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Inpatient care (number per 1,000 beneficiaries)						
Inpatient admissions	1,242	1,676	-434	-26	< .001	[-478, -390]
With a surgery	267	447	-180	-40	< .001	[-199, -161]
Number of days admitted	*2,489*	*4,585*	*-2,096*	-46	*< .001*	*[-2,341, -1,851]*
With an elective procedure	48	99	-50	-51	< .001	[-58, -43]
Number of days admitted	*317*	*778*	*-462*	-59	*< .001*	*[-539, -384]*
With a potentially preventable diagnosis	437	598	-161	-27	< .001	[-184, -138]
Number of days admitted	*2,974*	*4,532*	*-1,559*	*-34*	*< .001*	*[-1,768, -1,349]*
In the last 30 days of life with an aggressive life-prolonging procedure, surgery, or diagnostic testing	170	337	-167	-50	< .001	[-180, -155]
Number of days admitted	*1,475*	*3,206*	*-1,732*	-54	*< .001*	*[-1,889, -1,575]*
Emergency care (number per 1,000 beneficiaries)[3]						
Outpatient emergency department visits and observation stays	886	1,005	-119	-12	< .001	[-165, -73]
With a potentially preventable diagnosis	212	250	-38	-15	0.001	[-58, -19]
In the last 30 days of life with an aggressive life-prolonging procedure, surgery, or diagnostic testing	162	199	-37	-19	< .001	[-49, -24]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting).

CI = confidence interval; MCCM = Medicare Care Choices Model.

In Appendix Table E.4, we report the estimated impacts on enrollment in the Medicare hospice benefit and time spent time in hospice, which correspond to Figure 24 and Figure 25.

Table E.4. Differences in hospice use between deceased MCCM enrollees and matched comparison beneficiaries

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Percentage who used the Medicare hospice benefit	83.2	65.3	+17.9	+27	< .001	[16.7, 19.0]
Number of days in hospice	41.6	18.7	+22.8	+122	< .001	[20.8, 24.8]
Percentage admitted to hospice less than three days before death	19.6	18.7	+0.9	+5	0.16	[-0.2, 2.0]
Average percentage of days between enrollment and death the beneficiary was in hospice	27.6	15.8	+11.8	+75	< .001	[11.0, 12.6]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting).

CI = confidence interval; MCCM = Medicare Care Choices Model.

In Appendix Table E.5, we report the estimated hazard ratio of entering hospice, that is, the estimated difference that MCCM enrollees enter hospice, relative to the comparison group, on any given day.

Table E.5. Ratio of the hazard of electing the Medicare hospice benefit between deceased MCCM enrollees and matched comparison beneficiaries

Outcome	Estimated hazard ratio (impact estimate)	*p*-value	90 percent CI
Time from enrollment to entering hospice	1.41	< .001	[1.36, 1.46]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Cox proportional hazard model.

A hazard ratio of 1 would indicate no model effect on this outcome, while ratios greater than 1 indicate the propensity to enter hospice was higher for MCCM beneficiaries than matched comparison beneficiaries.

CI = confidence interval; MCCM = Medicare Care Choices Model.

Appendix Table E.6 contains impact estimates that disentangle regression-adjusted differences in total expenditures (with and without payments to hospices participating in the model), inpatient admissions, and emergency department visits and observation stays into estimated impacts that can be attributed to beneficiaries enrolling in the Medicare hospice benefit more often and earlier than beneficiaries in comparison group. The remainder of the impact is, by definition due to effects of MCCM that happen through other channels, which may include, for example, impacts of symptom management and care coordination that affect beneficiary outcomes before enrollees transitioned to hospice (Figure 26 and Figure 27). We describe our method to disentangle these estimated impacts in Appendix C, Section 4.3.

Table E.6. Differences in expenditures and hospital service use between deceased MCCM enrollees and matched comparison beneficiaries that operate through enrollment in hospice versus other channels

Channel	MCCM mean	Comparison mean	Impact estimate	Percentage of overall impact	*p*-value	90 percent CI
Medicare expenditures (dollars per beneficiary)						
Medicare Part A and B expenditures plus MCCM payments	48,393	55,898	-7,505		< .001	[-8,811, -6,198]
Through hospice			-4,785	64	< .001	[-5,145, -4,425]
Other channels[a]			-2,719	36	< .001	[-3,963, -1,475]
Medicare Part A and B expenditures	46,422	55,892	-9,470		< .001	[-10,774, -8,166]
Through hospice			-4,806	51	< .001	[-5,167, -4,446]
Other channels[a]			-4,663	49	< .001	[-5,908, -3,418]
Inpatient expenditures	16,126	25,888	-9,762		< .001	[-10,626, -8,898]
Through hospice			-2,520	26	< .001	[-2,708, -2,332]
Other channels[a]			-7,242	74	< .001	[-8,041, -6,444]
Inpatient care (number per 1,000 beneficiaries)						
Number of inpatient admissions	1,224	1,656	-432		< .001	[-476, -389]
Through hospice			-159	37	< .001	[-171, -147]
Other channels[a]			-273	63	< .001	[-314, -233]
Number of days admitted to a hospital	7,965	11,948	-3,982		< .001	[-4,359, -3,605]
Through hospice			-1,148	29	< .001	[-1,233, -1,063]
Other channels[a]			-2,834	71	< .001	[-3,185, -2,483]
Number of 30-day all-cause readmissions	292	419	-127		< .001	[-150, -103]
Through hospice			-38	30	< .001	[-42, -35]
Other channels[a]			-88	70	< .001	[-111, -66]

Channel	MCCM mean	Comparison mean	Impact estimate	Percentage of overall impact	*p*-value	90 percent CI
Emergency care (number per 1,000 beneficiaries)						
Number of outpatient emergency department visits and observation stays	869	989	-121		< .001	[-166, -75]
Through hospice			-89	74	< .001	[-96, -82]
Other channels[a]			-32	26	0.23	[-75, 12]
Number of emergency medical service ambulance transports	938	1,062	-123		< .001	[-166, -80]
Through hospice			-94	76	< .001	[-101, -86]
Other channels[a]			-30	24	0.24	[-71, 11]
Ambulatory visits (number per 1,000 beneficiaries)						
Number of ambulatory visits with primary care providers and specialist physicians	12,779	14,726	-1,947		< .001	[-2,287, -1,608]
Through hospice			-1,326	68	< .001	[-1,426, -1,226]
Other channels[a]			-621	32	0.001	[-933, -310]
Post-acute care (number per beneficiary)						
Number of post-acute care days	16.7	18.5	-1.8		< .001	[-2.6, -1.0]
Through hospice			-1.7	94	< .001	[-1.8, -1.6]
Other channels[a]			-0.1	6	0.82	[-0.9, 0.7]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,126) and matched comparison beneficiaries (N = 15,147 before weighting). The estimated overall impacts are slightly different from those reported in Table E.1 and Table E.2 because of different sample restrictions (this analysis excludes a small number of beneficiaries who died more than 30 days after disenrolling from the hospice benefit).

[a] Other channels refer to impacts of MCCM operating before enrollees transition into hospice; see text for examples.

CI = confidence interval; MCCM = Medicare Care Choices Model.

In Appendix Table E.7, we report impact estimates, including confidence intervals and *p*-values corresponding to the quality-of-care measures (receipt of an aggressive life-prolonging treatment, days at home, and health services use near the end of life) corresponding to Table 9.

Table E.7. Differences in quality of end-of-life care between deceased MCCM enrollees and matched comparison beneficiaries

Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life[a]	61.2	76.5	-15.3	-20	< .001	[-16.6, -14.0]
Percentage with an aggressive life-prolonging procedure or surgery	55.2	71.6	-16.4	-23	< .001	[-17.7, -15.1]
Percentage with an aggressive life-prolonging procedure[a]	41.0	58.9	-17.9	-30	< .001	[-19.3, -16.6]
Percentage with a surgery	42.5	57.4	-14.9	-26	< .001	[-16.3, -13.6]
Percentage with a diagnostic test	55.9	72.0	-16.1	-22	< .001	[-17.4, -14.8]
Number of days at home[b]	183.5	178.0	+5.5	+3	< .001	[4.7, 6.2]
Percentage of days between enrollment and death the beneficiary was at home	88	81	+7	+8	< .001	[6.2, 7.2]
Number of days at home in the last 30 days of life	22.4	19.5	+2.9	+15	< .001	[2.6, 3.1]
Percentage with more than one emergency department visit or hospitalization or at least one intensive care unit admission in the last 30 days of life	21.0	36.8	-15.8	-43	< .001	[-16.9, -14.6]
Percentage with more than one outpatient emergency department visit	2.5	3.2	-0.8	-24	0.005	[-1.2, -0.3]
Percentage with more than one hospitalization	5.1	9.7	-4.5	-47	< .001	[-5.2, -3.8]
Percentage with an intensive care unit admission	17.5	32.1	-14.5	-45	< .001	[-15.6, -13.4]
Percentage who died in an inpatient facility	10.4	21.8	-11.4	-52	< .001	[-12.4, -10.5]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting).

[a] *Aggressive life-prolonging procedures* are defined in Appendix D, Section 3.4.

[b] *Days at home* counts the number of days a beneficiary is alive and not admitted to a hospital, inpatient rehabilitation facility, long term care hospital, a skilled nursing facility, or inpatient hospice.

CI = confidence interval; MCCM = Medicare Care Choices Model.

2. Sensitivity analyses using *E*-values

Our analysis achieved excellent balance between MCCM enrollees and comparison beneficiaries for all the variables we included in matching (and especially close balance for matching variables deemed the most important). In addition, we included a similarly wide range of covariates in the regression analysis to increase the precision of the impact estimates and adjust for any residual differences that remained after matching. The doubly robust approach of matching and regression adjustment using an extensive list of baseline characteristics makes it less likely that important characteristics, that could spuriously affect estimates of model effects (that is, unobserved confounders), remain unaccounted for.[150] However, the possibility of bias from unobserved imbalances between the two groups cannot be ruled out absent a randomized trial. Unobserved confounders might be correlated with enrollment in MCCM and with outcomes such as whether a beneficiary enters hospice. For example, although we observe services and the associated diagnoses that a beneficiary received during the year before enrollment or pseudo-enrollment, we cannot directly observe other information about disease severity or the beneficiary's long-term prognosis that might be available to beneficiaries and clinicians. MCCM enrollees could have had, on average, more (or less) severe illnesses or worse (or better) prognoses than those beneficiaries who were eligible but who did not enroll, even after matching on observable service use, diagnoses, and Medicare expenditures. This type of unobserved differences between the two groups might have caused MCCM enrollees to be more likely to forgo aggressive medical treatment and enter hospice more often than (and sooner after enrollment) than those in the comparison group. As another example, beneficiaries who chose to enroll in MCCM could have been more accepting of their prognosis and more willing to consider receiving hospice benefits than those in the comparison group, which could lead to impact estimates that are biased by self-selection.[151,152] Selection bias and other unobserved confounding could make our impact estimates appear larger or smaller in magnitude than the true effects of the model. In more extreme cases, biases could make it appear that there are large and policy-relevant impacts of the model when, in fact, there are none.

Given these concerns, we assessed the threat of selection bias in our impact estimates by using the *E*-value approach described in Ding and VanderWeele (2016) and VanderWeele and Ding (2017). The

[150] All else equal, using a more extensive the list of matching (control) variables decreases the number of factors that remain unaccounted for in the analysis. In addition, limiting the comparison group to a matched subsample that closely matches the intervention group on an array of observed characteristics will also reduce differences between the two groups on unobserved characteristics that are correlated with the matching variables (Stuart 2010). See Technical Appendix A for more details about our methods.

[151] This issue is partially addressed because we excluded from the potential comparison group beneficiaries who were referred to MCCM but chose not to enroll. (None of the comparison beneficiaries were referred to the model according to MCCM program data.) The potential for selection bias remains, however, because our intervention group only includes beneficiaries who were referred to MCCM *and chose to enroll in* MCCM.

[152] We considered addressing potential selection bias by using an intent-to-treat evaluation design, in which everyone who qualifies for the model is included in the "intervention" group (not just those that enroll). This would avoid the potential problem in which people who enroll in the model might have different unobserved characteristics than those in the comparison group, biasing impact estimates. Unfortunately, we were not able to use an intent-to-treat approach to evaluate MCCM because the number of beneficiaries who enrolled in the model is small relative to the number who were eligible for MCCM and lived in the market of a participating hospice. Including so many nonparticipants in the intervention group would severely dilute the impact estimate, making it nearly impossible to detect an impact that might truly exist.

approach assesses how strong unobserved confounding would need to be to fully explain the estimated impact estimate. Specifically, the approach uses minimal assumptions to quantify an *E*-value—the threshold for the weakest correlations (measured on a risk ratio scale) between (1) a hypothetical unmeasured confounder and enrollment and (2) the confounder and the outcome variable of interest that would lead to the observed impact estimate if the model truly had no effect. Larger *E*-values indicate that larger unobserved differences between the intervention and comparison groups, on variables strongly related to outcomes, would be necessary to produce the observed impact estimate if the true impact of the model is zero; meanwhile, *E*-values close to 1 (the minimum) indicate the observed differences could be explained by very small (or negligible) differences between the intervention and comparison groups. In other words, this *E*-values captures the degree of confounding that, if removed, would cause the estimated impact of the model to go to zero effect. In another test for selection, if we assume that the unmeasured confounder is perfectly correlated with enrollment (for example, a binary measure that equals one for 100 percent of MCCM enrollees and 0 percent of comparison beneficiaries), we can calculate the correlation required for an unobserved confounder to have with the outcome variable in order to fully explain the observed impact. These two estimates describe the strength of confounding required to move the point estimate of the impact to zero. We also estimate the correlation required of a hypothetical confounder that, if removed, would move the 90 percent confidence interval around the impact estimate to include zero.

Appendix Table E.8 reports the *E*-values and relative risk ratios described above. Each row represents a different outcome variable. Column 2 shows the *E*-value that would cause the point estimate of the impact estimate to be zero, and Column 4 shows the *E*-value that would cause the 90 percent confidence interval around the point estimate of the impact estimate to include zero (or for the odds ratio or hazard ratio to include one). Column 3 shows the relative risk ratio required, when the unmeasured confounder is perfectly correlated with enrollment, that would cause the point estimate of the impact estimate to be zero effect, and Column 5 shows the relative risk ratio required, when the unmeasured confounder is perfectly correlated with enrollment, that would cause the 90 percent confidence interval around the point estimate of the impact estimate to include zero (or for the odds ratio or hazard ratio to include one). Details on the derivation of the formulas used to calculate these values for binary outcomes, continuous outcomes, and in hazard models are available in Ding and VanderWeele (2016), VanderWeele and Ding (2017), and Linden et al. (2020).

Table E.8. *E*-values and relative risk bounds for unmeasured confounders

Outcome	Confounding that, if removed, would change the impact estimate to zero		Confounding that, if removed, would change the 90 percent confidence interval to include zero	
	E-value	Confounder perfectly correlated with enrollment	*E*-value	Confounder perfectly correlated with enrollment
Medicare Part A and B expenditures plus MCCM payments	1.47	1.11	1.40	1.09
Medicare Part A and B expenditures	1.55	1.14	1.49	1.12
Number of inpatient admissions	1.73	1.22	1.66	1.19
Number of outpatient emergency department visits and observation stays	1.30	1.06	1.21	1.03
Used the Medicare hospice benefit	2.79	1.70	2.66	1.64
Time to using the Medicare hospice benefit (hazard analysis)	1.85	1.41	1.78	1.36
Received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	2.29	1.47	2.19	1.42
Days at home[a]	1.17	1.02	1.16	1.02

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: *E*-values and other bounds are calculated using impact estimates on regression-adjusted differences between MCCM enrollees and matched comparison beneficiaries.

MCCM = Medicare Care Choices Model.

After we establish the threshold for an unobserved confounder to explain away our impact results, we benchmark these values against observed associations in our regression models and with other estimates found in the literature to assess whether it is likely an unobserved confounder exists with the required correlation with both enrollment and the outcome. For example, if the unobserved confounder must be more strongly correlated with enrollment and the outcome than all other covariates in the model, including those known in the literature to be strongly and robustly correlated with the outcome, it would be unlikely that such unobserved confounders or selection bias exists that can fully explain away the estimated impacts. On the other hand, if an unobserved confounder that is only weakly correlated with enrollment or the outcome variable would be enough to explain away the observed impacts, then we would have less confidence in our estimated impacts. Intuitively, a higher *E*-value

means that an unobserved confounder would have to have a stronger correlation with enrollment and the outcome to explain away the estimated impacts and is therefore less likely to exist; an *E*-value closer to one means a relatively small level of selection bias could have produced the observed impact estimate if the impact of the model was truly zero, and an *E*-value or relative risk of 1 (the smallest possible value these statistics can take) means that no residual confounding would be necessary to fully explain the impact regression results.

We calculated findings for the eight outcomes listed in Appendix Table E.8:

- **Total Medicare Part A and B expenditures, including MCCM payments.** We calculated an *E*-value of 1.47, which means that the estimated impact of MCCM enrollment on expenditures (-$7,604) could be explained away by an unmeasured confounder that was associated with both enrollment and expenditures with a relative risk ratio of 1.47, but weaker confounding would not fully explain away the finding.[153] To put this in perspective, we found that the association between hierarchical condition category scores and total Medicare expenditures had a relative risk of 1.06, which means that a hypothetical unmeasured confounder would have to have a stronger association with Medicare expenditures (including MCCM payments) than a 5.6 point change in hierarchical condition category score. Further, this confounder would have to have an equally strong association with MCCM enrollment (even though we already matched on hierarchical condition category scores and other variables that are strong predictors of future expenditures).

  If the confounder were perfectly correlated with enrollment (completely imbalanced between intervention and comparison beneficiaries), the unmeasured confounder could be less strongly correlated with the outcome variable and explain away our impact estimates in comparison to the *E*-values scenario (in which the confounder is assumed to be partially, but not completely, correlated with enrollment). If perfectly correlated with enrollment, the observed association between MCCM enrollment and decreased expenditures could be explained by an unmeasured confounder that was associated with expenditures by a risk ratio of 1.11. To put this in perspective, the unmeasured confounder would require a stronger association with Medicare Part A and B expenditures than a 0.9 percentage point change in hierarchical condition category scores.
- **Medicare Part A and B expenditures, not including MCCM payments.** We calculated an *E*-value of 1.55. As a benchmark for this outcome, we estimated a relative risk ratio of 1.06 for the association with hierarchical condition category scores.
- **Inpatient admissions.** We calculated an *E*-value of 1.73. Other observed covariates less strongly predict inpatient admissions than this. For example, the relative risk ratios between inpatient admissions during the study period and inpatient hospitalizations in the last quarter of the baseline period was only 1.16.
- **Emergency department visits and observation stays.** We calculated an *E*-value of 1.30. The low *E*-value for emergency department visits and observation stays compared with the relative risk for lagged emergency department visits and observation stays indicates that a lower level of unobserved confounding could explain this estimated impact than for other outcomes such as

[153] For mean differences, we obtain an approximate *E*-value by using methods developed in Lipsey and Wilson (2001), which use the approximation: RR ≈ e[0.91 * d], where *d* represents the effect size (impact estimate of the intervention divided by standard deviation of the outcome variable).

expenditures or inpatient admissions. The main reason for this is that the model's estimated effect on emergency department visits and observation stays is relatively small compared with the model's effect on the other expenditure and service use outcomes.

- **Using the Medicare hospice benefit.** We calculated an *E*-value of 2.79. In comparison, this confounder would have to be fairly imbalanced and more strongly predict hospice use than other strong predictors in the literature. For example, Obermeyer et al. (2015) found that a physician's practice style was the strongest predictor in claims data for whether a terminally ill cancer beneficiary would use hospice. The *E*-value in our analysis is larger than the relative risk ratio for using hospice that is associated with switching from a doctor in the bottom decile of referring beneficiaries to hospice to a doctor in the top decile (Obermeyer et al. 2015).
- **Time to using the Medicare hospice benefit.** For the Cox proportional hazard model in Table E.5, we calculated an *E*-value of 1.85. The unmeasured confounder would require a stronger relationship with this outcome variable and with enrollment than was observed in any of the expenditures and utilization outcomes in Chapter 6.
- **Received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life.** We calculated an *E*-value of 2.29. The unmeasured confounder would require a stronger relationship with this outcome variable and with enrollment than was observed in any of the expenditure and utilization outcomes in Chapter 6.
- **Days at home.** We calculated an *E*-value of 1.17. By comparison, we found a relative risk ratio of 1.02 for days at home and inpatient hospitalizations in the last quarter of the last quarter of the baseline period.

3. Subgroup-specific impact estimates

In this section we present the results of the Bayesian subgroup analyses, which examine the variation in MCCM's effects across several subgroups of interest. Results include the regression-adjusted mean outcome values in the MCCM and matched comparison groups, impact estimates, credible intervals, and probabilities that impacts achieved relevant thresholds—for example, the probability that a particular subgroup achieved a strong impact in the hypothesized direction.

Appendix Table E.9 presents impact estimates on primary outcomes by beneficiaries' survival time—the length of enrollment in MCCM. For expenditures outcomes, impacts peak among those who survived 91 to 365 days, then decrease among those who survived for more than 365 days. By contrast, impacts on service use and some quality-of-care measures, such as days at home, are largest for beneficiaries who were enrolled for more than 365 days, likely because for these beneficiaries the model had the greatest opportunity to prevent adverse outcomes or facilitate high-quality care.

Table E.9. Differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by survival time

Survival time	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI
Medicare expenditures (dollars per beneficiary)					
Medicare Part A and B expenditures plus MCCM payments: all decedents	48,809	56,559	-7,769	-14	[-9,467, -6,053]
Survived 1 to 30 days	9,358	15,683	-6,341	-40	[-9,348, -3,041]
Survived 31 to 90 days	22,764	31,499	-8,736	-28	[-11,521, -6,083]
Survived 91 to 180 days	40,471	50,462	-10,033	-20	[-13,485, -6,848]
Survived 181 to 365 days	66,401	75,975	-9,629	-13	[-13,225, -6,480]
Survived more than 365 days	126,813	130,136	-3,319	-3	[-7,578, 1,062]
Medicare Part A and B expenditures: all decedents	46,832	56,534	-9,717	-17	[-11,380, -8,022]
Survived 1 to 30 days	8,078	16,465	-8,379	-51	[-11,116, -4,880]
Survived 31 to 90 days	21,799	31,694	-9,891	-31	[-12,249, -7,566]
Survived 91 to 180 days	39,313	50,276	-11,000	-22	[-14,184, -8,419]
Survived 181 to 365 days	64,409	75,381	-11,026	-15	[-14,719, -8,327]
Survived more than 365 days	121,489	129,616	-8,129	-6	[-10,955, -4,425]
Service use (number per 1,000 beneficiaries)					
Number of inpatient admissions: all decedents	1,230	1,679	-437	-26	[-490, -381]
Survived 1 to 30 days	267	690	-342	-50	[-438, -237]
Survived 31 to 90 days	621	1,063	-382	-36	[-464, -299]
Survived 91 to 180 days	1,071	1,549	-480	-31	[-575, -392]
Survived 181 to 365 days	1,664	2,132	-514	-24	[-610, -423]
Survived more than 365 days	3,030	3,468	-504	-15	[-596, -412]
Number of outpatient emergency department visits and observation stays: all decedents	882	1,002	-118	-12	[-176, -63]
Survived 1 to 30 days	122	214	-83	-39	[-162, 16.2]
Survived 31 to 90 days	334	438	-97	-22	[-170, -15.2]
Survived 91 to 180 days	709	840	-125	-15	[-206, -54]
Survived 181 to 365 days	1,127	1,266	-139	-11	[-226, -63]
Survived more than 365 days	2,566	2,714	-160	-6	[-262, -80]
Hospice use					
Percentage who used the Medicare hospice benefit: all decedents	83.1	64.9	+18.3	+28	[16.8, 19.6]
Survived 1 to 30 days	77.2	55.8	+21.5	+39	[19.4, 23.6]
Survived 31 to 90 days	85.4	68.4	+17.0	+25	[15.4, 18.6]
Survived 91 to 180 days	85.6	68.6	+17.1	+25	[15.4, 18.8]
Survived 181 to 365 days	84.7	67.2	+17.4	+26	[15.6, 19.3]
Survived more than 365 days	81.7	62.9	+18.7	+30	[16.8, 20.7]
Quality of end-of-life care					
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life: all decedents	61.2	76.6	-15.4	-20	[-16.9, -14.0]
Survived 1 to 30 days	63.8	78.6	-14.8	-19	[-16.6, -12.9]
Survived 31 to 90 days	67.4	81.1	-13.7	-17	[-15.4, -11.9]
Survived 91 to 180 days	56.7	73.6	-16.9	-23	[-19.2, -14.9]
Survived 181 to 365 days	57.7	73.9	-16.2	-22	[-18.3, -14.3]
Survived more than 365 days	57.5	73.6	-16.2	-22	[-18.2, -14.2]

Survival time	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI
Number of days at home: all decedents	184	177	+6.7	+4	[5.7, 7.7]
Survived 1 to 30 days	13	11	+1.7	+15	[1.2, 2.3]
Survived 31 to 90 days	49	44	+4.5	+10	[3.6, 5.4]
Survived 91 to 180 days	118	110	+7.2	+7	[5.6, 8.8]
Survived 181 to 365 days	238	230	+8.3	+4	[5.6, 10.9]
Survived more than 365 days	612	599	+13.4	+2	[8.8, 18.0]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. Bayesian analysis using methods described in Appendix C, Section 5.2. There were 1,003 enrollees who survived 1 to 30 days, 1,355 who survived 31 to 90 days, 1,038 who survived 91 to 180 days, 886 who survived 181 to 365 days, and 871 who survived more than 365 days. There were 2,957 matched comparison beneficiaries who survived 1 to 30 days, 4,049 who survived 31 to 90 days, 3,079 who survived 91 to 180 days, 2,627 who survived 181 to 365 days, and 2,557 who survived more than 365 days.

CI = credible interval; MCCM = Medicare Care Choices Model.

Appendix Table E.10 compares impact estimates among beneficiaries with three of the four qualifying conditions: cancer, congestive heart failure, and chronic obstructive pulmonary disease. In general, impacts are similar for beneficiaries with these three qualifying conditions, with a few notable exceptions. First, there is a moderately high probability that MCCM reduced Medicare Part A and B expenditures plus MCCM payments more for beneficiaries diagnosed with cancer than for other beneficiaries. Second, there is a very high probability that MCCM increased hospice use more among beneficiaries diagnosed with congestive heart failure or chronic obstructive pulmonary disease than other beneficiaries.

Table E.10. Differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by primary diagnosis category

	Beneficiaries with cancer				Beneficiaries with congestive heart failure				Beneficiaries with chronic obstructive pulmonary disease			
Outcome	MCCM mean	Impact estimate [90% CI]	Percentage impact	Probability impacts are more favorable[a]	MCCM mean	Impact estimate [90% CI]	Percentage impact	Probability impacts are more favorable[a]	MCCM mean	Impact estimate [90% CI]	Percentage impact	Probability impacts are more favorable[a]
Medicare Part A and B expenditures plus MCCM payments	45,301	-7,935 [-9,729, -6,115]	-15	76	54,742	-7,607 [-9,526, -5,649]	-12	40	53,944	-7,277 [-9,196, -5,300]	-12	15
Medicare Part A and B expenditures	43,554	-9,727 [-11,412, -7,976]	-18	52	52,484	-9,750 [-11,566, -7,864]	-16	59	51,683	-9,455 [-11,329, -7,567]	-15	25
Number of inpatient admissions per 1,000 beneficiaries	1,004	-447 [-525, -369]	-31	45	1,618	-442 [-505, -376]	-21	61	1,553	-454 [-521, -388]	-23	76
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries	747	-106 [-169, -42]	-12	19	1,083	-116 [-180, -51]	-10	49	1,091	-129 [-198, -64]	-11	69
Percentage who used the Medicare hospice benefit	86	+16.4 [15.0, 17.7]	+23	<1	77	+21.6 [19.8, 23.3]	+39	>99	79	+20.4 [18.7, 22.1]	+35	>99

Outcome	Beneficiaries with cancer				Beneficiaries with congestive heart failure				Beneficiaries with chronic obstructive pulmonary disease			
	MCCM mean	Impact estimate [90% CI]	Percentage impact	Probability impacts are more favorable[a]	MCCM mean	Impact estimate [90% CI]	Percentage impact	Probability impacts are more favorable[a]	MCCM mean	Impact estimate [90% CI]	Percentage impact	Probability impacts are more favorable[a]
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	60	-15.8 [-17.4, -14.2]	-21	95	66	-14.2 [-15.8, -12.7]	-18	2	62	-15.3 [-17.2, -13.6]	-20	32
Number of days at home	156	+5.9 [4.9, 6.9]	+4	<1	209	+7.6 [6.2, 9.0]	+4	99	215	+7.4 [6.0, 9.0]	+4	96

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. Bayesian analysis using methods described in Appendix C, Section 5.2. We did not present impacts for the 20 MCCM enrollees (less than 1 percent) with HIV/AIDS because the sample size was too small. There were 3,698 enrollees with cancer, 1,957 with congestive heart failure, and 1,719 with chronic obstructive pulmonary disease. There were 10,922 matched comparison beneficiaries with cancer, 5,810 with congestive heart failure, and 5,131 with chronic obstructive pulmonary disease. Some beneficiaries had more than one qualifying condition and are included in multiple columns of the table.

[a] Probabilities are calculated comparing beneficiaries with the qualifying condition to all beneficiaries without the qualifying condition. For example, we compute the probability that MCCM has a more favorable impact—that is, an impact in the hypothesized direction—on each outcome for beneficiaries with a cancer diagnosis than for beneficiaries who do not have a cancer diagnosis, regardless of their other diagnoses.

CI = credible interval; MCCM = Medicare Care Choices Model.

Appendix Table E.11 compares MCCM impacts for non-White or Hispanic beneficiaries to impacts for non-Hispanic White beneficiaries. MCCM was most successful at reducing the disparity in hospice use between non-White or Hispanic beneficiaries and non-Hispanic White beneficiaries, and increased the disparity in the percentage with an aggressive life-prolonging treatment in the last 30 days of life.

Table E.11. Differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by race and ethnicity

Outcome	Non-White or Hispanic beneficiaries			Non-Hispanic White beneficiaries			Difference in impact estimates[a] [90% CI]	Probability that MCCM reduced the disparity[b]
	MCCM mean	Impact estimate [90% CI]	Percentage impact	MCCM mean	Impact estimate [90% CI]	Percentage impact		
Medicare Part A and B expenditures plus MCCM payments	58,882	-8,794 [-11,993, -5,965]	-13	47,222	-7,607 [-9,356, -5,843]	-14	-1,187 [-4,391, 1,251]	79
Medicare Part A and B expenditures	56,952	-10,642 [-13,534, -8,166]	-16	45,235	-9,571 [-11,266, -7,816]	-17	-1,071 [-3,981, 1,036]	80
Number of inpatient admissions per 1,000 beneficiaries	1,596	-406 [-509, -284]	-20	1,173	-442 [-497, -385]	-27	+36 [-62, 166]	32
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries	1,026	-101 [-179, -11.8]	-9	859	-121 [-179, -64]	-12	+19.9 [-36, 109]	35
Percentage who used the Medicare hospice benefit	75	+21.8 [18.9, 24.3]	+41	84	+17.7 [16.3, 19.1]	+27	+4.1 [1.3, 6.1]	98
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	67	-13.6 [-15.8, -10.4]	-17	60	-15.7 [-17.3, -14.2]	-21	+2.1 [0.2, 5.6]	3
Number of days at home	174	+6.8 [5.0, 8.9]	+4	185	+6.6 [5.6, 7.7]	+4	+0.2 [-1.6, 2.4]	52
Percentage with more than one outpatient emergency department visit in last 30 days of life	3.0	-0.4 [-1.5, 1.0]	-12	2.4	-0.8 [-1.4, -0.3]	-26	+0.4 [-0.5, 1.9]	32
Percentage with more than one hospitalization in last 30 days of life	8.0	-3.2 [-5.4, -0.9]	-29	4.7	-4.7 [-5.6, -3.8]	-50	+1.5 [-0.7, 3.8]	13

Outcome	Non-White or Hispanic beneficiaries			Non-Hispanic White beneficiaries			Difference in impact estimates[a] [90% CI]	Probability that MCCM reduced the disparity[b]
	MCCM mean	Impact estimate [90% CI]	Percentage impact	MCCM mean	Impact estimate [90% CI]	Percentage impact		
Percentage with any ICU admission in last 30 days of life	20.0	-14.7 [-17.2, -11.4]	-42	17.2	-14.6 [-16.1, -13.2]	-46	-0.1 [-2.3, 3.4]	61
Percentage who died in an inpatient facility	14.8	-13.6 [-16.4, -10.5]	-48	9.7	-11.5 [-12.8, -10.2]	-54	-2.1 [-4.6, 1.2]	88

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. Bayesian analysis using methods described in Appendix C, Section 5.2. There were 4,451 MCCM enrollees who were non-Hispanic White and 702 who were non-White or Hispanic. There were 13,418 matched comparison beneficiaries who were non-Hispanic White and 1,851 who were non-White or Hispanic.

[a] Differences in impact estimates in this column reflect differences in the characteristics of non-White or Hispanic beneficiaries versus non-Hispanic White beneficiaries, and how those differences may translate into different impacts of MCCM.

[b] Values in this column represent the probability that MCCM has a larger impact in the hypothesized direction for non-White or Hispanic beneficiaries than for non-Hispanic White beneficiaries.

CI = credible interval; MCCM = Medicare Care Choices Model; ICU = intensive care unit.

Appendix Table E.12 compares MCCM's impacts on dually eligible and non-dually eligible beneficiaries. As among non-White or Hispanic beneficiaries, it is most likely that MCCM reduced the disparity in hospice use between dually eligible and non-dually eligible beneficiaries, and least likely that MCCM reduced the disparity in the percentage receiving aggressive life-prolonging treatments in the last 30 days of life.

Table E.12. Differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by dual eligibility

Outcome	Dually eligible beneficiaries			Non-dually eligible beneficiaries			Difference in impact estimates[a] [90% CI]	Probability that MCCM reduced the disparity[b]	Difference in impacts, holding covariates constant[c] [90% CI]
	MCCM mean	Impact estimate [90% CI]	Percentage impact	MCCM mean	Impact estimate [90% CI]	Percentage impact			
Medicare Part A and B expenditures plus MCCM payments	66,209	-6,198 [-9,256, -2,185]	-9	46,563	-7,972 [-9,747, -6,197]	-15	+1,774 [-976, 5,984]	21	+1,632 [-969, 5,904]
Medicare Part A and B expenditures	63,786	-8,659 [-11,401, -4,577]	-12	44,645	-9,854 [-11,560, -8,114]	-18	+1,195 [-1,084, 5,321]	30	+1,273 [-805, 5,381]
Number of inpatient admissions per 1,000 beneficiaries	1,991	-365 [-484, -213]	-15	1,132	-447 [-502, -389]	-28	+82 [-32, 247]	16	+51 [-61, 218]
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries	1,676	-109 [-194, -3.7]	-6	779	-119 [-177, -63]	-13	+9.9 [-60, 116]	49	+14.1 [-54, 120]
Percentage who received the Medicare hospice benefit	76	+20.4 [17.4, 22.8]	+37	84	+18.0 [16.6, 19.4]	+27	+2.4 [-0.6, 4.4]	92	+0.3 [-2.3, 2.1]
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	65	-14.0 [-16.1, -11.7]	-18	61	-15.6 [-17.2, -14.1]	-20	+1.6 [-0.01, 3.8]	5	+0.4 [-1.2, 2.6]

Outcome	Dually eligible beneficiaries			Non-dually eligible beneficiaries			Difference in impact estimates[a] [90% CI]	Probability that MCCM reduced the disparity[b]	Difference in impacts, holding covariates constant[c] [90% CI]
	MCCM mean	Impact estimate [90% CI]	Percentage impact	MCCM mean	Impact estimate [90% CI]	Percentage impact			
Number of days at home	225	+6.9 [4.2, 9.3]	+3	178	+6.6 [5.6, 7.7]	+4	+0.3 [-2.6, 2.5]	62	-0.8 [-3.3, 1.1]
Percentage with more than one outpatient emergency department visit in last 30 days of life	3.9	-0.9 [-2.0, 0.4]	-18	2.3	-0.8 [-1.3, -0.2]	-25	-0.1 [-0.9, 1.1]	64	+0.1 [-0.4, 1.0]
Percentage with more than one hospitalization in last 30 days of life	8.8	-3.3 [-5.8, -0.8]	-27	4.7	-4.7 [-5.6, -3.8]	-50	+1.3 [-1.1, 4.0]	21	+1.3 [-0.7, 3.5]
Percentage with any ICU admission in last 30 days of life	20.8	-14.6 [-17.0, -11.7]	-41	17.2	-14.6 [-16.1, -13.2]	-46	-0.002 [-2.0, 3.0]	58	+0.3 [-1.4, 2.8]
Percentage who died in an inpatient facility	14.0	-12.8 [-15.1, -10.3]	-48	9.9	-11.6 [-12.9, -10.4]	-54	-1.2 [-3.1, 1.3]	83	+0.5 [-1.1, 2.6]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. Bayesian analysis using methods described in Appendix C, Section 5.2. There were 589 MCCM enrollees who were dually eligible for Medicare and Medicaid and 4,564 who were eligible only for Medicare (that is, non-dually eligible). There were 1,757 matched comparison beneficiaries who were dually eligible for Medicare and Medicaid and 13,512 who were eligible only for Medicare.

[a] Differences in impact estimates in this column reflect differences in the characteristics of dually eligible and non-dually eligible beneficiaries, and how those differences might translate into different impacts of MCCM.

[b] Values in this column represent the probability that MCCM has a larger impact in the hypothesized direction for dually eligible beneficiaries than for non-dually eligible beneficiaries.

[c] Differences in impact estimates in this column hold constant the characteristics of dually eligible and non-dually eligible beneficiaries, so that differences in characteristics do not contribute to differences in the impact of MCCM.

CI = credible interval; MCCM = Medicare Care Choices Model; ICU = intensive care unit

Appendix Table E.13 compares MCCM's impact on rural and other (non-rural) beneficiaries. Impacts were generally similar for these populations. However, there is some indication that MCCM led to greater reductions in emergency department use in the last 30 days of life among rural than non-rural beneficiaries.

Table E.13. Differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by rural status

Outcome	Rural beneficiaries			Non-rural beneficiaries			Difference in impact estimates[a] [90% CI]	Probability that MCCM reduced the disparity[b]	Difference in impacts, holding covariates constant[c] [90% CI]
	MCCM mean	Impact estimate [90% CI]	Percentage impact	MCCM mean	Impact estimate [90% CI]	Percentage impact			
Medicare Part A and B expenditures plus MCCM payments	49,755	-5,583 [-8,569, -2,021]	-10	48,661	-8,104 [-9,872, -6,287]	-14	+2,521 [-260, 6,288]	7	+1,065 [-1,478, 4,937]
Medicare Part A and B expenditures	47,596	-7,823 [-10,540, -4,422]	-14	46,713	-10,008 [-11,732, -8,266]	-18	+2,184 [-168, 5,606]	7	+910 [-1,038, 4,238]
Number of inpatient admissions per 1,000 beneficiaries	1,331	-370 [-465, -266]	-21	1,215	-448 [-504, -390]	-27	+78 [-16.5, 181]	9	+20.8 [-67, 120]
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries	1,537	-118 [-205, -32]	-7	781	-118 [-175, -61]	-13	-0.7 [-78, 75]	52	-2.1 [-75, 73]
Percentage who received the Medicare hospice benefit	81	+18.0 [15.4, 20.3]	+29	83	+18.3 [16.9, 19.7]	+28	-0.3 [-2.8, 1.8]	43	+0.2 [-2.2, 1.9]
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	62	-14.1 [-16.4, -11.5]	-19	61	-15.6 [-17.2, -14.1]	-20	+1.5 [-0.4, 3.9]	10	+0.3 [-1.3, 2.7]
Number of days at home	204	+6.6 [4.2, 8.8]	+3	180	+6.7 [5.6, 7.7]	+4	-0.1 [-2.5, 2.1]	48	-0.2 [-2.4, 2.0]

Outcome	Rural beneficiaries			Non-rural beneficiaries			Difference in impact estimates[a] [90% CI]	Probability that MCCM reduced the disparity[b]	Difference in impacts, holding covariates constant[c] [90% CI]
	MCCM mean	Impact estimate [90% CI]	Percentage impact	MCCM mean	Impact estimate [90% CI]	Percentage impact			
Percentage with more than one outpatient emergency department visit in last 30 days of life	6.0	-1.9 [-3.5, -0.4]	-24	2.0	-0.6 [-1.1, -0.1]	-24	-1.3 [-2.7, 0.1]	94	-0.8 [-1.9, 0.2]
Percentage with more than one hospitalization in last 30 days of life	5.0	-4.9 [-6.4, -3.4]	-50	5.2	-4.5 [-5.4, -3.5]	-46	-0.4 [-2.0, 1.0]	69	-0.02 [-1.4, 1.2]
Percentage with any ICU admission in last 30 days of life	15.5	-12.8 [-15.0, -10.3]	-45	17.9	-14.9 [-16.4, -13.5]	-45	+2.2 [0.2, 4.6]	4	+1.5 [-0.3, 3.9]
Percentage who died in an inpatient facility	10.6	-10.8 [-12.9, -8.6]	-50	10.4	-11.9 [-13.3, -10.6]	-54	+1.1 [-0.7, 3.3]	16	+0.7 [-0.9, 2.8]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. Bayesian analysis using methods described in Appendix C, Section 5.2. There were 685 MCCM enrollees living in rural areas and 4,468 in non-rural areas. There were 2,086 matched comparison beneficiaries living in rural areas and 13,183 in non-rural areas.

[a] Differences in impact estimates in this column reflect differences in the characteristics of rural and non-rural beneficiaries, and how those differences may translate into different impacts of MCCM.

[b] Values in this column represent the probability that MCCM has a larger impact in the hypothesized direction for rural beneficiaries than for non-rural beneficiaries.

[c] Differences in impact estimates in this column hold constant the characteristics of rural and non-rural beneficiaries, so that differences in characteristics do not contribute to differences in the impact of MCCM.

CI = credible interval; MCCM = Medicare Care Choices Model; ICU = intensive care unit.

4. Robustness checks

4.1. Full sample robustness checks

Appendix Table E.14 presents results from several robustness checks we conducted to assess the sensitivity of the impact analysis results to alternative methodologies. The results are organized by outcome measure and include the results from our main impact analyses for comparison (labeled "main analysis"). In the following paragraphs, we describe each check; some checks were relevant to some, but not all, of the outcomes.

Unadjusted regression models. We estimated regression models without control variables to assess the influence of regression adjustment. These models relied entirely on matching to adjust for any observable differences between the intervention and comparison groups. We found little difference between the adjusted and unadjusted impact estimates, which is unsurprising because our analysis sample was well matched on most observable characteristics, especially those we anticipated were most.

Adjusting for COVID-19 diagnosis during the study period. We assessed the rates of COVID-19 diagnoses in the enrolled and matched comparison groups. COVID-19 diagnoses can lead to expensive emergency department visits or hospitalizations, so any imbalance in rates of COVID-19 infections, even if not a direct effect of the model, could bias estimated impacts. Even after matching and controlling for a number of observable differences between the two groups at baseline, we found that MCCM enrollees alive after the COVID-19 pandemic began had somewhat lower rates of COVID-19 than those in the comparison group (Table E.15): Among enrollees who were alive during the pandemic, 6 percent were diagnosed with COVID-19 versus 10 percent of comparison beneficiaries during that time period. Adjusting for COVID-19 diagnoses caused our impact estimates to attenuate slightly, but did not meaningfully change the results.

Estimate impacts on net expenditures using a separate regression model. This check used a single regression model to estimate impacts of MCCM on Medicare Part A and B expenditures plus MCCM payments. This differs from the main approach described in Footnote 116 in Appendix C. Results were similar with both approaches (-$7,610 compared to -$7,604).

Winsorizing continuous outcome measures. We winsorized the following continuous outcome measures at the 98th percentile: (1) total Medicare expenditures, including MCCM payments; (2) total Medicare expenditures excluding MCCM payments; (3) emergency department or observation stay visits; (4) inpatient stays; and (5) days at home. Winsorizing is a method that replaces values above a certain threshold (here, the 98th percentile of the pooled treatment and comparison populations) with the value of the outcome variable at that threshold. This method reduces the influence of extreme outliers on the impact estimates, especially when the outcome variable is highly skewed, as can be the case with expenditures outcomes. The estimated impacts were similar when winsorizing outcomes, alleviating concerns that our main findings might have been driven by outliers.

Matched set fixed effects. We added matched set fixed effects to the regression models for our continuous outcome measures: (1) total Medicare expenditures, including MCCM payments; (2) total Medicare expenditures excluding MCCM payments; (3) emergency department or observation stay visits; and (4) inpatient stays. A matched set comprises a single MCCM enrollee matched to one to three

comparison beneficiaries. Matched set fixed effects account for any unobserved variation that is common within each matched set. Including the fixed effects should further control for unobserved confounders and, by explaining variation in outcomes, add precision to the impact estimates.[154] When we included matched set fixed effects, we did not find any meaningful differences in our impact estimates. Confidence intervals were somewhat narrower, and *p*-values were smaller.

Generalized linear models (logarithm link function). We used generalized linear models with a logarithm link function for the following outcomes: (1) total Medicare expenditures, including MCCM payments, and (2) total Medicare expenditures excluding MCCM payments. Using generalized linear models with a log link can reduce the influence of outliers or skewness in the data, which is often the case with expenditures (Manning and Mullahy 2001). When we used this approach, we found that the estimated impacts on expenditures (with and without MCCM payments) were somewhat smaller in terms of percentage impact, but they had the same sign and were statistically significant.

Count data regression models. We estimated negative binomial regression models for the following count outcomes: (1) emergency department or observation stay visits, (2) inpatient stays, and (3) days at home. This allowed us to check the sensitivity of our estimated impacts to the functional form used in the main regression models (ordinary least squares). Negative binomial regression models can better fit the data when the outcome is non-negative and skewed, as we see with count data. We report all results from negative binomial regressions as marginal effects to make them more comparable to the results generated by linear models. When we used count data models, we did not find any meaningful differences in the estimated impacts.

Two-part regression models. We estimated two-part models for the following two count outcomes: (1) emergency department or observation stay visits and (2) inpatient stays. The two-part model approach separately estimates the probability a beneficiary has greater than zero visits or stays using a logistic regression model, and then, conditional on there being more than zero visits, models the number of visits using a negative binomial count data model. The two-part model can account for cases in which there are many zero values for the outcome variable better than ordinary least squares and count data models, because the latter two approaches do not separately model the first stage (that is, model the extensive margin). All results are reported as marginal effects to make them more comparable to the main models. When we used two-part models, we did not find any meaningful differences in our impact estimates (compared with the main approach).

Binary outcomes. We created binary outcome measures that identified whether a beneficiary had any of the following events in the study period: (1) inpatient admissions and (2) emergency department visits or observation stays. We used binary outcomes to assess the impact of MCCM at the extensive margin (that is, whether the model influenced whether an enrollee would have any service use) to supplement the main approach. When we examined the outcomes as binary indicators, we found large reductions in the percentage of beneficiaries with an inpatient stay and the percentage with an emergency department visit or observation stay. Impacts on the extensive margin (whether a beneficiary had any visits) help explain impacts on the main outcome measure (the average number of visits).

[154] The fixed effects address unobserved confounding if potential unobserved confounders are shared (that is, correlated) among beneficiaries in the same matched sets.

Partial interaction with survival time. We modified our main regression analysis to allow for the effect of MCCM enrollment and several other key covariates to vary by survival time category (1 to 30 days; 31 to 90 days; 91 to 180 days; 181 to 365 days; and 365+ days). We interacted the five survival time categories with the following covariates: age, gender, race, rural, dual eligibility status, MCCM qualifying diagnosis, baseline hierarchical condition category score, baseline Medicare Part A and B expenditures, baseline inpatient admissions, and baseline emergency department visits and observation stays. We then aggregated the impact estimates for each beneficiary to estimate an overall impact estimates. Impacts estimates from these models were sometimes larger than we obtained from the main analysis. For example, this model estimated larger impacts on Medicare expenditures ($8,456 per beneficiary) compared with the main analysis ($7,604).

Narrower definition of preventable acute care service use. We tested the sensitivity of our results to using alternative measures of admissions and emergency department visits and observation stays with *a potentially preventable diagnosis*. In this robustness check, we only used primary diagnosis codes to flag potentially preventable diagnoses, rather than a combination of primary and secondary codes (see Appendix D, Section 3.2). With this narrower outcome definition, the intervention and comparison means and estimated impacts were smaller, but the percentage impacts were similar to the percentage impact estimates with the main approach.

Table E.14. Impact analysis robustness checks

Robustness Check	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Medicare Part A and B expenditures plus MCCM payments						
Main analysis	48,781	56,385	-7,604	-13	< .001	[-8,910, -6,298]
Unadjusted regression models[a]	48,781	56,808	-8,027	-14	< .001	[-9,763, -6,291]
Adjusting for COVID-19 diagnosis in the study period[a]	48,781	56,054	-7,273	-13	< .001	[-8,574, -5,972]
Estimate impacts on net expenditures using a separate regression model[a]	48,781	56,391	-7,610	-13	< .001	[-8,920, -6,301]
Winsorize at 98th percentile[a]	46,772	54,291	-7,519	-14	< .001	[-8,543, -6,495]
Matched set fixed effects[a]	48,781	56,318	-7,537	-13	< .001	[-8,881, -6,193]
Generalized linear models (logarithm link function)[a]	51,521	54,849	-3,328	-6	0.02	[-5,683, -973]
Survival time category interacted with treatment and other key covariates[a]	48,781	57,237	-8,456	-15	< .001	[-9,660, -7,252]
Medicare Part A and B expenditures						
Main analysis	46,810	56,385	-9,576	-17	< .001	[-10,882, -8,269]
Unadjusted regression models	46,810	56,808	-9,998	-18	< .001	[-11,707, -8,290]
Adjusting for COVID-19 diagnosis in the study period	46,810	56,045	-9,236	-16	< .001	[-10,533, -7,938]
Winsorize at 98th percentile	44,896	54,245	-9,348	-17	< .001	[-10,374, -8,323]
Matched set fixed effects	46,810	56,301	-9,491	-17	< .001	[-10,828, -8,154]

Robustness Check	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Generalized linear models (logarithm link function)	49,528	54,872	-5,344	-10	< .001	[-7,716, -2,973]
Survival time category interacted with treatment and other key covariates	46,810	57,237	-10,427	-18	< .001	[-11,635, -9,219]
Number of inpatient admissions per 1,000 beneficiaries						
Main analysis	1,242	1,676	-434	-26	< .001	[-478, -390]
Unadjusted regression models	1,242	1,683	-441	-26	< .001	[-495, -388]
Adjusting for COVID-19 diagnosis in the study period	1,242	1,663	-421	-25	< .001	[-465, -377]
Winsorize at 98th percentile	1,163	1,600	-437	-27	< .001	[-473, -400]
Matched set fixed effects	1,242	1,673	-431	-26	< .001	[-477, -384]
Count data regression models	1,248	1,841	-593	-32	< .001	[-651, -535]
Two-part regression models	1,241	1,679	-438	-26	< .001	[-481, -396]
Binary outcome (percentage of beneficiaries)	55.9	74.9	-19.1	-25	< .001	[-20.3, -17.8]
Survival time category interacted with treatment and other key covariates	1,242	1,710	-468	-27	< .001	[-509, -426]
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries						
Main analysis	886	1,005	-119	-12	< .001	[-165, -73]
Unadjusted regression models	886	1,026	-141	-14	< .001	[-193, -88]
Adjusting for COVID-19 diagnosis in the study period	886	999	-114	-11	< .001	[-160, -67]
Winsorize at 98th percentile	786	913	-127	-14	< .001	[-158, -95]
Matched set fixed effects	886	996	-110	-11	< .001	[-157, -63]
Count data regression models	996	1,212	-216	-18	< .001	[-272, -161]
Two-part regression models	891	1,023	-133	-13	< .001	[-175, -90]
Binary outcome (percentage of beneficiaries)	39.2	44.8	-5.6	-12	< .001	[-6.8, -4.3]
Survival time category interacted with treatment and other key covariates	886	1,051	-165	-16	< .001	[-207, -123]
Percentage who used the Medicare hospice benefit						
Main analysis	83.2	65.3	+17.9	+27	< .001	[16.7, 19.0]
Unadjusted regression models	83.2	64.4	+18.7	+29	< .001	[17.6, 19.8]
Adjusting for COVID-19 diagnosis in the study period	83.2	65.6	+17.6	+27	< .001	[16.4, 18.7]
Survival time category interacted with treatment and other key covariates	83.2	65.3	+17.9	+27	< .001	[16.8, 19.0]
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life						
Main analysis	61.2	76.5	-15.3	-20	< .001	[-16.6, -14.0]

Robustness Check	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Unadjusted regression models	61.2	77.5	-16.3	-21	< .001	[-17.5, -15.0]
Adjusting for COVID-19 diagnosis in the study period	61.2	76.3	-15.1	-20	< .001	[-16.4, -13.9]
Survival time category interacted with treatment and other key covariates	61.2	76.6	-15.4	-20	< .001	[-16.7, -14.2]
Number of days at home						
Main analysis	183.5	178.0	+5.5	+3	< .001	[4.7, 6.2]
Unadjusted regression models	183.5	175.5	+8.0	+5	0.03	[1.8, 14.1]
Adjusting for COVID-19 diagnosis in the study period	183.5	178.3	+5.2	+3	< .001	[4.5, 6.0]
Winsorize at 98th percentile	179.4	173.8	+5.6	+3	< .001	[4.9, 6.3]
Matched set fixed effects	183.5	178.2	+5.3	+3	< .001	[4.6, 6.1]
Count data regression models	176.8	162.8	+14.0	+9	< .001	[12.9, 15.0]
Survival time category interacted with treatment and other key covariates	183.5	177.5	+6.0	+3	< .001	[5.3, 6.7]
Inpatient admissions with a potentially preventable diagnosis						
Main analysis (primary and some secondary diagnoses)	437	598	-161	-27	< .001	[-184, -138]
Number of days admitted	*2,974*	*4,532*	*-1,559*	*-34*	*< .001*	*[-1,768, -1,349]*
Use narrower outcome definition (primary diagnosis only)	276	393	-116	-30	0	[-134.0, -98.5]
Number of days admitted	*1,985*	*3,040*	*-1,056*	*-35*	*0*	*[-1,230, -881]*
Outpatient emergency department visits and observation stays with a potentially preventable diagnosis						
Main analysis (primary and some secondary diagnoses)	212	250	-38	-15	0	[-57.9, -19.0]
Use narrower outcome definition (primary diagnosis only)	171	211	-40	-19	0	[-56.1, -23.5]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: Each row represents a different regression model. We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting).

[a] Unlike the main analysis approach, these robustness checks used a single regression model to estimate impacts of MCCM on Medicare Part A and B expenditures plus MCCM payments.

CI = confidence interval; MCCM = Medicare Care Choices Model.

Table E.15. Percentage of deceased MCCM enrollees and matched comparison beneficiaries with a COVID-19 diagnosis

Sample	MCCM enrollees	Comparison group	Difference	90 percent CI
COVID-19 period: January 1, 2020, to December 31, 2021	6.1	9.8	-3.7	[-4.8, -2.5]
Full evaluation period: January 1, 2016, to December 31, 2021	2.1	3.6	-1.5	[-1.9, -1.1]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2016, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: Each row represents a different time period. The COVID-19 period represents the time period from January 1, 2020, to December 31, 2021, when we would expect to see beneficiaries diagnosed with COVID-19, and the second row represents the full evaluation period from January 1, 2016, to December 31, 2021, to put the rates in context of the overall evaluation time period. In the COVID-19 period, there were 1,174 MCCM enrollees and 4,760 comparison beneficiaries (before weighting). Overall, there were 5,153 MCCM enrollees and 15,269 matched comparison beneficiaries (before weighting).

CI = confidence interval; MCCM = Medicare Care Choices Model.

4.2. Frequentist subgroup analysis results

In this section, we present frequentist subgroup analysis results as a robustness check for the main approach (Bayesian analysis) presented in Chapter 7. Beginning with Medicare expenditures in Table E.16, the frequentist subgroup impacts generally align with the Bayesian findings, but the frequentist impacts are more variable—especially for smaller subgroups—which is expected without variance shrinkage (towards the mean). Frequentist subgroup impacts analyses do not account for how compositional differences could explain some of the differences in impacts across the subgroups.

Table E.16. Differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by survival time: Robustness analysis

Survival time	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI
Medicare expenditures (dollars per beneficiary)					
Medicare Part A and B expenditures plus MCCM payments: all decedents	48,781	56,385	-7,604	-13	[-8,910, -6,298]
Survived 1 to 30 days	9,724	14,841	-5,117	-34	[-6,039, -4,195]
Survived 31 to 90 days	22,345	32,198	-9,852	-31	[-11,074, -8,631]
Survived 91 to 180 days	39,472	51,450	-11,978	-23	[-13,873, -10,083]
Survived 181 to 365 days	65,469	77,131	-11,661	-15	[-14,589, -8,734]
Survived more than 365 days	129,001	131,670	-2,670	-2	[-7,844, 2,505]
Medicare Part A and B expenditures: all decedents	46,810	56,385	-9,576	-17	[-10,882, -8,269]
Survived 1 to 30 days	9,283	14,841	-5,559	-37	[-6,485, -4,633]
Survived 31 to 90 days	21,578	32,198	-10,620	-33	[-11,846, -9,393]
Survived 91 to 180 days	38,096	51,450	-13,354	-26	[-15,255, -11,452]
Survived 181 to 365 days	62,933	77,131	-14,197	-18	[-17,138, -11,257]
Survived more than 365 days	123,260	131,670	-8,410	-6	[-13,606, -3,215]
Medicare Part A and B expenditures in the last 30 days of life: all decedents	12,254	18,808	-6,554	-35	[-6,975, -6,133]
Survived 1 to 30 days	9,283	14,593	-5,310	-36	[-6,042, -4,579]
Survived 31 to 90 days	13,179	21,375	-8,196	-38	[-9,005, -7,386]
Survived 91 to 180 days	12,055	19,539	-7,484	-38	[-8,381, -6,587]
Survived 181 to 365 days	12,623	18,419	-5,796	-31	[-6,790, -4,801]
Survived more than 365 days	14,098	19,319	-5,220	-27	[-6,321, -4,119]
Service use (number per 1,000 beneficiaries)					
Number of inpatient admissions: all decedents	1,242	1,676	-434	-26	[-478, -390]
Survived 1 to 30 days	391	649	-258	-40	[-296, -220]
Survived 31 to 90 days	688	1,075	-387	-36	[-434, -340]
Survived 91 to 180 days	1,037	1,587	-550	-35	[-623, -477]
Survived 181 to 365 days	1,587	2,176	-589	-27	[-695, -482]
Survived more than 365 days	2,978	3,591	-613	-17	[-785, -441]
Number of outpatient emergency department visits and observation stays: all decedents	886	1,005	-119	-12	[-165, -73]
Survived 1 to 30 days	181	226	-45	-20	[-79, -11]
Survived 31 to 90 days	362	466	-105	-22	[-143, -66]
Survived 91 to 180 days	694	871	-178	-20	[-242, -113]
Survived 181 to 365 days	1,099	1,307	-207	-16	[-302, -113]
Survived more than 365 days	2,524	2,862	-338	-12	[-526, -151]

Survival time	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI
Hospice use					
Percentage who received the Medicare hospice benefit: all decedents	83.2	65.3	+17.9	+27	[16.7, 19.0]
Survived 1 to 30 days	76.6	56.0	+20.5	+37	[17.9, 23.2]
Survived 31 to 90 days	85.5	69.0	+16.5	+24	[14.5, 18.5]
Survived 91 to 180 days	86.2	68.5	+17.7	+26	[15.5, 19.9]
Survived 181 to 365 days	85.0	67.8	+17.2	+25	[14.8, 19.6]
Survived more than 365 days	81.6	63.6	+18.0	+28	[15.4, 20.7]
Quality of end-of-life care					
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life: all decedents	61.2	76.5	-15.3	-20	[-16.6, -14.0]
Survived 1 to 30 days	64.4	78.3	-13.9	-18	[-16.6, -11.1]
Survived 31 to 90 days	68.0	80.9	-12.9	-16	[-15.2, -10.6]
Survived 91 to 180 days	55.4	74.6	-19.2	-26	[-22.0, -16.4]
Survived 181 to 365 days	57.7	73.6	-15.9	-22	[-18.9, -12.8]
Survived more than 365 days	57.2	73.6	-16.4	-22	[-19.4, -13.3]
Number of days at home: all decedents	183.5	178.0	+5.5	+3	[4.7, 6.2]
Survived 1 to 30 days	13.4	11.3	+2.0	+18	[1.6, 2.5]
Survived 31 to 90 days	48.9	44.7	+4.2	+9	[3.6, 4.9]
Survived 91 to 180 days	117.6	110.7	+6.9	+6	[5.7, 8.1]
Survived 181 to 365 days	238.0	230.6	+7.4	+3	[5.4, 9.3]
Survived more than 365 days	611.8	601.1	+10.7	+2	[7.7, 13.7]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a frequentist regression model. There were 1,003 enrollees who survived 1 to 30 days, 1,355 who survived 31 to 90 days, 1,038 who survived 91 to 180 days, 886 who survived 181 to 365 days, and 871 who survived more than 365 days. There were 2,957 matched comparison beneficiaries who survived 1 to 30 days, 4,049 who survived 31 to 90 days, 3,079 who survived 91 to 180 days, 2,627 who survived 181 to 365 days, and 2,557 who survived more than 365 days.

CI = confidence interval; MCCM = Medicare Care Choices Model.

Estimates from both the frequentist and Bayesian regression models indicate MCCM had similar impacts for beneficiaries with different qualifying conditions (Table E.17 and Table E.10, respectively). That is, the results from frequentist analyses were similar to the Bayesian analysis in Section 3 of this appendix.

Table E.17. Differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by primary diagnosis category: Robustness analysis

Qualifying diagnosis	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Medicare expenditures (dollars per beneficiary)						
Medicare Part A and B expenditures plus MCCM payments: all decedents	48,781	56,385	-7,604	-13	< .001	[-8,910, -6,298]
Beneficiaries with cancer	45,113	53,316	-8,204	-15	< .001	[-9,621, -6,787]
Beneficiaries with CHF	55,186	62,567	-7,381	-12	< .001	[-9,692, -5,069]
Beneficiaries with COPD	54,199	60,305	-6,107	-10	< .001	[-8,326, -3,887]
Medicare Part A and B expenditures: all decedents	46,810	56,385	-9,576	-17	< .001	[-10,882, -8,269]
Beneficiaries with cancer	43,410	53,316	-9,906	-19	< .001	[-11,324, -8,488]
Beneficiaries with CHF	52,864	62,567	-9,702	-16	< .001	[-12,028, -7,376]
Beneficiaries with COPD	51,959	60,305	-8,347	-14	< .001	[-10,582, -6,112]
Service use (number per 1,000 beneficiaries)						
Number of inpatient admissions: all decedents	1,242	1,676	-434	-26	< .001	[-478, -390]
Beneficiaries with cancer	1,016	1,439	-423	-29	< .001	[-468, -378]
Beneficiaries with CHF	1,667	2,098	-431	-21	< .001	[-514, -348]
Beneficiaries with COPD	1,536	2,019	-483	-24	< .001	[-571, -396]
Number of outpatient emergency department visits and observation stays: all decedents	886	1,005	-119	-12	< .001	[-165, -73]
Beneficiaries with cancer	769	838	-68	-8	0.03	[-120, -17]
Beneficiaries with CHF	1,130	1,194	-65	-5	0.21	[-149, 20]
Beneficiaries with COPD	1,061	1,242	-181	-15	0.001	[-275, -88]
Hospice use						
Percentage who entered the Medicare hospice benefit: all decedents	83.2	65.3	+17.9	+27	< .001	[16.7, 19.0]
Beneficiaries with cancer	86.4	70.9	+15.5	+22	< .001	[14.2, 16.8]
Beneficiaries with CHF	76.0	55.9	+20.1	+36	< .001	[18.1, 22.0]
Beneficiaries with COPD	79.3	59.5	+19.8	+33	< .001	[17.8, 21.8]
Quality of end-of-life care						
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life: all decedents	61.2	76.5	-15.3	-20	< .001	[-16.6, -14.0]
Beneficiaries with cancer	59.6	75.0	-15.5	-21	< .001	[-17.0, -13.9]
Beneficiaries with CHF	67.8	80.9	-13.0	-16	< .001	[-15.0, -11.1]
Beneficiaries with COPD	60.6	78.0	-17.4	-22	< .001	[-19.6, -15.2]

Qualifying diagnosis	MCCM mean	Comparison mean	Impact estimate	Percentage impact	*p*-value	90 percent CI
Number of days at home: all decedents	183.5	178.0	+5.5	+3	< .001	[4.7, 6.2]
Beneficiaries with cancer	155.4	151.0	+4.4	+3	< .001	[3.7, 5.2]
Beneficiaries with CHF	209.9	202.8	+7.1	+4	< .001	[5.7, 8.5]
Beneficiaries with COPD	215.3	209.0	+6.3	+3	< .001	[4.8, 7.8]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a frequentist regression model. There were 3,698 enrollees with cancer, 1,957 with congestive heart failure, and 1,719 with chronic obstructive pulmonary disease. There were 10,922 matched comparison beneficiaries with cancer, 5,810 with congestive heart failure, and 5,131 with chronic obstructive pulmonary disease. Some beneficiaries had more than one qualifying condition and are included in multiple rows of the table.

CHF = congestive heart failure; CI = confidence interval; COPD = chronic obstructive pulmonary disease; MCCM = Medicare Care Choices Model.

In frequentist analyses, non-White or Hispanic beneficiaries generally had smaller impacts than non-Hispanic White beneficiaries with two exceptions: (1) entering hospice and (2) death in an inpatient facility (Table E.18). The results were very similar to the Bayesian analysis in Section 3 of this appendix.

Table E.18. Differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by race and ethnicity: Robustness analysis

Outcome	Non-White or Hispanic					Non-Hispanic White					Difference in impact estimates	90 percent CI
	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI		
Medicare Part A and B expenditures plus MCCM payments	58,118	69,303	-11,185	-16	[-15,323, -7,046]	47,308	54,372	-7,063	-13	[-8,396, -5,731]	-4,121	[-8,398, 155]
Medicare Part A and B expenditures	56,121	69,303	-13,182	-19	[-17,296, -9,069]	45,341	54,372	-9,030	-17	[-10,366, -7,695]	-4,152	[-8,406, 102]
Number of inpatient admissions per 1,000 beneficiaries	1,638	1,980	-342	-17	[-501, -184]	1,180	1,627	-448	-28	[-493, -402]	+105	[-62, 272]
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries	1,064	1,133	-69	-6	[-195, 58]	858	985	-127	-13	[-176, -78]	+59	[-76, 194]
Percentage who used the Medicare hospice benefit	74.6	54.5	+20.1	+37	[16.9, 23.3]	84.5	67.0	+17.5	+26	[16.3, 18.7]	+2.6	[-0.7, 6.0]
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	68.5	79.9	-11.4	-14	[-14.6, -8.2]	60.0	75.9	-15.9	-21	[-17.3, -14.6]	+4.6	[1.1, 8.0]
Number of days at home	174.5	169.1	+5.5	+3	[3.1, 7.8]	184.9	179.4	+5.5	+3	[4.7, 6.3]	-0.0	[-2.5, 2.4]
Percentage with more than one outpatient ED visit in last 30 days of life	3.6	3.3	+0.2	+7	[-1.1, 1.6]	2.3	3.2	-0.9	-28	[-1.4, -0.5]	+1.1	[-0.2, 2.5]
Percentage with more than one hospitalization in last 30 days of life	8.7	11.4	-2.7	-24	[-4.8, -0.5]	4.6	9.4	-4.8	-51	[-5.5, -4.1]	+2.1	[-0.1, 4.3]
Percentage with any ICU admission in last 30 days of life	21.2	34.4	-13.2	-38	[-16.3, -10.1]	17.0	31.7	-14.7	-46	[-15.9, -13.5]	+1.5	[-1.8, 4.8]
Percentage who died in an inpatient facility	15.1	28.5	-13.4	-47	[-16.2, -10.6]	9.6	20.7	-11.1	-54	[-12.1, -10.1]	-2.3	[-5.2, 0.6]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a frequentist regression model. There were 702 MCCM enrollees who were non-White or Hispanic and 4,451 who were non-Hispanic White. There were 1,851 matched comparison beneficiaries who were non-White or Hispanic and 13,418 who were non-Hispanic White.

CI = confidence interval; MCCM = Medicare Care Choices Model.

Dually eligible beneficiaries generally had smaller impacts than non-dually eligible beneficiaries (Table E.19). The results were very similar to the Bayesian analysis in Section 3 of this appendix.

Table E.19. Differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by dual eligibility: Robustness analysis

	Dually eligible					Non-dually eligible					Difference in impact estimates	90 percent CI
Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI		
Medicare Part A and B expenditures plus MCCM payments	67,809	71,329	-3,521	-5	[-8,027, 985]	46,325	54,480	-8,155	-15	[-9,494, -6,816]	+4,634	[-40, 9,308]
Medicare Part A and B expenditures	65,519	71,329	-5,811	-8	[-10,281, -1,340]	44,395	54,480	-10,085	-19	[-11,426, -8,743]	+4,274	[-366, 8,914]
Number of inpatient admissions per 1,000 beneficiaries	2,075	2,342	-268	-11	[-469, -66]	1,135	1,591	-456	-29	[-500, -412]	+189	[-21, 398]
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries	1,710	1,787	-77	-4	[-290, 136]	779	904	-125	-14	[-168, -82]	+48	[-169, 264]
Percentage who used the Medicare hospice benefit	74.5	56.5	+18.0	+32	[14.6, 21.4]	84.3	66.4	+17.9	+27	[16.7, 19.0]	+0.1	[-3.4, 3.7]
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	65.7	78.2	-12.5	-16	[-16.0, -9.0]	60.6	76.3	-15.7	-21	[-17.1, -14.3]	+3.2	[-0.5, 6.9]
Number of days at home	224.8	221.2	+3.6	+2	[0.6, 6.6]	178.2	172.4	+5.7	+3	[5.0, 6.5]	-2.1	[-5.2, 1.0]
Percentage with more than one outpatient ED visit in last 30 days of life	4.4	4.6	-0.2	-4	[-1.8, 1.4]	2.2	3.1	-0.8	-28	[-1.3, -0.4]	+0.7	[-1.0, 2.3]
Percentage with more than one hospitalization in last 30 days of life	9.5	12.2	-2.7	-22	[-5.0, -0.3]	4.6	9.3	-4.8	-51	[-5.5, -4.1]	+2.1	[-0.3, 4.5]

Outcome	Dually eligible					Non-dually eligible					Difference in impact estimates	90 percent CI
	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI		
Percentage with any ICU admission in last 30 days of life	21.9	35.0	-13.1	-37	[-16.3, -9.8]	17.0	31.7	-14.7	-46	[-15.9, -13.5]	+1.6	[-1.8, 5.1]
Percentage who died in an inpatient facility	14.4	25.5	-11.0	-43	[-13.8, -8.2]	9.9	21.3	-11.5	-54	[-12.5, -10.5]	+0.5	[-2.5, 3.4]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a frequentist regression model. There were 589 MCCM enrollees who were dually eligible for Medicare and Medicaid and 4,564 who were eligible only for Medicare (that is, non-dually eligible). There were 1,757 matched comparison beneficiaries who were dually eligible for Medicare and Medicaid and 13,512 who were eligible only for Medicare.

CI = confidence interval; MCCM = Medicare Care Choices Model.

Rural beneficiaries generally had smaller impacts than non-rural beneficiaries with one exception: having more than one outpatient emergency department visit in last 30 days of life (Table E.20). The results were very similar to the Bayesian analysis in Section 3 of this appendix.

Table E.20. Differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by rural status: Robustness analysis

	Rural					Non-rural					Difference in impact estimates	90 percent CI
Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI		
Medicare Part A and B expenditures plus MCCM payments	50,449	53,159	-2,710	-5	[-6,634, 1,215]	48,468	56,783	-8,315	-15	[-9,702, -6,928]	+5,605	[1,447, 9,763]
Medicare Part A and B expenditures	48,459	53,159	-4,700	-9	[-8,628, -773]	46,502	56,783	-10,281	-18	[-11,669, -8,893]	+5,581	[1,419, 9,743]
Number of inpatient admissions per 1,000 beneficiaries	1,368	1,679	-311	-19	[-433, -188]	1,223	1,674	-451	-27	[-499, -403]	+141	[9, 272]
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries	1,546	1,625	-79	-5	[-262, 104]	785	903	-118	-13	[-162, -73]	+39	[-149, 226]
Percentage who used the Medicare hospice benefit	80.1	63.6	+16.6	+26	[13.5, 19.6]	83.6	65.6	+18.0	+27	[16.8, 19.2]	-1.4	[-4.7, 1.8]
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	63.4	74.5	-11.1	-15	[-14.6, -7.7]	60.9	76.8	-15.9	-21	[-17.3, -14.5]	+4.8	[1.1, 8.4]
Number of days at home	203.3	198.7	+4.6	+2	[2.5, 6.7]	180.0	174.4	+5.6	+3	[4.8, 6.4]	-1.0	[-3.2, 1.3]
Percentage with more than one outpatient ED visit in last 30 days of life	5.9	8.4	-2.4	-29	[-4.3, -0.6]	1.9	2.4	-0.5	-21	[-0.9, -0.1]	-1.9	[-3.8, -0.1]
Percentage with more than one hospitalization in last 30 days of life	4.7	9.1	-4.3	-48	[-6.1, -2.6]	5.2	9.7	-4.5	-47	[-5.3, -3.8]	+0.2	[-1.7, 2.1]
Percentage with any ICU admission in last 30 days of life	16.2	25.6	-9.4	-37	[-12.2, -6.7]	17.8	33.0	-15.2	-46	[-16.4, -14.0]	+5.7	[2.8, 8.7]

Outcome	Rural					Non-rural					Difference in impact estimates	90 percent CI
	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI		
Percentage who died in an inpatient facility	10.8	20.3	-9.5	-47	[-12.0, -7.0]	10.3	22.1	-11.8	-53	[-12.8, -10.8]	+2.3	[-0.4, 4.9]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a frequentist regression model. There were 685 MCCM enrollees living in rural areas and 4,468 in non-rural areas. There were 2,086 matched comparison beneficiaries living in rural areas and 13,183 in non-rural areas.

CI = confidence interval; MCCM = Medicare Care Choices Model.

5. Additional analyses

This section shows results from estimating impacts for additional hospice and beneficiary subgroups not previously explored in Chapter 7 (and Section 3 of this appendix). In addition, we estimated impacts across the distribution of Medicare expenditures (quantile treatment effects).

5.1. Beneficiaries enrolled in MCCM Cohort 1 and 2 hospices

CMS randomly assigned hospices participating in MCCM to two cohorts. Cohort 1 started enrolling Medicare beneficiaries on January 1, 2016, and Cohort 2 started enrolling beneficiaries on January 1, 2018. Because enrollment in the model started slowly and Cohort 2 hospices might have benefitted from changes in the model or the experience of their Cohort 1 counterparts, we assessed to what extent estimated impacts differed between beneficiaries enrolled in Cohort 1 and 2 hospices. Appendix Table E.21 shows estimated impacts of MCCM enrollment on the study's primary outcomes for beneficiaries who enrolled in MCCM at Cohort 1 and 2 hospices, using Bayesian methods described in Appendix C, Section 5.2. Overall, we did not find significant differences in estimated impacts between Cohorts 1 and 2.

Table E.21. Differences in expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries by hospices in Cohorts 1 and 2

Outcome	Cohort 1 beneficiaries					Cohort 2 beneficiaries					Difference in impact estimates between Cohorts 1 and 2[a] [90% CI]
	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	
Medicare Part A and B expenditures plus MCCM payments	50,685	58,641	-7,980	-14	[-10,019, -5,941]	46,490	53,980	-7,507	-14	[-9,732, -5,309]	+473 [-2,064, 2,972]
Medicare Part A and B expenditures	48,583	58,601	-10,034	-17	[-11,964, -8,082]	44,665	53,973	-9,325	-17	[-11,465, -7,174]	+709 [-1,664, 3,116]
Number of inpatient admissions per 1,000 beneficiaries	1,313	1,767	-453	-26	[-519, -387]	1,127	1,570	-418	-27	[-490, -344]	+35 [-49, 121]
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries	906	1,033	-124	-12	[-188, -62]	852	965	-110	-11	[-177, -43]	+14.2 [-49, 87]
Percentage who used the Medicare hospice benefit	83	64	+18.8	+29	[17.1, 20.4]	83	65	+17.6	+27	[15.8, 19.4]	-1.1 [-3.2, 0.9]
Received any aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	61	77	-15.7	-21	[-17.5, -14.0]	62	77	-15.0	-20	[-16.8, -13.2]	+0.7 [-1.2, 2.7]
Number of days at home	197	190	+7.1	+4	[5.8, 8.4]	167	161	+6.1	+4	[4.9, 7.5]	-0.9 [-2.6, 0.7]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. There were 2,851 MCCM enrollees in Cohort 1 and 2,302 in Cohort 2. There were 8,478 matched comparison beneficiaries in Cohort 1 and 6,791 in Cohort 2.

[a] Differences in impact estimates in this column reflect differences in the characteristics of beneficiaries enrolled at Cohort 1 vs. Cohort 2 hospices, and how those differences might translate into different impacts of MCCM.

CI = credible interval; MCCM = Medicare Care Choices Model.

5.2 Year in which beneficiaries enrolled

To assess the evolution of the model, we estimated impacts separately for beneficiaries who enrolled in each year, 2016 through 2021. Impact estimates do not show a consistent pattern over time (Table E.22). For Medicare expenditures, percentage impacts increase over time, which might be a result of lower MCCM and comparison beneficiary means in later years. Lower intervention and comparison means in later years could be partly caused by a mechanical relationship between enrollment dates and survival times. The analysis excludes beneficiaries who enrolled in the model in the last few years if they did not die by December 31, 2021, leaving only beneficiaries with shorter survival times.

Table E.22. Differences in Medicare expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries, by enrollment year

Survival time	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI
Medicare expenditures (dollars per beneficiary)					
Medicare Part A and B expenditures plus MCCM payments: all decedents	48,781	56,385	-7,604	-13	[-8,910, -6,298]
Enrolled in 2016	64,337	71,171	-6,838	-10	[-10,209, -3,412]
Enrolled in 2017	55,240	61,661	-6,425	-10	[-9,226, -3,365]
Enrolled in 2018	50,597	57,229	-6,660	-12	[-8,925, -4,186]
Enrolled in 2019	49,800	58,813	-9,064	-15	[-11,757, -6,706]
Enrolled in 2020	40,222	49,049	-8,809	-18	[-11,801, -6,029]
Enrolled in 2021	28,964	37,064	-8,037	-22	[-11,652, -4,444]
Medicare Part A and B expenditures: all decedents	46,810	56,385	-9,576	-17	[-10,882, -8,269]
Enrolled in 2016	61,599	70,899	-9,298	-13	[-12,375, -6,162]
Enrolled in 2017	52,733	61,627	-8,895	-14	[-11,470, -5,998]
Enrolled in 2018	48,437	57,331	-8,923	-16	[-11,034, -6,534]
Enrolled in 2019	47,952	58,674	-10,763	-18	[-13,314, -8,500]
Enrolled in 2020	38,742	49,004	-10,238	-21	[-13,008, -7,675]
Enrolled in 2021	27,821	37,203	-9,313	-25	[-12,589, -5,998]
Service use (number per 1,000 beneficiaries)					
Number of inpatient admissions: all decedents	1,242	1,676	-434	-26	[-478, -390]
Enrolled in 2016	1,622	2,059	-480	-23	[-590, -375]
Enrolled in 2017	1,545	1,988	-435	-22	[-520, -350]
Enrolled in 2018	1,279	1,734	-458	-26	[-526, -389]
Enrolled in 2019	1,259	1,711	-453	-26	[-515, -385]
Enrolled in 2020	868	1,317	-388	-29	[-477, -301]
Enrolled in 2021	699	1,119	-335	-30	[-445, -225]

Survival time	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI
Number of outpatient emergency department visits and observation stays: all decedents	886	1,005	-119	-12	[-165, -73]
Enrolled in 2016	1,304	1,440	-136	-9	[-226, -55]
Enrolled in 2017	1,108	1,236	-125	-10	[-202, -50]
Enrolled in 2018	945	1,069	-123	-11	[-189, -57]
Enrolled in 2019	898	1,015	-116	-11	[-179, -51]
Enrolled in 2020	577	691	-108	-16	[-188, -30]
Enrolled in 2021	394	499	-97	-20	[-185, -5.0]
Hospice use					
Percentage who received the Medicare hospice benefit: all decedents	83.2	65.3	+17.9	+27	[16.7, 19.0]
Enrolled in 2016	83.4	66.2	+17.2	+26	[14.4, 19.5]
Enrolled in 2017	81.8	63.4	+18.4	+29	[16.1, 20.5]
Enrolled in 2018	82.8	64.5	+18.4	+28	[16.7, 20.1]
Enrolled in 2019	83.3	64.9	+18.4	+28	[16.8, 20.1]
Enrolled in 2020	84.0	65.9	+18.1	+27	[16.1, 20.1]
Enrolled in 2021	83.9	66.5	+17.5	+26	[15.2, 19.9]
Quality of end-of-life care					
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life: all decedents	61.2	76.5	-15.3	-20	[-16.6, -14.0]
Enrolled in 2016	59.9	75.0	-15.1	-20	[-17.4, -12.4]
Enrolled in 2017	61.6	76.7	-15.1	-20	[-17.1, -13.0]
Enrolled in 2018	61.4	76.6	-15.2	-20	[-16.9, -13.5]
Enrolled in 2019	60.7	76.5	-15.9	-21	[-17.7, -14.2]
Enrolled in 2020	60.9	76.6	-15.7	-20	[-17.9, -13.6]
Enrolled in 2021	63.4	78.0	-14.6	-19	[-16.9, -12.2]
Number of days at home: all decedents	183.5	178.0	+5.5	+3	[4.7, 6.2]
Enrolled in 2016	302	292	+9.9	+3	[6.6, 13.9]
Enrolled in 2017	236	229	+7.0	+3	[4.5, 9.2]
Enrolled in 2018	195	188	+7.0	+4	[5.6, 8.6]
Enrolled in 2019	180	173	+6.7	+4	[5.4, 8.0]
Enrolled in 2020	128	122	+5.4	+4	[3.9, 6.8]
Enrolled in 2021	77	72	+4.8	+7	[3.6, 6.0]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. There were 195 beneficiaries who enrolled in MCCM in 2016, 694 in 2017, 1,636 in 2018, 1,585 in 2019, 774 in 2020, and 269 in 2021. There were 763 matched comparison beneficiaries with pseudo-enrollment dates in 2016, 2,304 in 2017, 4,600 in 2018, 4180 in 2019, 2,798 in 2020, and 624 in 2021.

CI = credible interval; MCCM = Medicare Care Choices Model.

5.3. Hospices with the highest MCCM enrollment versus other participating hospices

Although 141 hospices participated in MCCM, just five participating hospices accounted for more than 45 percent of enrollees. We assessed whether estimated impacts were different for beneficiaries who enrolled in MCCM at one of these five hospices. Appendix Table E.23 shows estimated impacts on the primary outcomes for beneficiaries who enrolled in MCCM at top five enrolling hospices versus at all other participating hospices. Although we estimated larger reductions in Medicare expenditures and inpatient admissions among beneficiaries enrolled at the top five enrolling hospices, none of the differences in estimated impacts were statistically significant. This is a positive finding, suggesting that the model's impacts were widespread—not driven solely by the experiences of the five hospices with the largest enrollment.

Table E.23. Differences in expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries for enrollees at hospices with the highest MCCM enrollment versus all other participating hospices

	Top five enrolling hospices					Other participating hospices					Difference in estimate between top five and other hospices	90 percent CI
Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI		
Medicare Part A and B expenditures plus MCCM payments	46,283	56,831	-10,548	-19	[-12,495, -8,601]	51,183	56,164	-4,981	-9	[-6,734, -3,228]	-5,567	[-8,187, -2,947]
Medicare Part A and B expenditures	44,374	56,831	-12,457	-22	[-14,412, -10,502]	49,151	56,164	-7,013	-12	[-8,768, -5,257]	-5,444	[-8,072, -2,817]
Number of inpatient admissions per 1,000 beneficiaries	1,128	1,626	-498	-31	[-558, -437]	1,351	1,738	-387	-22	[-451, -323]	-111	[-199, -23]
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries	749	859	-111	-13	[-169, -53]	1,018	1,157	-139	-12	[-207, -71]	+29	[-61, 118]
Percentage who used the Medicare hospice benefit	84.0	66.0	+18.1	+27	[16.5, 19.7]	82.3	64.2	+18.1	+28	[16.5, 19.6]	+0.0	[-2.2, 2.3]
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	59.0	76.3	-17.4	-23	[-19.2, -15.5]	63.3	76.8	-13.6	-18	[-15.3, -11.8]	-3.8	[-6.4, -1.2]
Number of days at home	169.6	163.7	+5.9	+4	[4.9, 6.9]	196.9	191.8	+5.1	+3	[4.0, 6.2]	+0.8	[-0.6, 2.3]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a frequentist regression model. There were 2,526 MCCM enrollees in the top five enrolling hospices and 2,627 enrolled with other participating hospices. There were 7,432 matched comparison beneficiaries in the top five enrolling hospices and 7,837 enrolled with other participating hospices.

CI = confidence interval; MCCM = Medicare Care Choices Model.

5.4. Beneficiaries who survived one year or less from enrollment versus those who survived over one year.

As expected, most MCCM enrollees (83 percent) survived one year or less, but a nontrivial fraction of enrollees survived for more than one year (17 percent). Appendix Table E.24 shows estimated impacts on the primary outcomes for beneficiaries who survived at most one year versus those who survived longer than one year. We found that those surviving more than one year had smaller reductions in Medicare Part A and B expenditures plus MCCM payments in both absolute and percentage terms. MCCM enrollees who survived for more than one year had larger absolute increases in days at home, but this finding is largely because of longer survival times; the percentage impact on days at home was larger for those who survived less than one year.

Table E.24. Differences in expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries for enrollees who survived for more than one year versus those who survived at most one year

	Survived greater than one year					Survived at most one year					Difference in impact estimates	90 percent CI
Outcome	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI		
Medicare Part A and B expenditures plus MCCM payments	129,001	128,984	+16	<1	[-5,436, 5,469]	32,464	42,199	-9,735	-23	[-10,666, -8,805]	+9,752	[4,220, 15,283]
Medicare Part A and B expenditures	123,260	128,984	-5,724	-4	[-11,203, -246]	31,259	42,199	-10,940	-26	[-11,876, -10,004]	+5,216	[-342, 10,773]
Number of inpatient admissions per 1,000 beneficiaries	2,978	3,570	-592	-17	[-772, -412]	889	1,319	-430	-33	[-465, -395]	-162	[-346, 21]
Number of outpatient emergency department visits and observation stays per 1,000 beneficiaries	2,524	2,893	-369	-13	[-570, -169]	553	668	-115	-17	[-146, -84]	-254	[-457, -51]
Percentage who used the Medicare hospice benefit	81.6	64.5	+17.1	+27	[14.3, 19.9]	83.5	65.5	+18.0	+27	[16.8, 19.2]	-0.9	[-3.9, 2.2]
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	57.2	72.7	-15.5	-21	[-18.6, -12.4]	62.0	77.3	-15.4	-20	[-16.8, -14.0]	-0.2	[-3.6, 3.2]
Number of days at home	611.8	602.1	+9.7	+2	[6.6, 12.8]	96.4	91.5	+4.9	+5	[4.3, 5.5]	+4.8	[1.7, 7.9]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a frequentist model. There were 871 MCCM enrollees who survived for greater than one year and 4,282 who survived for one year or less. There were 2,557 matched comparison beneficiaries who survived for greater than one year and 12,712 who survived for one year or less.

CI = confidence interval; MCCM = Medicare Care Choices Model.

5.5 Impacts before versus during the COVID-19 pandemic

This report analyzes outcomes for beneficiaries who enrolled in MCCM from January 1, 2016, to June 30, 2021, with outcomes measured through December 31, 2021. This period overlaps with the COVID-19 pandemic, as we discussed in the Fourth Annual Evaluation Report (Kranker et al. 2022). Appendix Table E.25 shows the results from estimating impacts separately for beneficiaries were enrolled in MCCM through August 31, 2019 (the pre-COVID-19 cohort), and on or after September 1, 2019 (the COVID-19 cohort). For most outcomes, MCCM's impacts were similar before and during the COVID-19 pandemic. However, there was a high probability (greater than 90 percent) that MCCM led to larger reductions in the number of inpatient admissions, and larger increases in the number of days at home, for beneficiaries who enrolled before the pandemic began.

Table E.25. Differences in expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched comparison beneficiaries for enrollees who survived for more than one year versus those who survived at most one year

Outcome	Before the COVID-19 pandemic				During the COVID-19 pandemic				Difference in impact estimates[a] [90% CI]	Probability that impacts were more favorable pre-COVID[b]
	MCCM mean	Comparison mean	Impact estimate [90% CI]	Percentage impact	MCCM mean	Comparison mean	Impact estimate [90% CI]	Percentage impact		
Medicare Part A and B expenditures plus MCCM payments	52,229	59,440	-7,249 [-9,156, -5,354]	-12	40,420	49,491	-9,045 [-11,744, -6,607]	-18	+1,796 [-660, 4,867]	13
Medicare Part A and B expenditures	50,044	59,438	-9,423 [-11,230, -7,577]	-16	38,945	49,409	-10,440 [-12,997, -8,082]	-21	+1,017 [-1,093, 3,935]	27
Number of inpatient admissions	1,352	1,804	-458 [-516, -397]	-25	929	1,372	-385 [-464, -303]	-28	-73 [-155, 5.8]	94
Number of outpatient emergency department visits and observation stays	998	1,122	-122 [-182, -62]	-11	596	709	-107 [-180, -34]	-15	-15.0 [-88, 49]	66
Used the Medicare hospice benefit	83	65	+18.2 [16.7, 19.7]	+28	84	65	+18.3 [16.5, 20.1]	+28	-0.1 [-1.6, 1.5]	48

Outcome	Before the COVID-19 pandemic				During the COVID-19 pandemic				Difference in impact estimates[a] [90% CI]	Probability that impacts were more favorable pre-COVID[b]
	MCCM mean	Comparison mean	Impact estimate [90% CI]	Percentage impact	MCCM mean	Comparison mean	Impact estimate [90% CI]	Percentage impact		
Received any aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	61	76	-15.4 [-16.9, -13.8]	-20	61	77	-15.6 [-17.5, -13.8]	-20	+0.2 [-1.3, 1.9]	39
Number of days at home	205	198	+7.1 [5.9, 8.4]	+4	131	126	+5.5 [4.2, 6.8]	+4	+1.6 [0.2, 3.3]	97
More than one outpatient emergency department visit in last 30 days of life	2.6	3.4	-0.8 [-1.4, -0.2]	-24	2.3	3.0	-0.8 [-1.4, -0.1]	-25	-0.04 [-0.6, 0.6]	59
More than one hospitalization in last 30 days of life	5.3	9.8	-4.5 [-5.5, -3.5]	-46	4.8	9.3	-4.5 [-5.7, -3.4]	-49	+0.005 [-1.1, 1.2]	51
Any ICU admission in last 30 days of life	17.9	32	-14.3 [-15.8, -12.8]	-44	16.9	32	-15.5 [-17.5, -13.6]	-48	+1.2 [-0.4, 3.3]	12
Percentage who died in an inpatient facility	10.7	22.2	-11.5 [-12.9, -10.1]	-52	9.6	22.1	-12.5 [-14.5, -10.8]	-57	+1.1 [-0.7, 3.2]	18

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting), estimated with a Bayesian regression model. There were 3,661 beneficiaries who enrolled in MCCM before August 31, 2019 (before the COVID-19 pandemic) and 1,492 who enrolled on September 1, 2019 or later (during the COVID-19 pandemic). There were 10,909 matched comparison beneficiaries with pseudo-enrollment dates before August 31, 2019 (before the COVID-19 pandemic) and 4,360 with pseudo-enrollment dates on September 1, 2019 or later (during the COVID-19 pandemic).

[a] Differences in impact estimates in this column reflect differences in the characteristics of beneficiaries enrolled before vs. during the COVID-19 pandemic, and how those differences might translate into different impacts of MCCM.

[b] Values in this column represent the probability that MCCM has a larger impact in the hypothesized direction for beneficiaries who enrolled before the COVID-19 pandemic than for beneficiaries who enrolled during the pandemic.

CI = credible interval; MCCM = Medicare Care Choices Model.

5.6. Quantile treatment effects on Medicare expenditures

We estimated quantile treatment effects on total Medicare expenditures including model payments. Quantile treatment effects show the estimate impact across the outcome distribution. For example, the quantile treatment effect at the 25th percentile shows the difference in Medicare expenditures between MCCM enrollees and comparison beneficiaries whose total expenditures are at the 25th percentile of the expenditure distribution. We estimated quantile treatment effects to assess whether the estimated impact of MCCM varies over the expenditure distribution.[155] For example, the estimated impact could be larger for beneficiaries in the top 10 percent of the expenditure distribution than in the bottom 10 percent. We conducted this analysis using our main impact sample consisting of 5,153 MCCM enrollees and their matched comparison beneficiaries.

Appendix Table E.26 contains our estimated quantile treatment effects for the 5th, 10th, 15th, through 95th quantiles. Estimated quantile treatment effects are larger for higher quantiles, but the effects are roughly proportional to mean expenditures. At the 5th to 15th percentiles, the estimated quantile treatment effects are not statistically significant at the 10 percent level. Meanwhile, at the 30th percentile and above, the estimated quantile treatment effects range from 12 to 16 percent and are statistically significant. We conclude from this analysis that MCCM decreased Medicare expenditures to roughly the same extent, in percentage terms, across the expenditure distribution. However, in the bottom 15 percent, the model had no discernable impact. In absolute terms, the impacts are larger at higher quantiles.

[155] Specifically, we estimated unconditional quantile treatment effects accounting for covariates, using the generalized quantile estimator proposed by Powell (2020). This method cannot accommodate the large number of covariates we used in our main impact analyses, so we adjusted only for survival time (number of days from enrollment in MCCM until death), beneficiary age, dual eligibility status, and qualifying diagnoses.

Table E.26. Quantile treatment effects on Medicare Part A and B expenditures plus MCCM payments

Quantile	MCCM mean	Comparison mean	Impact estimate	Percentage impact	90 percent CI
5th	10,104	9,615	+489	+5	[-105, 1,083]
10th	14,079	14,068	+12	<1	[-701, 724]
15th	17,416	18,061	-645	-4	[-1,409, 119]
20th	20,416	22,022	-1,606	-7	[-2,396, -816]
25th	23,516	26,004	-2,488	-10	[-3,293, -1,682]
30th	26,509	29,962	-3,452	-12	[-4,273, -2,631]
35th	29,421	33,886	-4,464	-13	[-5,304, -3,624]
40th	32,546	37,724	-5,177	-14	[-6,044, -4,310]
45th	35,338	41,563	-6,226	-15	[-7,124, -5,327]
50th	38,552	45,596	-7,043	-15	[-7,984, -6,102]
55th	42,388	50,187	-7,799	-16	[-8,795, -6,803]
60th	46,574	55,362	-8,788	-16	[-9,858, -7,718]
65th	51,879	61,492	-9,613	-16	[-10,775, -8,451]
70th	56,843	67,879	-11,036	-16	[-12,307, -9,765]
75th	63,227	75,720	-12,493	-16	[-13,896, -11,091]
80th	71,252	84,938	-13,686	-16	[-15,272, -12,101]
85th	81,826	96,958	-15,132	-16	[-17,017, -13,248]
90th	97,831	114,277	-16,446	-14	[-18,707, -14,185]
95th	119,943	142,925	-22,982	-16	[-26,294, -19,670]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We estimated quantile treatment effects using the generalized quantile estimator proposed by Powell (2020), adjusting quantile treatment effects for survival time (number of days from enrollment in MCCM until death), beneficiary age, dual eligibility status, and qualifying diagnoses. The sample includes MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 15,269 before weighting).

CI = confidence interval; MCCM = Medicare Care Choices Model.

6. Comparison group of beneficiaries who enrolled directly in hospice

In Appendix Table E.27, we report regression-adjusted estimates, including confidence intervals and *p*-values corresponding to the estimated impacts on several outcomes for the comparison group, which comprises beneficiaries who went directly into hospice. The motivation for this analysis and a description of the comparison group is available in Appendix C, Section 6. The corresponding results were summarized in Chapter 6, Section 6.7.

Table E.27. Differences in expenditures, health care service use, and quality of care between deceased MCCM enrollees and matched non-hospice enrollees *who enrolled directly in hospice at the start of the study period*

Outcome	MCCM mean	Comparison (always in hospice) mean	Difference	Percentage difference	*p*-value	90 percent CI
Medicare expenditures						
Medicare Part A and B expenditures plus MCCM payments (dollars per beneficiary)	48,781	35,350	+13,431	+38	< .001	[12,356, 14,505]
Medicare Part A and B expenditures (dollars per beneficiary)	46,810	35,350	+11,459	+32	< .001	[10,388, 12,531]
Medicare Part A and B expenditures per day (dollars per beneficiary per day)	362	173	+190	+110	< .001	[180, 199]
Service use (number per 1,000 beneficiaries)						
Number of inpatient admissions	1,242	441	+801	+181	< .001	[760, 841]
Number of outpatient emergency department visits and observation stays	886	409	+477	+117	< .001	[438, 516]
Quality of end-of-life care						
Percentage who received an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life	61	25	+37	+148	< .001	[35, 38]
Number of days at home	183	192	-8	-4	< .001	[-9, -7]

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021. The estimates cover beneficiaries who enrolled through June 30, 2021, and who died on or before December 31, 2021, and their experiences in the model.

Notes: We base impact estimates on regression-adjusted differences between MCCM enrollees (N = 5,153) and matched comparison beneficiaries (N = 179,168 before weighting). We used inverse propensity weighting for the comparison group that enrolled directly in hospice, as described in Appendix C, Section 6.

CI = confidence interval; MCCM = Medicare Care Choices Model.

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Appendix F

Synthesis of Model Implementation and Impacts: Methods and Supplemental Results

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In this appendix, we provide additional details for the synthesis analysis we discuss in Chapter 8 of this report. Section 1 describes the methods we used, and Section 2 contains detailed results.

1. Methods for the synthesis analysis

The synthesis analysis assessed the association of participating hospices' model performance with hospice-level factors. We measured hospice performance using estimated hospice-specific impacts. (See Appendix C, Section 5.2, for information on how we estimated hospice-specific impacts.) In the synthesis analysis, we considered hospice-specific impacts on three outcomes: (1) reductions in total Medicare expenditures including model payments; (2) increases in rates of using the Medicare hospice benefit; and (3) reduced likelihood of receiving aggressive life-prolonging procedures, surgeries, or diagnostic tests in the last 30 days of life. To ease interpretation of our findings, we multiplied impacts on total Medicare expenditures including model payments and receipt of aggressive life-prolonging procedures by –1, so a larger positive impact always indicates better performance.

Drawing on extant evaluation data, our previous evaluation experience, and the relevant literature, we identified 113 hospice-level factors we hypothesized could be associated with hospice performance (Table F.1). These factors fell into five categories: (1) hospice organizational characteristics and context, (2) MCCM implementation metrics, (3) service delivery factors, (4) quality metrics, and (5) enrollee characteristics. As described in Appendix A, Section 1.2, we obtained these data from various sources including aggregated MCCM program data and organizational survey data conducted by Abt Associates in 2017 and 2018.

We estimated hospice-specific impacts for 79 participating hospices, for which we observed at least one MCCM enrollee in Medicare claims data, but we did not have data on all hospice-level factors for all 79 hospices. Specifically, only 57 out of 79 hospices responded to the organizational survey that we used to measure hospice-level factors related to model implementation. For the remaining 22 hospices, we replaced the missing values with the cohort-specific mean for the factors we obtained from the organizational survey.

To narrow down the hospice-level factors to a more manageable number of characteristics that were most strongly associated with hospice performance, we combined three approaches:[156]

- First, we divided hospices into terciles by how favorable their impacts on the three outcomes were. For example, for impacts on total Medicare expenditures, the top third of hospices with the largest decrease in expenditures were in the top tercile. We then selected factors that differed by at least 50 percent between hospices in the top and bottom terciles. For example, we selected affiliation with an accountable care organization because hospices in the top tercile of expenditure impacts were 70 percent more likely to be affiliated with an accountable care organization than hospices in the bottom tercile.

[156] Our approach is based on Brown et al. (2021).

- Second, we estimated lasso regressions of hospice-specific impacts on hospice-level factors separately for each category of characteristics.[157] We chose a target number of factors in each category and adjusted the lasso penalty parameter such that the lasso regression picked the desired number of independent variables.
- Third, we used insights from our implementation analysis to select additional factors that were not chosen by the first two approaches and to drop factors that were chosen but were not deemed to be important. Specifically, we included some factors for all three outcomes that were identified by one of the two methods described above for only one of the outcomes. For example, whether a hospice operates or is affiliated with a hospital-based palliative care program was only picked for the hospice use outcome (based on a comparison of top and bottom impact terciles and by the lasso approach), but we included this factor for all three outcomes because it was identified as an important factor through our interviews with exemplar hospices (see Chapter 4, Section 4.6).

We applied these approaches to each of the three outcomes separately and retained about 20 to 25 factors each. Table F.1 shows the factors we included for each of the three outcomes and indicates why we included or excluded certain a factor was included or excluded.

To summarize the association between hospice performance and the hospice-level factors our selection approach identified, we estimated multivariate linear regressions with hospice-specific impacts as the dependent variable and the selected hospice-level factors as independent variables. From these regressions, we calculated standardized (beta) coefficients that allowed us to compare how strongly each factor was associated with hospice performance, given all other included factors.[158] That is, we can interpret both the sign and the magnitude of these standardized coefficients. A positive coefficient means that the corresponding factor is associated with higher hospice performance, and a negative coefficient indicates that the factor is associated with lower performance. Coefficients with larger absolute values imply a stronger association with performance. When presenting the findings, we showed the estimated beta coefficients along with the mean of each factor for hospices in the bottom, middle, and top tercile of hospice-specific impacts (Table F.2, Table F.3, and Table F.4 in Section 2 of this appendix).

Some hospices enrolled very few beneficiaries. To check sensitivity of our findings to the number of enrollees, we excluded 10 hospices, because they had five or fewer enrollees. The results using the remaining 69 hospices were not qualitatively different from our main findings.

[157] A lasso (least absolute shrinkage and selection operator) regression lets researchers include many independent variables in a regression model and selects relevant regressors that receive a non-zero regression coefficient. Specifically, a lasso model includes a penalty parameter that determines how parsimonious the model will be. The larger the penalty parameter, the more parsimonious the model—that is, the fewer regressors selected for inclusion in the model. A penalty parameter of zero is equivalent to estimating a standard regression model where all regressors are retained and have a non-zero coefficient.

[158] Beta coefficients are regression coefficients normalized by the ratio of the standard deviation of the regressor to the standard deviation of the dependent variable.

Table F.1. Factors considered and included in the synthesis analysis

Hospice-level factor	Data source	Included in synthesis analysis		
		Decreased Medicare expenditures	Increased hospice use	Decreased aggressive treatments
Hospice organizational characteristics and context				
Affiliation or contracts with health care organizations	OS			
Assisted living community				
Continuing care retirement community		T	L, T	
Home health agency		L	L, T	
Hospital				
Inpatient rehabilitation facility				
Medical home		T, Ex	T	
Palliative care program				
Personal care home			T	
Physician practice				
(Skilled) nursing facility				
Other				T, Ex
None				
Participation in other alternative payment models	OS			
Accountable care organizations		L, T	T	L, T
Bundled payment programs		T, Ex		
Medical home			T, Ex	
Preferred provider network			T	T
Shared savings program		T, Ex		
Other		T, Ex		T, Ex
None other than MCCM				
Census region	HMF			
Midwest		T, Ex		L, T, Ex
Northeast				
South			L, T, Ex	
West		T, Ex	T, Ex	L, T, Ex
Percentage of Medicare deaths occurring in hospital	DA			
Facility type (freestanding or not)	HMF	In	T	L
Hospice length of operation	HMF			
Since 1980s				
Since 1990s				
Since 2000s		T, Ex	T, Ex	
Since 2010s		L, T, Ex	T, Ex	

Hospice-level factor	Data source	Included in synthesis analysis		
		Decreased Medicare expenditures	Increased hospice use	Decreased aggressive treatments
Percentage of Medicare beneficiaries with hospice in last year of life	EDB	L	L	
Hospice size	HMF			
Large (20,000 or more routine home care days)		In	In	In
Medium (3,500–19,999 routine home care days)		In	T	T
Small (0–3,499 routine home care days)		T	In	In
Type of health records	OS			
Electronic				
Mix of electronic and paper				
Paper				
Intensive care unit days per decedent	HMF			
Urban/rural location	HMF	L, T		
Medicare Advantage penetration	HMF			L, Ex
Hospice ownership status	HMF			
Government		T	In	In
Nonprofit		In	In	In
For profit		In	T	T
Other		In	T	T
Operates or is affiliated with a community-based palliative care program	OS			
Operates or is affiliated with a hospital-based palliative care program	OS	In	L, T	In
Physician visits per decedent	HMF			
Experience with pre-hospice or bridge programs	OS	In	In	L
Hospice rating	HMF	L, Ex		
MCCM implementation metrics				
Changes in business or clinical operations to accommodate MCCM	OS			
Billing/finance				
Care coordination for the provision of therapy services		L, T		
Data collection/reporting			L	
Coordination of durable medical equipment		T, Ex	T, Ex	L, T
Patient intake processes				
Information technology				
Marketing/public relations				
Patient care protocols				
Quality assurance/performance improvement			L, Ex	
Medical records				T

Hospice-level factor	Data source	Included in synthesis analysis		
		Decreased Medicare expenditures	Increased hospice use	Decreased aggressive treatments
Other		L, T, Ex		T, Ex
None of the above			T, Ex	
Changes in MCCM leadership	OS	L, T	T, Ex	
Has an MCCM-dedicated coordinator or manager	OS	L, T	T	In
Concern about staff turnover	OS			
Extremely concerned			L, T	L, T
Moderately concerned			T	In
Slightly concerned			T	L, T
Not at all concerned			T	In
Percentage of eligible referrals who enrolled in MCCM	PD		L, Ex	
Hospice notified if MCCM enrollee goes to emergency department	OS			In
Hospice notified if MCCM enrollee is hospitalized	OS			
Hospice supplements MCCM reimbursement with funding from other sources	OS	T, Ex		L, T
Percentage of referrals meeting eligibility criteria	PD			
Hospice staff receipt of MCCM-focused training	OS			
MCCM billing processes		T, Ex		
Coordination of palliative and curative care		T, Ex		
Delivery of clinical services in the home		L, T		
MCCM eligibility				L, Ex
MCCM enrollment strategies				
MCCM marketing and outreach		T, Ex		
Using the MCCM portal		T, Ex		
Quality assurance/performance improvement		L, T		L, T
Service delivery factors				
Average number of encounters per beneficiary per month	PD	L, T		T
Percentage of MCCM encounters delivered in person before March 2020 (that is, before the COVID-19 pandemic)	PD	L	L, Ex	L, Ex
Hospice team member providing the greatest proportion of services to MCCM beneficiaries	PD			
MCCM RN care coordinator		T	L, T	
Nurse aide		T, Ex		L, T
Hospice RN or LPN				
Social worker		L, Ex	L	L, Ex
Other				

Hospice-level factor	Data source	Included in synthesis analysis		
		Decreased Medicare expenditures	Increased hospice use	Decreased aggressive treatments
Quality metrics				
Percentage of enrolled beneficiaries who received an initial and a comprehensive assessment within five days of enrollment	PD			L, T, Ex
Percentage of encounters that discussed advance care planning	PD		L	
Percentage of eligible encounters treated for bowel regimen with symptom alleviation	PD		L, Ex	
Percentage of encounters that initiated a bowel regimen for enrollee taking an opioid	PD			
Percentage of eligible encounters where the treatment improved the enrollee's breathing	PD		L	
Percentage of encounters that screened for shortness of breath	PD	L, Ex		
Percentage of encounters that initiated treatment for enrollee with shortness of breath	PD			
Percentage of eligible encounters treated for emotional well-being (depression) with symptom alleviation	PD			
Percentage of eligible encounters during which the enrollee was screened for emotional well-being (depression)	PD			L, Ex
Percentage of eligible encounters during which screened enrollee with need was treated for emotional well-being (depression)	PD	L	L, Ex	
Percentage of eligible encounters during which the enrollee was screened for pain	PD	L, Ex		L, Ex
Percentage of eligible encounters where pain management plan achieved the enrollee's comfort goal	PD		L, Ex	
Percentage of eligible encounters during which a screened enrollee with need received pain management	PD			
Percentage of encounters that attempted a discussion of spiritual or religious concerns	PD	L, Ex		L
Enrollee characteristics				
Percentage of enrollees with cancer diagnosis	PD			
Percentage of enrollees with congestive heart failure	PD			
Percentage of enrollees with chronic obstructive pulmonary disease	PD	L, T	L, T	
Percentage of enrollees with HIV/AIDS	PD	T, Ex	L, T, Ex	L, T, Ex
Percentage of enrolled beneficiaries who had a gap in services of 15 to 30 days	PD			

Hospice-level factor	Data source	Included in synthesis analysis		
		Decreased Medicare expenditures	Increased hospice use	Decreased aggressive treatments
Percentage of enrolled beneficiaries who had a gap in services of 31 to 60 days	PD		In	
Percentage of enrolled beneficiaries who had a gap in services of 60 days or more	PD	T		
Percentage of enrolled beneficiaries who had a gap in services of 8 to 14 days	PD			
Percentage of enrolled beneficiaries who had a gap in services of fewer than 8 days	PD			
Percentage of enrolled beneficiaries who require considerable assistance or are disabled	PD			L, Ex
Percentage of enrolled beneficiaries who live alone	PD	L		
Percentage of enrolled beneficiaries without a caregiver	PD	T, Ex		T, Ex
Number of beneficiaries enrolled throughout the model duration	PD	L, T	In	L, T

Notes: This table lists the hospice-level factors we considered in the synthesis analysis. In the Data source column, **DA** denotes Dartmouth Atlas; **EDB** denotes Medicare Enrollment Database; **HMF** denotes hospice-level matching file, which consists of the roster of MCCM hospices merged with a hospice-level file created by Abt Associates (for constructing a matched comparison group of hospices) that contained hospice characteristics for all hospices in the country (see Appendix A, Section 1.2); **OS** denotes organizational survey conducted by Abt Associates; and **PD** denotes MCCM program data.

In the last three columns, cells shaded green indicate hospice-level factors we included in the synthesis analysis for each of the three outcomes. **L** denotes the factor was selected in a lasso regression; **T** denotes a larger than 50 percent difference between top and bottom terciles of hospice-specific impacts; **Ex** denotes we excluded a factor selected by either the lasso or due to a difference between terciles; and **In** denotes factors we included manually (see text for details).

LPN = licensed practical nurse; MCCM = Medicare Care Choices Model; RN = registered nurse.

2. Supplemental results from the synthesis analysis

This section contains detailed results supporting the synthesis analysis findings discussed in Chapter 8. Table F.2 shows the hospice-level factors that were most strongly associated with hospice-specific impacts on total Medicare expenditures. The three columns labeled "Low performers," "Middle tercile," and "Top performers" contain the average of each factor for hospices in each of the three terciles of hospice-specific impacts. The last column contains the association score that indicates how strongly and in which direction a factor was associated with hospice-specific impacts, given all other included factors. Table F.3 and Table F.4 show the corresponding results for the two outcomes: (1) using the Medicare hospice benefit and (2) receipt of aggressive life-prolonging procedures, surgeries, or diagnostic tests in the last 30 days of life. Table 11 in Chapter 8 also shows whether association scores from the last column in each of these three tables are positive or negative.

Table F.2. Hospice-level factors associated with performance in decreasing total Medicare expenditures

Factors with largest association with performance	Low performers	Middle tercile	Top performers	Association score
Hospice organizational characteristics and context				
Hospice size				
Large (20,000 or more routine home care days)	81%	88%	81%	0.05
Medium (3,500–19,999 routine home care days)	19%	12%	15%	0.19
Small (0–3,499 routine home care days)	0%	0%	4%	(reference)
Hospice ownership status				
Nonprofit	59%	69%	69%	-0.08
For profit	15%	19%	15%	(reference)
Government	4%	0%	0%	-0.10
Other	22%	12%	15%	-0.02
Freestanding facility*	26%	23%	31%	0.14
Affiliation or contracts with continuing care retirement community	24%	25%	40%	0.08
Affiliation or contracts with home health agency	76%	65%	65%	-0.09
Participation in accountable care organization*	18%	20%	30%	0.14
Operates or is affiliated with a hospital-based palliative care program	88%	75%	65%	-0.05
Experience with pre-hospice or bridge programs	41%	55%	40%	-0.04
Percentage of Medicare beneficiaries in HRR with hospice in last year of life*	47%	51%	52%	0.16
Rural location*	22%	8%	8%	-0.10
MCCM implementation metrics				
Changes in care coordination for the provision of therapy services to accommodate MCCM	35%	50%	65%	0.04
Changes in MCCM leadership*	38%	25%	5%	-0.29
Has an MCCM-dedicated coordinator or manager*	29%	15%	15%	-0.10
Hospice staff receipt of MCCM-focused training: delivery of clinical services in the home	35%	80%	85%	0.10
Hospice staff receipt of MCCM-focused training: QAPI*	35%	80%	85%	0.32
Service delivery factors				
Average number of encounters per beneficiary per month	2.5	1.3	0.9	0.01
Percentage of MCCM encounters delivered in person before March 2020 (that is, before the COVID-19 pandemic)*	73%	72%	78%	0.11
MCCM RN care coordinator providing the greatest proportion of services to MCCM beneficiaries	37%	42%	50%	0.06

Factors with largest association with performance	Low performers	Middle tercile	Top performers	Association score
Quality metrics				
Percentage of eligible encounters during which screened enrollee with need was treated for emotional well-being (depression)	86%	92%	93%	-0.08
Percentage of enrolled beneficiaries who had a gap in services of 60 days or more*	10%	5%	7%	-0.11
Enrollee characteristics				
Percentage of enrollees with chronic obstructive pulmonary disease	27%	17%	15%	-0.47
Percentage of enrolled beneficiaries who live alone*	27%	20%	23%	0.13
Number of beneficiaries enrolled throughout the model duration	45	101	128	0.08

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021; MCCM program data, January 1, 2016 to December 31, 2021, merged with a data set describing all hospice agencies participating in the Medicare program constructed by Abt Associates for previous MCCM evaluation reports (Abt Associates 2020a, 2020b); survey data collected from an organizational survey conducted by Abt Associates; and Dartmouth Atlas.

Notes: The first three columns show the percentages or means for each hospice's characteristics by tercile of estimated hospice-specific impacts on "Medicare Part A and B expenditures plus MCCM payments."

The association score (last column) shows the change in standard deviations for hospice-specific impacts on "Medicare Part A and B expenditures plus MCCM payments" when the corresponding hospice characteristics changes by one standard deviation. These standardized coefficients are from a multivariate regression with an R-squared of 0.65. We selected hospice characteristics by considering the difference between top and low performers and estimating lasso regressions separately for each category. See Section 1 of this appendix for details.

HRR = hospital referral region; MCCM = Medicare Care Choices Model; QAPI = quality assurance/performance improvement; RN = registered nurse.

* This hospice-level factors is included in Table 11 in Chapter 8.

Table F.3. Hospice characteristics associated with performance in increasing use of the Medicare hospice benefit

Characteristics with largest association with performance	Low performers	Middle tercile	Top performers	Association score
Hospice organizational characteristics and context				
Hospice size				
Large (20,000 or more routine home care days)	89%	85%	77%	0.12
Medium (3,500–19,999 routine home care days)	7%	15%	23%	0.07
Small (0–3,499 routine home care days)	4%	0%	0%	(reference)
Hospice ownership status				
Nonprofit	78%	65%	54%	-0.25
For profit	11%	15%	23%	(reference)
Government	0%	0%	4%	0.03
Other	11%	19%	19%	-0.04
Freestanding facility	30%	31%	19%	-0.01
Affiliation or contracts with continuing care retirement community*	24%	25%	40%	0.14
Affiliation or contracts with medical home*	5%	17%	15%	-0.18
Affiliation or contracts with personal care home*	16%	22%	40%	0.17
Participation in accountable care organization*	11%	28%	30%	0.17
Participation in preferred provider network*	11%	11%	25%	-0.19
Operates or is affiliated with a hospital-based palliative care program*	58%	78%	90%	0.19
Experience with pre-hospice or bridge programs	42%	56%	40%	0.07
Percentage of Medicare beneficiaries in HRR with hospice in last year of life*	51%	53%	46%	-0.31
MCCM implementation metrics				
Changes in data collection/reporting to accommodate MCCM*	84%	94%	100%	0.26
Has an MCCM-dedicated coordinator or manager	5%	33%	20%	0.01
Concern about staff turnover				
Extremely concerned	11%	6%	25%	(reference)
Moderately concerned	32%	22%	20%	0.08
Slightly concerned	47%	61%	30%	-0.06
Not at all concerned	11%	11%	25%	-0.09
Service delivery factors				
MCCM RN care coordinator providing the greatest proportion of services to MCCM beneficiaries*	44%	58%	27%	-0.13
Social worker providing the greatest proportion of services to MCCM beneficiaries*	0%	4%	8%	0.13

Characteristics with largest association with performance	Low performers	Middle tercile	Top performers	Association score
Quality metrics				
Percentage of eligible encounters where the treatment improved the enrollee's breathing*	78%	63%	66%	-0.16
Percentage of encounters that discussed advance care planning	73%	76%	66%	-0.07
Percentage of enrolled beneficiaries who had a gap in services of 31 to 60 days*	11%	20%	22%	0.14
Enrollee characteristics				
Number of beneficiaries enrolled throughout the model duration*	88	78	107	0.11

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021; MCCM program data, January 1, 2016 to December 31, 2021, merged with a data set describing all hospice agencies participating in the Medicare program constructed by Abt Associates for previous MCCM evaluation reports (Abt Associates 2020a, 2020b); survey data collected from an organizational survey conducted by Abt Associates; and Dartmouth Atlas.

Notes: The first three columns show the percentages or means for each hospice characteristics by tercile of estimated hospice-specific impacts on "election of the Medicare hospice benefit."

The association score (last column) shows the change in standard deviations for hospice-specific impacts on "election of the Medicare hospice benefit" when the corresponding hospice characteristics changes by one standard deviation. These standardized coefficients are from a multivariate regression with an R-squared of 0.50. We selected hospice characteristics by considering the difference between top and low performers and estimating lasso regressions separately for each category. See Section 1 of this appendix for details.

HRR = hospital referral region; MCCM = Medicare Care Choices Model; RN = registered nurse.

* This hospice-level factors is included in Table 11 in Chapter 8.

Table F.4. Hospice characteristics associated with performance in decreasing receipt of aggressive life-prolonging procedures, surgeries, or diagnostic tests in the last 30 days of life

Characteristics with largest association with performance	Low performers	Middle tercile	Top performers	Association score
Hospice organizational characteristics and context				
Hospice size				
Large (20,000 or more routine home care days)	85%	85%	81%	0.22
Medium (3,500–19,999 routine home care days)	11%	15%	19%	0.26
Small (0–3,499 routine home care days)	4%	0%	0%	(reference)
Hospice ownership status				
Nonprofit	74%	62%	62%	-0.08
For profit	11%	19%	19%	(reference)
Government	4%	0%	0%	-0.23
Other	11%	19%	19%	-0.14
Freestanding facility*	19%	38%	23%	0.16
Participation in accountable care organization	5%	41%	25%	0.09
Participation in preferred provider network*	10%	18%	20%	0.11
Operates or is affiliated with a hospital-based palliative care program	65%	82%	80%	-0.06
Experience with pre-hospice or bridge programs*	45%	35%	55%	0.23
MCCM implementation metrics				
Changes in medical records to accommodate MCCM	80%	65%	50%	0.01
Changes in coordination of durable medical equipment to accommodate MCCM*	55%	35%	30%	-0.34
Has an MCCM-dedicated coordinator or manager	20%	24%	15%	0.02
Hospice supplements MCCM reimbursement with funding from other sources	5%	6%	30%	0.07
Hospice notified if MCCM enrollee goes to emergency department*	53%	75%	63%	0.11
Hospice staff receipt of MCCM-focused training: QAPI*	50%	65%	90%	0.34
Concern about staff turnover				
Extremely concerned	5%	24%	15%	(reference)
Moderately concerned	25%	18%	30%	0.09
Slightly concerned	55%	47%	35%	-0.17
Not at all concerned	15%	12%	20%	-0.07
Service delivery factors				
Average number of encounters per beneficiary per month	1.4	0.8	2.5	0.06
Nurse aide providing the greatest proportion of services to MCCM beneficiaries*	22%	15%	4%	-0.21

Characteristics with largest association with performance	Low performers	Middle tercile	Top performers	Association score
Quality metrics				
Percentage of encounters that attempted a discussion of spiritual or religious concerns	76%	69%	70%	0.05
Enrollee characteristics				
Number of beneficiaries enrolled throughout the model duration*	56	56	162	0.22

Sources: Medicare Enrollment Database, Master Beneficiary Summary File, and Medicare claims data, January 1, 2013, to December 31, 2021; MCCM program data, January 1, 2016 to December 31, 2021, merged with a data set describing all hospice agencies participating in the Medicare program constructed by Abt Associates for previous MCCM evaluation reports (Abt Associates 2020a, 2020b); survey data collected from an organizational survey conducted by Abt Associates; and Dartmouth Atlas.

Notes: The first three columns show the percentages or means for each hospice characteristics by tercile of estimated hospice-specific impacts on "receipt of an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life."

The association score (last column) shows the change in standard deviations for hospice-specific impacts on "receipt of an aggressive life-prolonging procedure, surgery, or diagnostic test in the last 30 days of life" when the corresponding hospice characteristics changes by one standard deviation. These standardized coefficients are from a multivariate regression with an R-squared of 0.50. We selected hospice characteristics by considering the difference between top and low performers and estimating lasso regressions separately for each category. See Section 1 of this appendix for details.

MCCM = Medicare Care Choices Model; QAPI = quality assurance/performance improvement.

* This hospice-level factor is included in Table 11 in Chapter 8.

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