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Analysis of Participation in the Medicare EHR Incentive Program

Report of Findings

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ANALYSIS OF PARTICIPATION IN THE MEDICARE EHR INCENTIVE PROGRAM

Report of Findings

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EXECUTIVE SUMMARY

ES.1 Introduction

Health information technology (health IT) is central to transforming health care in the United States from a system that frequently delivers more episodic, uncoordinated, and variable care to one that consistently achieves more preventive, longitudinal, and coordinated services. To achieve this transformation, health care providers will need information systems that capture, share, analyze, and enable action on a range of health care data. These systems include electronic health records (EHRs) in physician offices and hospitals, and a range of mechanisms to share health care information electronically among multiple health care stakeholders.

The Medicare EHR Incentive Program is one of many federal efforts to promote adoption and use of EHRs and health information exchange (HIE). Enacted through federal economic recovery legislation—the Health Information Technology for Economic and Clinical Health Act (HITECH Act) within the American Recovery and Reinvestment Act (ARRA) of 2009—the Medicare EHR Incentive Program pays eligible professionals (EPs) and eligible hospitals (EHs) according to their success in implementing and meaningfully using certified EHR technologies. Meaningful use is defined in three stages, each featuring functional and quality measures that participants must meet to receive incentive payments. Like an escalator steadily conveying people between building floors, meaningful use is designed to achieve value from EHRs by helping providers use EHRs to first capture data (Stage 1), then to change clinical processes (Stage 2), and finally to improve outcomes (Stage 3).

The Centers for Medicare & Medicaid Services (CMS) rules define what types of professionals are eligible to participate in the Medicare EHR Incentive Program. EPs include physicians, osteopaths, dentists, podiatrists, optometrists, and chiropractors. EHs include hospitals paid under the Medicare Inpatient Prospective Payment System (IPPS), critical access hospitals (CAHs), and hospitals affiliated with Medicare Advantage plans. Participation in the Medicare EHR Incentive Program is defined by (1) an EP, EH, or CAH meeting eligibility criteria but not registering; (2) registering for the program but not attesting to meaningful use measures; and (3) attesting to meaningful use.

This study analyzes EPs', EHs', and CAHs' participation in Stage 1 of the Medicare EHR Incentive Program over the first two program years (January 2011 – February 2013). It aims to help CMS better understand which EPs, EHs, and CAHs are participating in the Medicare EHR Incentive Programs, which are not, and to identify factors that predict participation and nonparticipation alike. This study also assesses to what extent the characteristics of Medicare beneficiaries may be related to EP, EH, and CAH program participation. Although others have analyzed program participation, this study is the first to consider if beneficiary characteristics differ by EP, EH, and CAH participation status. The results of this analysis will be used to help identify barriers to participation and to develop strategies to address them.

The remainder of this executive summary reviews methods, findings, and implications of EP, EH, and CAH participation in Stage 1 of the Medicare EHR Incentive Program.

ES.2 Methods

RTI began by searching the peer-reviewed literature to identify factors associated with EHR adoption. Researchers found a total of 154 studies, 32 of which ultimately met the inclusionary criteria. These studies showed that several factors have affected professional and hospital adoption and use of EHRs, including:

- Professional demographics (e.g., age, gender, specialty, years since award of degree);
- Practice characteristics (e.g., practice size, practice ownership, patient volume);
- Hospital characteristics (e.g., hospital bed size, type, ownership, bed days);
- Regional characteristics (e.g., CMS region, rural/urban location, primary care health professional shortage area, medically underserved area/population); and,
- Prior adoption of EHRs.

These factors served as a basis for our analysis—defining the types of characteristics to be assessed relative to participation status. By compiling and linking various federal and commercial data sources, RTI assessed the characteristics of EPs and EHs that are eligible, registered, or attested to Stage 1 meaningful use of the Medicare EHR Incentive Program during the first 2 program years. We created descriptive statistics (numbers and percentages) of EPs, EHs, and CAHs by various demographic, practice/hospital, regional, and technological characteristics.

We also assessed the characteristics of Medicare beneficiaries who lived in the areas in which EPs, EHs, and CAHs practiced. Beneficiary characteristics included age, gender, race, disability status, disease risk (through a risk score), and chronic conditions. CMS provided data on 100% of the Medicare beneficiary population (fee-for-service and Medicare Advantage) who had been eligible to receive benefits from January – December 2010. To assess the burden of chronic disease in both Medicare plans, we used Hierarchical Condition Categories (HCCs). CMS uses HCCs to group related conditions together to risk-adjust payments to Medicare Advantage plans. For this study's purposes, we used HCCs and their associated risk scores as proxies for disease burden and severity because these data were more complete and more current than other sources.

RTI then developed a set of logistic regression models to identify the most significant characteristics for program registration and attestation. Using the set of descriptive statistics as the basis for an analytic file, we estimated models for EPs, EHs, and CAHs, respectively, which included overall characteristics and subsets of variables for which we had limited data (e.g., EP age and years since award of degree). We also modeled beneficiary data using a logistic regression model. Dependent variables in all regression models included the two primary modes of participation (registration and attestation), while independent variables considered the demographic, organizational, geographic, technical, and beneficiary characteristics defined above. We developed separate regression models for EPs, EHs, and CAHs to determine factors associated with registration and with attestation. All models were developed in SAS, version

9.3, and were checked for consistency and accuracy. Regression model results were reported as odds ratios (ORs), with significance levels of 0.0001 for EP characteristics, and 0.05 EH and CAH characteristics.

ES.3 Results

We begin by reviewing the descriptive statistics for EPs, followed by those for hospitals (EHs and CAHs). For professionals and hospitals, we report the characteristics of the most frequent participants (attesters), followed by the characteristics of the least frequent (eligible but not registering). We then discuss summary results from the regression models, reported by characteristics associated with a decreased likelihood of participation, and those associated with an increased likelihood, for registration and attestation alike. For the regression results, we discuss the effects of beneficiary characteristics separately.

ES.3.1 EP Descriptive Statistics

More than 583,000 professionals were eligible to participate during the first 2 years of the Medicare EHR Incentive Program. Of these, over 40% had registered in the program, with 25% attesting to Stage 1 meaningful use by the end of the second program year (December 2012, but reported up to February 2013).

The most frequent EP attesters included those who represent the greatest proportion of practicing professionals: male professionals, family practitioners, and internists, those who were in practices of 3 to 10 professionals, and those who treated 1 to 99 patients daily. Two-thirds of all EP attesters came from one of 10 specialties that attested at a cumulative rate of 35%, compared to the 25% population average. Most attesting professionals (68%) worked in practices that were not owned by hospitals or health systems. The majority of attesting EPs were in CMS regions 3 to 5, i.e., mid-Atlantic, southern, and midwestern states, respectively. Most attesting EPs practiced in overwhelmingly urban (50%) and medically underserved areas (79%), but not in areas with medically underserved populations (35%). We did not have sufficient data to clearly determine the most common age ranges of attesting EPs, although our limited data indicate that professionals who registered and attested most often were 40 to 59 years old and 11 to 30 years post-degree. Finally, although we have incomplete data, one-quarter or more of professionals across all participation categories reported having an EHR prior to participation (i.e., registration and attestation).

Again, reflecting the general makeup of practicing providers, male professionals, family practitioners, and internists were also the largest numbers of professionals who had neither registered nor attested—although specialists such as anesthesiologists, diagnostic radiologists, obstetrician/gynecologists, emergency medicine physicians, and psychiatrists made up more than one-quarter of nonparticipating professionals in total. Reflecting the concentration of physicians in smaller practices generally, physicians in solo practices and practices of 3 to 5 professionals were least likely to participate, and more than half of professionals practiced in sites that saw less than 50 patients daily (those who saw no patients plus those who saw 1 to 49 patients).

Most nonparticipating EPs were in practices owned by entities other than hospitals, independent practice associations (IPAs) or health systems; in highly urban, medically underserved areas; and in CMS regions 2, 4, 5, and 9 (New York, New Jersey, Puerto Rico, U.S.

Virgin Islands (USVI), and southern, midwestern, and western states). Moreover, nonparticipating professionals appeared to be slightly older, between 40 to 59 years old, but still with 11 to 30 years of practice experience.

ES.3.2 EH Descriptive Statistics

The most frequent EH attesters included medium-size hospitals (55%); not-for-profit (66%) and nonteaching hospitals (72%); and hospitals not in networks (61%). Most attesting EHs were in rural locations (combined rate of 58%) and in CMS regions 4, 5, and 6, i.e., southeastern, midwestern and south-central states, respectively. They were in primary care (73%) and dental health professional shortage areas (HPSAs) (68%); in medically underserved areas (64%) but not in areas with medically underserved populations. The most frequently attesting EHs also had a case mix index (CMI) of 1.44 or greater (54%).

The most frequent nonparticipating EHs were those with small bed size (57%); for profit (48%); nonteaching hospitals (87%); and those operating in 100% rural locations (42%). Nonparticipants had beneficiaries with supplemental security incomes (SSIs) from 0.001 to 0.149 (combined rate of 52%), and were in CMS regions 4 and 6, i.e., southeastern and south-central states, respectively. As with the attesters, the nonparticipants were most frequently in primary care (71%) and dental HPSAs (69%), and in medically underserved areas (66%) but not in areas with medically underserved populations.

ES.3.3 CAH Descriptive Statistics

The most frequent CAH attesters included small bed size (95%); not-for-profit and government (non-federal) hospitals (98%); hospitals not in networks (62%); and those located in 50 to <90% urban zip code areas (52%). Most CAH attesters were in CMS regions 5 and 7, i.e., midwestern and central plains states, respectively. As with EHs, the frequent CAH attesters were in primary care (79%) and dental HPSAs (66%), and were in medically underserved areas (66%) but not in areas with medically underserved populations.

The most frequent nonparticipating CAHs were those with small bed size (97%); not-for-profit (50%) and government hospitals (43%); nonteaching hospitals (100%); and those operating in 100% urban and 50 to <90% urban locations (44% and 40%, respectively); in CMS regions 5 and 7, i.e., midwestern and central plains states, respectively. As with the attesters, the nonparticipants were most frequently in primary care (81%) and dental HPSAs (68%), and were in medically underserved areas (67%) but not in areas with medically underserved populations.

ES.3.4 EP Regression Results

The model results indicate that EPs in a medically underserved area; specialists without patient contact; rural professionals; professionals under ages 30 or over 60; and professionals who obtained their medical degree 40 or more years ago were less likely to register for the Medicare EHR Incentive Program. The likelihood of professionals registering if they were specialists or were aged 70 and older was particularly low relative to other characteristics.

Conversely, the model indicated that EPs with one of the following characteristics was more likely to register: between ages 30 to 50, in an urban area, and who had previously adopted

an EHR. Two variables—practice ownership and practice size—were predictive of registration for all subcategories (i.e., all ownership types and all practice sizes): professionals in independently owned practices and in practices of 6 to 10 professionals were most likely to register.

For attestation, the model results indicate that female professionals, professionals in a medically underserved area, all professional types (primary care and specialists), rural professionals, professionals aged 60 and older, and professionals who obtained their medical degree between 0 to 10 years ago were less likely to attest for the Medicare EHR Incentive Program, once registered. The likelihood of professionals attesting if they were specialists without patient contact—70% less likely—was particularly low relative to other characteristics.

Conversely, the model indicated that a professional in an urban area was more likely to attest. As with the registration model, two variables—practice ownership and practice size—were predictive of attestation for all subcategories (i.e., all ownership types and all practice sizes), with professionals in independently owned practices and practices of 3 to 10 professionals most likely to attest. For practice size, all practices that had more than one professional had a greater likelihood of attesting than solo practices.

Odds ratios for significant variables in the EP attestation model typically fell into a range of 0.95 to 1.05, with a few exceptions outside this range. For example, the beneficiary characteristic Race: Unknown, indicated more likelihood of EP registration, but less likelihood of attestation. We also observed one possible trend: higher decile risk scores (i.e., greater risk) were often associated with lower likelihood of attestation. Finally, as with the EP registration model, HCCs did not appear to be strongly predictive of either less or more EP participation; the largest HCC odds ratio we found was for HCC55 (Depression − OR = 1.10), associated with a 10% increased likelihood of EP attestation.

ES.3.5 EH Regression Results

EHs in completely rural settings and hospitals that were for-profit were significantly less likely to register. A missing SSI was associated with a very high likelihood (92%) that an EH did not register for the Medicare EHR Incentive Program.

Conversely, EHs with prior adoption of an EHR that cared for beneficiaries with an SSI of between 0–0.15, were in a medium- to large-sized hospital, and saw a relatively greater proportion of Medicare patients were more likely to register. The most highly predictive variables were being a network member (over 3 times more likely to register) and seeing beneficiaries with an SSI of greater than 0.30 (over 5 times more likely to register). This finding is potentially very positive, because hospitals that serve relatively lower-income beneficiaries were more likely to register.

As with the EP models, we included hospital characteristics and beneficiary characteristics (i.e., age, gender, race, risk scores, top 10 HCCs) and modeled noncritical access hospitals and CAH hospitals separately. For EHs, very few of the beneficiary variables were significant for registration. Variables that were significant, such as Race: Black, HCCs for Diabetes, COPD and Vascular disease, had very small effect sizes: all within the range of odds ratios 0.95–1.05. The HCC for breast, prostate, colorectal, and other cancers was most

predictive: hospitals operating in counties that had beneficiaries with this diagnosis had an 8% greater likelihood of registering.

We also modeled the results of hospital and beneficiary characteristics on EH attestation. For EHs, a missing SSI was the only variable associated with a decreased likelihood of attesting, once registered. Although the effect of this variable was quite pronounced—it was associated with a 97% lower chance of attestation—it may not be particularly meaningful, because the number of EHs with a missing SSI was very low (n =2).

Being a located in a rural area, prior EHR adoption, and being a for-profit hospital were associated with an increased likelihood of EHs attesting to Stage 1 meaningful use, once registered.

For beneficiary characteristics, only one variable was significantly associated with EHs being less likely to attest. EHs with a relatively higher proportion of beneficiaries in a county who reported their race as Black had a slightly (2%) decreased likelihood of attesting. On the other hand, two HCCs were associated with an increased likelihood of EH attestation. EHs in counties whose beneficiaries had a diagnosis of breast, prostate, colorectal, and other cancers (HCC10) had a 20% or greater likelihood of attesting, whereas those with depressive disorders (HCC55) had a 12% increase.

ES.3.6 CAH Regression Results

CAHs *less likely* to register were those with a relatively greater proportion of patients whose race was identified as Other and CAHs that treated a relatively greater proportion of diabetes patients without complication (HCC19) and beneficiaries with cancer (HCC10).

Conversely, CAHs with prior adoption of an EHR, that were network members, and that treated a relatively greater proportion of vascular disease patients (HCC105) were more likely to register. The most highly predictive variable was seeing a relatively greater proportion of Medicare (over 3 times more likely to register) or Medicaid patients (over 4 times more likely to register).

For CAHs, several beneficiary variables were significant for registration. Race: Other was most predictive with a 45% greater likelihood of not registering, whereas the HCC for vascular disease was predictive, with CAHs operating in counties that had beneficiaries with this diagnosis had a 12% greater likelihood of registering.

For attestation, CAHs that were members of a network and CAHs that operated in areas with medically underserved populations were less likely to attest.

On the other hand, CAHs that saw a relatively greater proportion of patients who were Native Americans and CAHs that were government hospitals were more likely to attest. Prior adoption of an EHR was most highly predictive (over 2 times more likely to attest) of attestation.

For CAHs, with the exception of Race: Native American, no other beneficiary variables were significant for attestation.

ES.4 Implications

Relative to CMS's primary objective, the analysis of descriptive statistics showed who was and was not participating, while the regression analyses identified characteristics associated with these same aspects. The sets of descriptive statistics (counts and percentages) reporting lower levels of registration and attestation, and regression model results indicating less likelihood of participation, suggest what types of EPs, EHs, and CAHs may need additional support and where these entities may be located. We note these below and discuss implications for supporting nonparticipating entities.

Across both registration and attestation, additional assistance may be needed for EPs with the following characteristics:

- Practice types: small practices, independently owned, lower visit volume (fewer than 50 patients daily)
- Professional types: younger and older professionals, specialists without patient contact, female professionals (attestation only)
- Locations: medically underserved areas and populations, rural care settings, in CMS regions 2, 4, 5, and 9 (New York, New Jersey, Puerto Rico, USVI, and southern, midwestern, and western states)

Also, further consideration of two professional types may be warranted even though they do not appear in the lists above. Family practice physicians and internists are overrepresented in the EP population in their rates of registration and attestation; yet because of their numbers within the total provider community, they constitute more than 20% of the professionals who do not participate (i.e., register).

In considering the descriptive data and regression model results on EH participation, additional assistance for both registration and attestation may be needed for EHs with:

- Small to medium bed size
- For-profit status (registration only), lower or missing SSI ratios
- Location: primary care and dental HPSAs and medically underserved areas, rural care settings, in CMS regions 4, 5, 6, and 9 (midwestern, southeastern, south-central, and western states)

Similarly, in considering the descriptive data and regression model results on CAH participation, more assistance for both registration and attestation may be needed for CAHs with:

- Small bed size
- Not-for-profit status, members of a network (attestation only)

- Location: primary care and dental HPSAs and medically underserved areas/populations, more urban locations, in CMS regions 5 and 7 (midwestern and central plains states)

For both EHs and CAHs, prior EHR adoption is a significant predictor of greater likelihood to register and greater likelihood to attest after registration. Conversely, this predictor may suggest that late adopters of EHR technology will require greater support to guide system implementations that enable attestation.

The analysis of beneficiary data did not identify many characteristics important to EP, EH, and CAH participation. For EPs, we observed more overall significance for beneficiary characteristics (age, race, gender, risk scores, and HCCs) relative to EP program participation, but usually with small to very small effects. Odds ratios for significant variables typically fell into a range of 0.95 to 1.05, with a few exceptions outside this range. We believe that the general significance across many variables occurred because of the very large datasets that were modeled. Given the small effects observed, however, many of these variables are likely not very important in explaining EPs' participation or nonparticipation in the Medicare EHR Incentive Program. Therefore, a limited association appears to exist between beneficiaries' age, gender, race, location, and conditions and a professional's participation in the Medicare EHR Incentive Program. There may be no disparities in patients of providers who participate versus those who do not, but our methods were not able to determine this conclusively.

We observed one possible trend for EPs related to beneficiary characteristics, however: higher decile risk scores (i.e., greater risk) were often associated with lower likelihood of attestation. One implication, then, may be to identify EPs serving Medicare beneficiaries with higher decile risk scores and assess these professionals' needs for technical assistance.

The beneficiary risk scores for EHs and CAHs were not significant—using the available data, we did not observe any significant associations between Medicare beneficiaries' risk of medical expenditure and a hospital's participation (or nonparticipation) in the Medicare EHR Incentive Program. Moreover, HCCs were not very significant. HCC10 (Cancers) was the most consistently significant HCC, associated with non-CAHs being more likely to register and attest; and with CAHs being less likely to register. This finding requires more investigation, but it may suggest targeting nonregistered CAHs in regions (counties) with greater numbers of Medicare beneficiaries who have a cancer diagnosis included in HCC10. As with EPs, a limited relationship appears to exist between beneficiaries' age, gender, race, location, and conditions and hospital's participation in the Medicare EHR Incentive Program. Our analyses were not able to identify disparities in patients of hospitals who participate versus those who do not.

ES.5 Conclusions

Achieving the promise of EHRs as a tool to help transform the U.S. health care system—that is, improving quality and safety while controlling costs—begins with system adoption and use. Ensuring that all patients receive the benefits of a more efficient and equitable health care system enabled by technology is tied, in part, to professionals' and hospitals' ability to participate in the Medicare EHR Incentive Program. This analysis characterizes who is and is not participating in this program and the factors associated with participation and

nonparticipation. In a more limited way, this analysis also begins the process of assessing to what extent professionals and hospitals that do and do not participate also serve beneficiaries who are more or less ill or are at greater or lesser risk of becoming so. Developing targeted and effective means of support for all EPs, EHs, and CAHs who want to participate in the Medicare EHR Incentive Program should be informed by the results of this analysis.

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SECTION 1
INTRODUCTION

Landmark federal legislation in the past several years has enabled the adoption and use of health information technology (health IT) across the U.S. health care system. The passage of the American Recovery and Reinvestment Act (ARRA) and the Health Information Technology for Economic and Clinical Health Act (HITECH Act) in 2009 provided financial and organizational support for the adoption of certified electronic health record (EHR) technologies, including the Medicare and Medicaid EHR Incentive Program. The passage of the Patient Protection and Affordable Care Act (PPACA or ACA) in 2010 aims to reform the U.S. health care system by expanding access to care; improving care quality, efficiency, and safety; and reducing costs. Health IT, including EHRs, will play a crucial role in realizing the ACA's goals. These bills and other efforts have resulted in pronounced increases in EHR adoption. A recent report to Congress from the Office of the National Coordinator for Health Information Technology (ONC) noted that, since the passage of the HITECH act, EHR adoption by professionals and hospitals increased substantially. In 2012, "nearly three-quarters (72%) of office-based physicians adopted an EHR that was all or partially electronic, up from 42% in 2008. Hospital adoption of at least a basic EHR system tripled since 2009, increasing from 12% to 44%" (ONC 2013; Charles, et al., 2013).

The primary objective of the Medicare EHR Incentive Program is to increase the adoption and *meaningful use* of certified EHR technologies through incentive payments to eligible professionals (EPs), eligible hospitals (EHs), and critical access hospitals (CAHs). As the cornerstone of this program, meaningful use has been defined as a series of three stages, each with criteria that EPs, EHs, and CAHs must meet to receive incentive payments.[1] In short, CMS pays for the use of EHRs in ways that improve care quality, safety, and outcomes—not simply to support EHR implementation. The stages of meaningful use start with data capture and sharing (Stage 1), then progress to advanced clinical processes (Stage 2), which, in the final stage (Stage 3) improve outcomes (Table 1).

However, there is a risk that some patients and providers will be left behind as EHRs are deployed nationally, potentially creating a gap in quality, cost, and efficiency between those who have adopted and meaningfully use EHRs and those who have not. An analysis of the literature performed under this contract found that provider location, size, ownership, patient mix, and system costs all effect EHR adoption (Banger, et al., 2013). Rural hospitals, for example, have been shown to have significantly lower adoption rates than their urban counterparts. Moreover, CAHs have lower adoption rates than acute care hospitals; CAHs were also less likely to have received EHR incentive payments in 2011 (GAO 2012). Older professionals and those in smaller practices also had lower rates of EHR adoption (McCullough, et al., 2011).

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[1] Blumenthal, NEJM 2009: HITECH also threatens financial penalties to spur adoption. Physicians who are not using EHRs meaningfully by 2015 will lose 1% of their Medicare fees, then 2% in 2016, and 3% in 2017. Hospitals, too, face penalties for nonadoption as of 2015—in their case, taking the form of cuts in their annual updates under the DRG system.

Table 1
Stages of meaningful use

Stage 1: Meaningful use criteria focus on:	Stage 2: Meaningful use criteria focus on:	Stage 3: Meaningful use criteria focus on:
Electronically capturing health information in a standardized format	Promoting more rigorous health information exchange (HIE)	Improving quality, safety, and efficiency, leading to improved health outcomes
Using that information to track key clinical conditions	Increasing requirements for e-prescribing and incorporating lab results	Providing decision support for national high-priority conditions
Communicating that information for care coordination processes	Electronically transmitting patient care summaries across multiple settings	Granting patient access to self-management tools
Initiating the reporting of clinical quality measures and public health information	Allowing more patient-controlled data	Granting access to comprehensive patient data through patient-centered HIE
Using information to engage patients and their families in their care	—	Improving population health

Source: http://www.healthit.gov/policy-researchers-implementers/meaningful-use

As the agency leading the Medicare EHR Incentive Program and critical health system reform efforts under the ACA, the Centers for Medicare & Medicaid Services (CMS) has an important interest in ensuring program success: namely, that all EPs, EHs, and CAHs adopt and meaningfully use certified EHR technologies. In support of this effort, the CMS Office of Minority Health (OMH) contracted with RTI International to study which EPs, EHs, and CAHs are participating, which are not, and to identify factors that explain participation. The results of this analysis will be used to help identify barriers to participation and to develop strategies, such as technical assistance, to address them.[2]

Through compilation and analysis of various federal, state, and industry data sources, RTI assessed the characteristics of EPs, EHs, and CAHs that are eligible, registered, or have attested to Stage 1 of meaningful use. We then performed statistical analysis of these characteristics to identify predictors of program registration and of attestation to Stage 1 meaningful use criteria.

[2] There are sources available to understand participation patterns and trends related to professional and hospital participation in the Medicare EHR Incentive Program, including those from the Health Services Research Administration (HRSA) related to community health centers, from ONC related to barriers to participation for Critical Access Hospitals and small, rural hospitals, and from CMS and Quality Improvement Organizations regarding technical assistance to report quality data. These resources can be accessed on HRSA, ONC, and CMS web sites.

This report discusses the results of RTI's analysis of the Medicare EHR Incentive Program; a separate analysis and report will be prepared for selected states in the Medicaid EHR Incentive Program. We begin by reviewing our approach, including research questions, data sources, and analytic methods. Accompanying appendices provide details on variable definitions and additional selected results. We then review findings, composed of descriptive statistics and regression model results, and follow with a discussion of implications for the Medicare EHR Incentive Program and for support of EPs, EHs, and CAHs.

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SECTION 2
METHODS

2.1 Overview

The goals of this analysis were (1) to assess EP, EH, and CAH participation in the first 2 years of the Medicare EHR Incentive Program, and (2) to identify the main predictors of participation in this program. To accomplish these goals, RTI first reviewed the available peer-reviewed literature to understand existing studies of EHR adoption, including Medicare EHR Incentive Program participation. Through this review, we sought to determine what characteristics might be important predictors of participation. We identified several factors that were related to EHR adoption—as suggested by prior research—and we included them as the basis for our analysis.

Using these characteristics, we developed a set of descriptive statistics for EPs, EHs, and CAHs, respectively, and created profiles of each according to their participation status in three general categories: not participating, registered, and attested. We defined participation status according to CMS definitions of attested and registered in the National Level Repository (NLR)—the database that stores program registration and attestation data. EPs, EHs, and CAHs that were neither registered nor attested were deemed not participating, although many of these may intend to participate in the program at some point. For EPs, we included demographic characteristics and selected practice characteristics. For EHs and CAHs, we included organizational and network characteristics. Finally, because no prior analysis had assessed if and how beneficiary characteristics affect program participation, we included data on Medicare beneficiaries. RTI relied upon a mix of public and private-sector data sources to develop these profiles, which then served as inputs for a series of regression models to determine which EP, EH, and CAH characteristics were most significant predictors of participation.

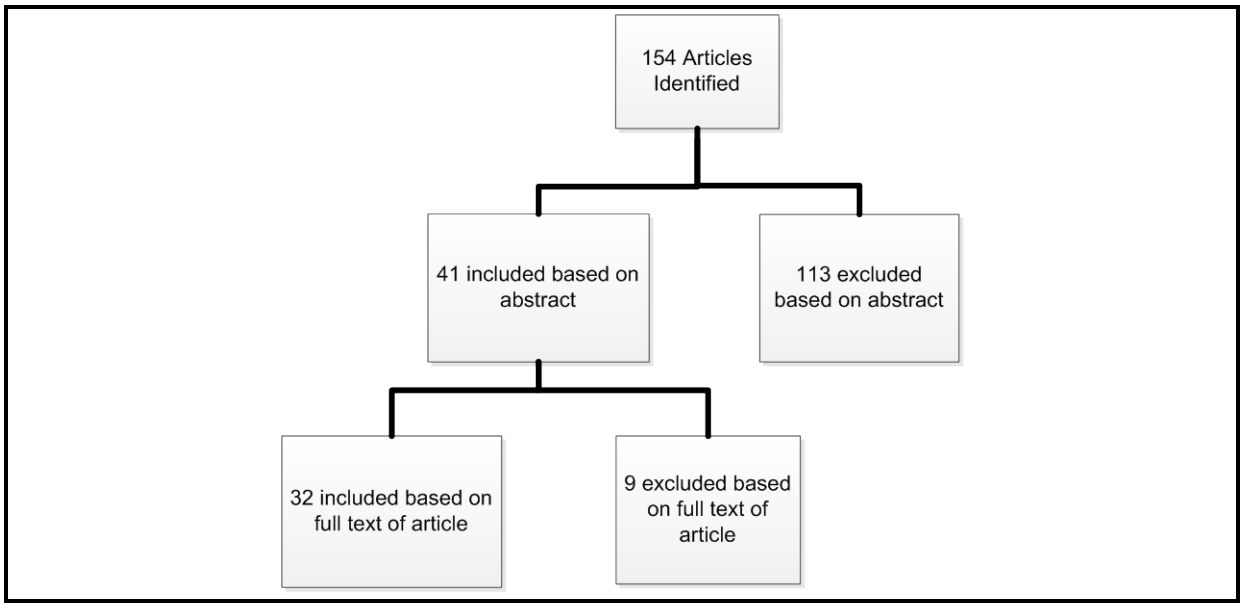
With the characteristics defined, RTI then developed a set of regression models to identify the most significant characteristics for program registration and attestation. We developed models for EPs, EHs, and CAHs, respectively, which included overall characteristics as well as subsets of variables for which we had limited data. We also modeled beneficiary data using a mixed-model approach. All models were developed in SAS, version 9.3, and were checked for consistency and accuracy. Additional details on these methods are discussed below.

2.2 Literature Review

The literature review drew from peer-reviewed articles published in English between January 2005 and October 2012 focused on EHR adoption among U.S. health care providers. We focused on identifying either primary or secondary research on trends, factors, and barriers related to EHR adoption in any care setting. The initial search terms, which included EHR, adoption, barriers, information technology, and health IT, were reviewed and refined by a medical librarian. Searches were completed in Web of Science, MedLine, PyscInfo, and CINAHL (Cumulative Index to Nursing and Allied Health Literature) and compiled into an EndNote database.

As shown in Figure 1, we identified 154 articles based on the initial search parameters; 41 were included in the review based on content of abstract and applicability to research questions, and 32 were included in final review.

Figure 1
Literature review totals



For this analysis, we considered studies that used data collected in 2009 and later years compared to those that used data collected in 2008 and earlier to determine if barriers, such as cost, were eliminated or reduced as a result of the Medicare EHR Incentive Programs. (The HITECH Act was signed into law in February 2009.)

The studies reviewed included data from a variety of sources. The American Hospital Association's (AHA's) health IT supplement was a common source of data on EHR adoption, as was the National Ambulatory Medical Care Survey (NAMCS). Other studies conducted independent surveys or focus groups; these studies were generally confined to a single state or group of specialists. For example, Menachemi and colleagues conducted several surveys of Florida providers (Menachemi 2011) and Warholak and Murcko conducted focus groups with pharmacists in Arizona (Warholak, et al., 2011).

Our review of the 32 studies identified in the literature search produced a range of factors associated with EHR adoption, including professional demographics; practice, hospital and patient characteristics; regional characteristics (geography, location); technology; and Medicare EHR Incentive Program participation. Table 2 lists these factors, and indicates which were included in our analysis. A full report of literature review results, including an appendix summarizing all the studies we reviewed, is available in a separate volume (Banger 2013).

The results of the review informed both the types of factors we included in the participant analysis—professional, patient, and hospital characteristics; current adoption and use of technology; and Medicare EHR Incentive Program characteristics—as well the specific attributes to assess (e.g., age, gender, race/ethnicity, etc.). However, data were insufficient to determine if and how barriers to adoption previously identified in the literature have been altered by the EHR Incentive Programs. Moreover, only a few studies considered factors related to Medicare or Medicaid providers and beneficiaries, and those that did found nothing unique or exceptional relative to those programs. That is, none of the factors we identified were specific to only Medicare/Medicaid or to EHR Incentive Programs.

Table 2
Factors impacting EHR adoption: Literature and RTI participant analysis

Possible factors impacting EHR adoption	Factors studied in literature	Factors in RTI analysis
Professional demographics		
Age	Y	Y (where available)
Gender	Y	Y
Race/ethnicity	N	N
Medical specialist	Y	Y
Years since award of degree	Y	Y (where available)
Practice characteristics		
Regional Extension Center participation	Y	N
Practice size (number of physicians)	Y	Y
Hospital characteristics		
Hospital type	Y	Y
Ownership (including chains)	Y	Y
Consolidation trends	N	N
Bed size (total beds)	Y	Y
Inpatient bed days	Y	N
Average daily census	Y	N
Total charges	Y	N
Patient characteristics		
Age	N	Y
Gender	N	Y
Race/ethnicity	Y	Y
Chronic disease burden	N	Y
Insurance status	Y	N

(continued)

Table 2 (continued)
Factors impacting EHR adoption: Literature and RTI participant analysis

Possible factors impacting EHR adoption	Factors studied in literature	Factors in RTI analysis
Regional characteristics		
Geographic region (NE, MW, S, W)	Y	Y (CMS region)
Urban/rural	Y	Y
Health professional shortage area	Y	Y
Medically underserved area	Y	Y
Hospital referral regions	N	N
In a Beacon community	Y	N
Technology characteristics		
EHR adoption	Y	Y
eRx adoption	Y	N
Broadband availability	Y	N
Health IT staff availability/capability	Y	N
Usability	Y	N
Financial characteristics		
Initial system costs (capital availability)	Y	N
Maintenance and upgrade costs	Y	N
Reduced productivity	Y	N
Increased staffing costs	Y	N
Return on investment	Y	N
EHR Incentive Program characteristics		
Program start date (Medicaid)	N	N
EHR Incentive Program eligibility, registration, & attestation	Only professionals eligible and paid under Incentive Program	Y

Using the characteristics identified through the literature search, RTI then assessed public and private data sources to create profiles of EPs, EHs, and CAHs. We sought to identify data for all professionals and hospitals that would meet CMS eligibility criteria for participation (see Table 3) and that had complete records for the first 2 Medicare EHR Incentive Program years: January 2011 through the end of February 2013 for EPs, and January 2011 through the end of September 2012 for EHs. These data sources are summarized in the table, reported first by

general sources used across all analyses, and then by data sources specific to EPs and EHs/CAHs.

Table 3
Medicare EHR Incentive Program eligibility criteria for professionals and hospitals

Eligible Professionals	Eligible Hospitals
• Doctor of medicine or osteopathy • Doctor of dental surgery or dental medicine • Doctor of podiatry • Doctor of optometry • Chiropractor **Hospital-based eligible professionals are not eligible for incentive payments.** An eligible professional is considered hospital-based if 90% or more of his or her services are performed in a hospital inpatient (Place of Service code 21) or emergency room (Place of Service code 23) setting.	• "Subsection (d) hospitals" in the 50 states or DC that are paid under the Inpatient Prospective Payment System (IPPS) • Critical Access Hospitals (CAHs) • Medicare Advantage (MA-Affiliated) Hospitals

Source: http://www.cms.gov/Regulations-and-Guidance/Legislation/EHRIncentivePrograms/index.html?redirect=/ehrincentiveprograms/

2.3 Data Sources

To provide data on program context for EP and EH and CAH analyses, we relied on several public data sources. The CMS National Level Repository (NLR) provided data regarding EP, EH, and CAH participation in Stage 1 of the Medicare EHR Incentive Program. The NLR contains a complete record of registrations and attestations reported to CMS; RTI selected data for the period of January 2011 through the end of February 2013 for EPs, and January 2011 to the end of September 2012 for EHs and CAHs.

To characterize health professional shortage areas (HPSAs), we relied on data from the Health Resources and Services Administration's (HRSA) Area Health Resource File (AHRF). The AHRF provided county-level information on primary care and dental HPSAs, as well as data on medically underserved areas (MUAs) and medically underserved populations (MUPs). These designations—HPSA, MUA/P—gave us the ability to analyze the relationship between professional and hospital resources available in a given region and program participation. HRSA defines HPSAs (http://bhpr.hrsa.gov/shortage/hpsas/designationcriteria/index.html) and MUA/Ps (http://www.hrsa.gov/shortage/mua/index.html) on its Web site.

To assess EP, EH, and CAH participation geographically, RTI relied upon CMS region definitions. We analyzed and reported EP, EH, and CAH participation status by county and state, and crosswalked state-level data to the corresponding CMS regions 1–10, as defined by CMS (http://www.cms.gov/medicare-coverage-database/staticpages/region-descriptions.aspx).

Percent urban and rural designations were assigned according to the U.S. Census Bureau's 2010 Census Urban and Rural Classification and Urban Area Criteria (http://www.census.gov/geo/reference/ua/urban-rural-2010.html). The Census uses two primary urban designations—Urban Areas (UAs) and Urban Clusters (UCs)—based on population density. Populations not included in UA and UCs are deemed to be rural. We crosswalked county codes to Census Urban/Rural designations to identify to what degree professional or hospital zip codes were considered urban or rural.

2.3.1 EP Data Sources

In addition to the general data sources described above, RTI relied upon a single source of data for EP characteristics—the SK&A Office Based Providers (OBP) dataset. SK&A currently collects EHR adoption data for ONC, and ONC and other federal agencies have used OBP as a comprehensive and current data source on practicing physicians and other providers. SK&A surveys all practicing U.S.-based providers continually and collects self-reported data on practice location, staffing, visit volume, Medicare and Medicaid status, technology adoption, and many other attributes. SK&A's database of over 740,000 office-based physicians are telephone-verified every 6 months and updated monthly. OBP also included data important to our analysis, including EHR adoption status, National Provider Identifiers (NPIs), and provider county data (FIPS) that enabled RTI to link professional characteristics with Medicare EHR Incentive Program participation data from the NLR.

RTI considered many other data sources for professional characteristics, including publicly available data from the HRSA AHRF on Health Care Professions, CMS National Plan & Provider Enumeration System, and the CMS Provider Enrollment, Chain, and Ownership System (PECOS). We determined that SK&A would provide the most current and complete source of professional data with a minimal amount of file linking required to generate a dataset for our analysis. Table 4 contains a list of characteristics for our EP analysis, data sources, definitions, and date ranges.

To create the final dataset for EPs, RTI used the NPI to link data on professional characteristics (SK&A OBP) with program participation data (CMS NLR). In addition, RTI assigned urban/rural status to professional attestation and registration using zip code data. We linked county data from the NLR to OBP using the CMS Social Security Administration (SSA) to FIPS State and County crosswalk for FY2013 (http://www.nber.org/data/ssa-fips-state-county-crosswalk.html). Using this crosswalk, we then assigned professionals by attestation status to HPSA and MUA/Ps at the county level. The complete, linked dataset was then used to report descriptive statistics of EP participation status as well as serve as inputs into a series of regression models.

Table 4
Professional characteristics and data sources

Characteristics	Data source	Data definitions	Date range
Professional demographics			
Age	SK&A office based physicians (OBP)	Date of birth subtracted from date of analysis (August 2013), then grouped into ranges	Jan 2011–Dec 2012
Gender	SK&A OBP	Male, female, or unknown	Jan 2011–Dec 2012
Years since award of degree	SK&A OBP	Date of birth subtracted from date of analysis (August 2013), then grouped into ranges	Jan 2011–Dec 2012
Medical specialist	SK&A OBP	87 total specialties are represented in SK&A dataset; cutoff for inclusion in RTI analysis was 10,000 across all participation categories—eligible (not registered), registered, attested; all specialties under 10,000 are "other"	Jan 2011–Dec 2012
Practice characteristics			
Practice size	SK&A OBP	Number of physicians in a given office, grouped into ranges	Jan 2011–Dec 2012
Average daily patient volume per site	SK&A OBP	Average number of patient visits per office as reported by a practice, grouped into ranges	Jan 2011–Dec 2012
Practice ownership	SK&A OBP	Defined according to hospital owned, health system owned, Independent Physician Association, or other	Jan 2011–Dec 2012

(continued)

Table 4 (continued)
Professional characteristics and data sources

Characteristics	Data source	Data definitions	Date range
Location	CMS region definitions	Regions 1–10 as defined by CMS based upon states included in a given region. http://www.cms.gov/medicare-coverage-database/staticpages/region-descriptions.aspx	N/A
Urban/rural	U.S. Census Bureau	2010 Census Urban and Rural Classification and Urban Area Criteria. http://www.census.gov/geo/reference/ua/urban-rural-2010.html	2010
Health professional shortage areas (HPSA)	2012–2013 area health resource file (AHRF)	HPSA as defined by the Health Resources and Services Administration (HRSA) http://bhpr.hrsa.gov/shortage/hpsas/designationcriteria/index.html	2010
Primary care HPSA	2012–2013 AHRF	Primary care health professional shortage area as defined by HRSA	2010
Dental HPSA	2012–2013 AHRF	Dental care health professional shortage area as defined by HRSA	2010
Medically underserved area (MUA)	2012–2013 AHRF	MUA as defined by HRSA http://www.hrsa.gov/shortage/mua/index.html	2010
Medically underserved population (MUP)	2012–2013 AHRF	MUP as defined by HRSA http://www.hrsa.gov/shortage/mua/index.html	2010
EHR adoption	SK&A OBP	Y/N response to the question whether or not a physician office has EMR (Electronic Health/Medical Record) software	Jan 2011–Dec 2012

(continued)

Table 4 (continued)
Professional characteristics and data sources

Characteristics	Data source	Data definitions	Date range
Medicare EHR Incentive Program participation status			
Registration	CMS National Level Repository (NLR)	Total number of registrations in the Medicare EHR Incentive Program as reported to CMS	Jan 2011–Feb 2013[1]
Attestation	CMS NLR	Total number of attestations in the Medicare EHR Incentive Program as reported to CMS	Jan 2011–Feb 2013[1]

[1] The second Medicare EHR Incentive Program for EPs ended in December 2012, but 2012 registration and attestation data were received through the end of February 2013.

2.3.2 EH and CAH Data Sources

Similar to the EP analysis, and in addition to the general data sources described above, RTI relied on a single source of data for many hospital characteristics: the 2012 American Hospital Association (AHA) Annual Survey database. AHA collects data on over 6,400 hospitals in the United States, which represents a near census of all hospitals operating nationally. This database contains data on a wide range of organizational, financial, geographic, utilization, service, and other characteristics. A health IT supplement to the Annual Survey provided data on EHR adoption by hospitals.

In addition to AHA data, RTI also included data from CMS on hospital case mix index (CMI) as well as SSI ratios (as part of disproportionate share hospital, or DSH, payment adjusters). We used CMI as a proxy for beneficiary severity of illness and the SSI ratio to represent hospitals that serve low-income beneficiaries. Since CAHs are reimbursed according to reasonable costs (and not the inpatient prospective payment system, or IPPS), they do not receive payment adjustments based upon CMI or DSH/SSI status. We were not able to identify corresponding indicators for disease-risk and low-income populations for CAHs within the timeframe of this analysis and, therefore, do not report these variables for CAHs.

Finally, as with the professional analysis, the NLR provided data on EP and CAH registration and attestation to Stage 1 meaningful use in the Medicare EHR Incentive Program. RTI used NLR data reported for January 2011 through end of September 2012. Table 5 contains a list of characteristics in our hospital analysis, including data sources, variable definitions, and date ranges.

Table 5
Hospital characteristics and data sources

Characteristics	Data source	Data definitions	Date range
Hospital bed size	2012 AHA Annual Survey	Distribution of hospitals by small (1–99 beds), medium (100–399 beds), and large (400+ beds)	2012
Average daily census	2012 AHA Annual Survey	As a measure of patient volume, the average number of inpatients treated over a given time period	2012
Average total inpatient days	2012 AHA Annual Survey	As a measure of patient volume, the total number of days patients were admitted to a hospital over a given time period. Total inpatient bed days are reported for Medicare and Medicaid	2012
Ownership type	2012 AHA Annual Survey	Defined as hospital owned by government, for-profit, or not-for-profit organization	2012
Hospital type	2012 AHA Annual Survey	Hospital types defined as teaching, critical access hospital, and all other	2012
Network membership	2012 AHA Annual Survey	Indication as to whether or not a hospital is part of a network	2012
Location	CMS region definitions	Regions 1–10 as defined by CMS based on states included in a given region. http://www.cms.gov/medicare-coverage-database/staticpages/region-descriptions.aspx	N/A
Urban/rural	U.S. Census	2010 Census Urban and Rural Classification and Urban Area Criteria. http://www.census.gov/geo/reference/ua/urban-rural-2010.html	2010
Health professional shortage area (HPSA)	2012–2013 AHRF	HPSA as defined by the Health Resources and Services Administration (HRSA). Includes primary care and dental HPSA. http://bhpr.hrsa.gov/shortage/hpsas/designationcriteria/index.html	2010
Medically underserved area (MUA)	2012–2013 AHRF	MUA as defined by HRSA. http://www.hrsa.gov/shortage/mua/index.html	2010
Medically underserved population (MUP)	2012–2013 AHRF	MUP as defined by HRSA. http://www.hrsa.gov/shortage/mua/index.html	2010
Case mix index (CMI)	CMS FY2012 final CMI	CMI is a measure of the resources used to treat patients in a hospital. It is the average diagnosis-related group (DRG) weight of patients discharged from a hospital. In this analysis, CMI is used as a proxy for severity of illness in Medicare patients.	2012
Disproportionate share hospital (DSH)/SSI ratio	CMS DSH adjustment and 2010–2011 file	The SSI ratio is used to adjust payments to Medicare DSH hospitals. It is a measure of the amount of low-income beneficiaries seen by short-term and general acute hospitals.	Sept. 2011
EHR adoption	2012 AHA Health IT Survey	Indicates whether the hospital has adopted an EHR system.	2012
Medicare EHR Incentive Program participation status			
Registration	CMS NLR	Total number of registrations in the Medicare EHR Incentive Program as reported to CMS	Jan 2011–Sept 2012
Attestation	CMS NLR	Total number of attestations in the Medicare EHR Incentive Program as reported to CMS	Jan 2011–Sept 2012

As with EPs, to create a dataset for EHs and CAHs, RTI used the NPI to link data on hospital characteristics (AHA Annual Survey) with program participation data (CMS NLR). CMI and DSH data were then linked to hospitals using the Medicare provider number. RTI assigned urban/rural status to hospital attestation and registration data through cross walking hospital zip code to county data, and then mapping to U.S. Census Bureau urban/rural county designations. The complete, linked dataset was then used to generate descriptive statistics (overall counts and percent distributions of EHs by participation status: not registered, registered and attested) and to serve as inputs into a series of regression models.

2.3.3 Beneficiary Data Sources

To characterize Medicare beneficiaries, RTI requested and received access to the most current risk score files used by CMS Division of Payment Policy in risk-adjusting payments to professionals and hospitals. RTI selected the risk score files over other publicly available sources because they offer several advantages for this analysis. These files contain data on 100% of Medicare beneficiaries—both Fee-for-Service and Medicare Advantage. The 100% figure includes any beneficiary who received services during the year—over 56 million beneficiaries—regardless of their duration in the program; consequently, the counts of beneficiaries reported in this analysis are higher than those in other CMS sources. In addition, the risk score files contain data on beneficiary age, gender, and race, as well as indications of disease status and risk. Regarding these last two characteristics, disease status is reported as Hierarchical Condition Categories (HCCs), which represent Condition Categories, Diagnosis Groups, and, ultimately, International Classification of Disease (ICD) codes from Medicare claims data. Medicare uses HCCs to adjust payments to private insurers based upon their members' risk of health care expenditures. We use HCCs as a proxy for disease burden, as HCCs are calculated for 100% of beneficiaries and represent their current diagnoses. Finally, the risk score is a proxy for condition severity; it is a single measure representing the likelihood of a beneficiary's costs of care being greater, lesser, or remaining constant in the next program year. A higher score likely connotes higher cost and, consequently, likely more complex or severe disease. By having a single, complete source of data for beneficiary demographic, disease, and risk characteristics, we reduce the complexities of data file linking and the missing data that would likely result if RTI relied on other public sources for this same data. Table 6 summarizes beneficiary characteristics used in our analysis.

Table 6
Medicare beneficiary characteristics and data sources

Characteristics	Data source	Data definitions	Date range
Gender	2011 CMS risk score file	Sex of the beneficiary defined as male, female, unknown	January–December 2010
Disabled	2011 CMS risk score file	Disability status indicated as under 65 and eligible through disability	January–December 2010

(continued)

Table 6 (continued)
Medicare beneficiary characteristics and data sources

Characteristics	Data source	Data definitions	Date range
Age	2011 CMS risk score file	Age of the beneficiary defined as date of birth subtracted from current year (2010)	January–December 2010
Race	2011 CMS risk score file	Defined as unknown, white, black, other, Asian, Hispanic, North American Native	January–December 2010
Location (by county)	2011 CMS risk score file	County of residence defined as Social Security Administration state and county code	January–December 2010
Conditions	2011 CMS risk score file	Defined in terms of 70 Hierarchical Condition Categories (HCCs). RTI modeled the top 10 most prevalent HCCs.	January–December 2010
Risk scores	2011 CMS risk score file	Defined as the sum total of a beneficiary's relative risk factor scores. Scores reported as a value greater, lesser, or equal to 1.	January–December 2010

The CMS risk score file contains records on all beneficiaries who had ever been enrolled in Medicare for the 2010 calendar year, or over 56 million people. We lacked sufficient data, such as claims, to link beneficiaries to specific professionals and hospitals, and thereby to any indication of participation status. Although we had a complete, comprehensive source of data on beneficiary characteristics, the inability to directly associate beneficiaries with EPs, EHs, and CAHs limited our ability to truly assess the effect of beneficiary characteristics on participation. To create a dataset for our analysis, however, we assigned beneficiaries to counties, and then used our existing crosswalks to roll beneficiaries up by county, state, and CMS region. Using county as the unit of analysis for beneficiaries then enabled RTI to associate beneficiaries with groups of professionals and hospitals at the county level. This approach allowed RTI to model, in a limited way, the association between beneficiary characteristics and EP, EH, and CAH participation in the Medicare EHR Incentive Program.

2.4 Defining Eligible Populations of Professionals and Hospitals

Critical to our analysis was defining the proportion of professionals and hospitals that would be eligible to participate. As referenced above, RTI identified data sources for all professionals and hospitals that would meet CMS eligibility criteria for participation (see Table 3), and that had complete records for the first 2 Medicare EHR Incentive Program years.

To define the eligible population of professionals, RTI accessed all SK&A OBP records whose titles included the CMS provider types (doctor of medicine, etc.). Data on certain kinds of professionals—dentists, chiropractors, and optometrists—were largely unavailable in SK&A

OBP, and challenging to access from other sources. These professional types are, therefore, limited in our analysis. RTI factored out hospital-based professionals from our datasets though two means. First, we excluded types of professionals that are typically hospital based, such as emergency room physicians and hospitalists, for the OBP dataset. Then we further excluded hospital-based professionals using the CMS hospital-based provider data file. This exclusion resulted in a set of over 580 thousand EPs—greater than CMS estimates (ONC 2013) but less than those produced by the GAO (GAO 2013), and likely reflective of more recent counts of professionals in the SK&A OBP.

To define the eligible population of hospitals, RTI used data on "hospital type" from AHA's Annual Survey and included those hospitals in our dataset that met CMS criteria. For example, we included short stay, general acute hospitals, and CAHs, but excluded federally-owned hospitals (i.e., Department of Veterans Affairs), behavioral health, long-term care, and rehabilitation hospitals. This exclusion resulted in a set of over 5,100 eligible hospitals, of which over 1,300 were CAHs.

2.5 Reports and Modeling

With characteristics determined, data sources identified, and eligible populations defined, RTI then produced a series of descriptive statistics that reported total numbers (counts) and percent distributions of EPs, EHs, and CAH characteristics by their participation status. The results section that follows provides these counts and percents tables. Presenting summary data in a tabular format allowed RTI to further assess which characteristics may be more or less important to explaining program participation. We typically discuss results that represent the upper and lower bound for the ranges reported. In some cases, however, we did not discuss results that were substantially different from zero; for instance, results that had a high percentage but a relatively low number of EPs and EHs for a given characteristic.

The characteristics and associated data sources also served as inputs into a series of regression analyses. RTI modeled registration and attestation to reflect the numbers of EPs, EHs, and CAHs as they progressed from nonparticipating (neither registered and nor attested) to registered, and then from registered to attested over the first 2 program years. Our regressions included most EP, EH, and CAH characteristics, with a few exceptions, and data on beneficiary characteristics. We also assessed correlations between similar characteristics, such as primary care HPSA and MUA/P, and removed highly correlated variables from our regression models. This process removed two variables for EPs ("HPSA" was highly correlated with "MUA/P," and "patient volume" with "practice size"). We also did not include "CMS region" as it was not of interest for the regression analysis. Similarly, we also excluded "CMS region" and "primary care and dental HPSA" from our regression models for EHs and CAHs. Finally, using zip codes, we aggregated beneficiary data to the county level, and then tried to determine the association between these data and EP, EH, and CAH program participation within counties.

The following section on results includes the counts and percent tables described above and the findings from our regression analyses, including the most significant characteristics associated with EP, EH, and CAH registration and attestation in the Medicare EHR Incentive Program.

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SECTION 3
RESULTS

3.1 Number and Percent of Professionals, Hospitals and Medicare Beneficiaries

To characterize the population of EPs, EHs, and CAHs and determine their progress in participating in the Medicare EHR Incentive Program, we used the data sources described above to determine the number (counts) and percent distributions of participation by EP, EH, and CAH. We report the data in three categories: eligible but not participating; registered; and attested. We split the registered category into two subsets: (1) "registered not attested" for the total number of EPs, EHs, and CAHs registered at the end of the 2012 program year that had not yet attested; and (2) "registered ever" for the total number of EPs, EHs, and CAHs that have either registered or attested. In addition, we also report the characteristics of Medicare beneficiaries during this same period, and we show their demographic, disease risk, and disease burden data by CMS region (Appendix A).

3.1.1 Eligible Professionals

For the first two of the Medicare EHR Incentive Program years, January 2011 to December 2012, we estimated that there were more than 583,000 EPs. Of these, data from the NLR indicate that over 40% had registered in the program, with 25% attesting to Stage 1 meaningful use (see Table 7) by the end of the second program year (December 2012, but reported up to February 2013).

Table 7
Eligible professional participation totals

Stage 1 meaningful use participation status	Count	Percent
Not registered or attested	342,048	59%
Registered not attested	93,683	16%
Attested	147,552	25%
Total	**583,283**	**100%**

Table 8 provides a breakdown of EPs by selected characteristics and Medicare EHR Incentive Program participation status.

Table 8
EPs participation status by selected characteristics: January 2011–December 2012

	Not registered or attested		Registered			Attested		Total values and percents
			Registered not attested		Registered ever			
Professional characteristics	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	Count (%)
Column	A	B	C	D	E	F	G	H
Age								
20-29	551 (0%)	50%	237 (0%)	22%	547 (0%)	310 (0%)	28%	1,098 (0%)
30-39	7,928 (2%)	40%	4,469 (5%)	22%	12,009 (5%)	7,540 (5%)	38%	19,937 (3%)
40-49	11,496 (3%)	40%	6,113 (7%)	21%	17,521 (7%)	11,408 (8%)	39%	29,017 (5%)
50-59	12,230 (4%)	44%	5,730 (6%)	20%	15,764 (7%)	10,034 (7%)	36%	27,994 (5%)
60-69	7,366 (2%)	52%	2,678 (3%)	19%	6,778 (3%)	4,100 (3%)	29%	14,144 (2%)
70-79	1,735 (1%)	63%	502 (1%)	18%	1,033 (0%)	531 (0%)	19%	2,768 (0%)
80-89	267 (0%)	70%	73 (0%)	19%	112 (0%)	39 (0%)	10%	379 (0%)
90+	27 (0%)	75%	4 (0%)	11%	9 (0%)	5 (0%)	14%	36 (0%)
Missing	300,448 (88%)	62%	73,877 (79%)	15%	187,462 (78%)	113,585 (77%)	23%	487,910 (84%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**
Gender								
Male	184,206 (54%)	59%	46,998 (50%)	15%	130,493 (54%)	83,495 (57%)	27%	314,699 (54%)
Female	52,236 (15%)	57%	17,334 (19%)	19%	40,212 (17%)	22,878 (16%)	25%	92,448 (16%)
Missing	105,606 (31%)	60%	29,351 (31%)	17%	70,530 (29%)	41,179 (28%)	23%	176,136 (30%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**
Years since award of degree								
0 to 10	6,707 (2%)	43%	3,661 (4%)	24%	8,774 (4%)	5,113 (3%)	33%	15,481 (3%)
11 to 20	10,794 (3%)	42%	5,495 (6%)	21%	14,912 (6%)	9,417 (6%)	37%	25,706 (4%)
21 to 30	11,292 (3%)	45%	5,085 (5%)	20%	13,728 (6%)	8,643 (6%)	35%	25,020 (4%)
31 to 40	7,519 (2%)	50%	2,868 (3%)	19%	7,377 (3%)	4,509 (3%)	30%	14,896 (3%)

(continued)

Table 8 (continued)
EPs participation status by selected characteristics: January 2011–December 2012

	Not registered or attested		Registered not attested		Registered ever	Attested		Total values and percents
Professional characteristics	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	Count (%)
Column	A	B	C	D	E	F	G	H
41 to 50	2,624 (1%)	60%	791 (1%)	18%	1,724 (1%)	933 (1%)	21%	4,348 (1%)
51 to 60	470 (0%)	70%	115 (0%)	17%	204 (0%)	89 (0%)	13%	674 (0%)
61 to 70	33 (0%)	66%	9 (0%)	18%	17 (0%)	8 (0%)	16%	50 (0%)
71 to 80	4 (0%)	100%	— (0%)	—	— (0%)	— (0%)	—	4 (0%)
81+	1 (0%)	50%	— (0%)	—	1 (0%)	1 (0%)	50%	2 (0%)
Missing	302,604 (88%)	61%	75,659 (81%)	15%	194,498 (81%)	118,839 (81%)	24%	497,102 (85%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**
Medical specialty[1]								
Anesthesiologist	20,111 (6%)	86%	2,385 (3%)	10%	3,409 (1%)	1,024 (1%)	4%	23,520 (4%)
Cardiovascular disease	11,590 (3%)	45%	3,499 (4%)	14%	14,020 (6%)	10,521 (7%)	41%	25,610 (4%)
Dermatology	7,044 (2%)	65%	1,124 (1%)	10%	3,712 (2%)	2,588 (2%)	24%	10,756 (2%)
Diagnostic radiologist	15,739 (5%)	79%	2,727 (3%)	14%	4,294 (2%)	1,567 (1%)	8%	20,033 (3%)
Emergency medicine specialist	19,992 (6%)	96%	578 (1%)	3%	797 (0%)	219 (0%)	1%	20,789 (4%)
Family practitioner	38,573 (11%)	47%	16,173 (17%)	20%	43,320 (18%)	27,147 (18%)	33%	81,893 (14%)
Gastroenterologist	5,715 (2%)	42%	1,758 (2%)	13%	7,976 (3%)	6,218 (4%)	45%	13,691 (2%)
General surgeon	10,813 (3%)	59%	2,439 (3%)	13%	7,445 (3%)	5,006 (3%)	27%	18,258 (3%)
Internist	31,627 (9%)	50%	9,288 (10%)	15%	31,781 (13%)	22,493 (15%)	35%	63,408 (11%)
Nephrologist	4,225 (1%)	46%	1,429 (2%)	15%	5,014 (2%)	3,585 (2%)	39%	9,239 (2%)
Neurologist	7,118 (2%)	53%	2,122 (2%)	16%	6,231 (3%)	4,109 (3%)	31%	13,349 (2%)
Obstetrician/gynecologist	15,801 (5%)	53%	8,070 (9%)	27%	13,920 (6%)	5,850 (4%)	20%	29,721 (5%)

(continued)

Table 8 (continued)
EPs participation status by selected characteristics: January 2011–December 2012

	Not registered or attested		Registered not attested		Registered ever	Attested		Total values and percents
Professional characteristics	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	Count (%)
Column	A	B	C	D	E	F	G	H
Oncologist/hematologist	5,473 (2%)	49%	1,694 (2%)	15%	5,662 (2%)	3,968 (3%)	36%	11,135 (2%)
Ophthalmologist	11,765 (3%)	62%	2,321 (2%)	12%	7,209 (3%)	4,888 (3%)	26%	18,974 (3%)
Orthopedic surgeon	12,613 (4%)	53%	3,201 (3%)	13%	11,212 (5%)	8,011 (5%)	34%	23,825 (4%)
Otolaryngologist	4,705 (1%)	50%	1,314 (1%)	14%	4,646 (2%)	3,332 (2%)	36%	9,351 (2%)
Pediatrician	9,694 (3%)	54%	7,852 (8%)	44%	8,203 (3%)	351 (0%)	2%	17,897 (3%)
Podiatrist	6,933 (2%)	51%	1,252 (1%)	9%	6,773 (3%)	5,521 (4%)	40%	13,706 (2%)
Psychiatrist	18,105 (5%)	79%	3,802 (4%)	16%	4,949 (2%)	1,147 (1%)	5%	23,054 (4%)
Urologist	5,038 (1%)	47%	1,283 (1%)	12%	5,649 (2%)	4,366 (3%)	41%	10,687 (2%)
Other	78,764 (23%)	64%	19,258 (21%)	16%	44,775 (19%)	25,517 (17%)	21%	123,539 (21%)
Missing	610 (0%)	72%	114 (0%)	13%	238 (0%)	124 (0%)	15%	848 (0%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100.00%)**
Practice size[2]								
Solo	76,181 (22%)	65%	16,731 (18%)	14%	40,686 (17%)	23,955 (16%)	20%	116,867 (20%)
Partner	43,648 (13%)	61%	10,965 (12%)	15%	28,220 (12%)	17,255 (12%)	24%	71,868 (12%)
3 to 5	76,392 (22%)	55%	22,522 (24%)	16%	61,731 (26%)	39,209 (27%)	28%	138,123 (24%)
6 to 10	55,174 (16%)	54%	17,552 (19%)	17%	47,902 (20%)	30,350 (21%)	29%	103,076 (18%)
11 to 20	41,608 (12%)	57%	12,723 (14%)	17%	31,137 (13%)	18,414 (12%)	25%	72,745 (12%)
21+	49,045 (14%)	61%	13,190 (14%)	16%	31,559 (13%)	18,369 (12%)	23%	80,604 (14%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**

(continued)

Table 8 (continued)
EPs participation status by selected characteristics: January 2011–December 2012

	Not registered or attested		Registered			Attested		Total values and percents
			Registered not attested		Registered ever			
Professional characteristics	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	Count (%)
Column	A	B	C	D	E	F	G	H
Average daily patient volume per site								
0	72,375 (21%)	72%	13,929 (15%)	14%	28,445 (12%)	14,516 (10%)	14%	100,820 (17%)
1 to 49	123,601 (36%)	62%	29,163 (31%)	15%	75,380 (31%)	46,217 (31%)	23%	198,981 (34%)
50 to 99	67,222 (20%)	53%	21,867 (23%)	17%	59,139 (25%)	37,272 (25%)	29%	126,361 (22%)
100 to 199	48,711 (14%)	50%	17,979 (19%)	19%	48,159 (20%)	30,180 (20%)	31%	96,870 (17%)
200+	30,139 (9%)	50%	10,745 (11%)	18%	30,112 (12%)	19,367 (13%)	32%	60,251 (10%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**
Practice ownership								
Hospital	28,642 (8%)	60%	9,550 (10%)	20%	19,491 (8%)	9,941 (7%)	21%	48,133 (8%)
Independent practice Association (IPA)	12,525 (4%)	56%	3,317 (4%)	15%	9,947 (4%)	6,630 (4%)	30%	22,472 (4%)
Other	240,560 (70%)	60%	58,719 (63%)	15%	159,141 (66%)	100,422 (68%)	25%	399,701 (69%)
Health system	60,321 (18%)	53%	22,097 (24%)	20%	52,656 (22%)	30,559 (21%)	27%	112,977 (19%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**
Location (CMS region)								
Region 1	18,622 (5%)	53%	5,867 (6%)	17%	16,553 (7%)	10,686 (7%)	30%	35,175 (6%)
Region 2	40,711 (12%)	64%	10,170 (11%)	16%	22,806 (9%)	12,636 (9%)	20%	63,517 (11%)
Region 3	34,686 (10%)	56%	10,043 (11%)	16%	27,721 (11%)	17,678 (12%)	28%	62,407 (11%)
Region 4	63,131 (18%)	59%	17,772 (19%)	17%	44,479 (18%)	26,707 (18%)	25%	107,610 (18%)
Region 5	56,546 (17%)	54%	16,550 (18%)	16%	48,242 (20%)	31,692 (21%)	30%	104,788 (18%)
Region 6	35,735 (10%)	60%	10,315 (11%)	17%	23,894 (10%)	13,579 (9%)	23%	59,629 (10%)

(continued)

Table 8 (continued)
EPs participation status by selected characteristics: January 2011–December 2012

	Not registered or attested		Registered			Attested		Total values and percents
			Registered not attested		Registered ever			
Professional characteristics	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	Count (%)
Column	A	B	C	D	E	F	G	H
Region 7	13,822 (4%)	55%	4,007 (4%)	16%	11,538 (5%)	7,531 (5%)	30%	25,360 (4%)
Region 8	11,893 (3%)	59%	2,863 (3%)	14%	8,244 (3%)	5,381 (4%)	27%	20,137 (3%)
Region 9	51,947 (15%)	65%	12,081 (13%)	15%	27,732 (11%)	15,651 (11%)	20%	79,679 (14%)
Region 10	14,710 (4%)	60%	3,946 (4%)	16%	9,926 (4%)	5,980 (4%)	24%	24,636 (4%)
Missing	245 (0%)	71%	69 (0%)	20%	100 (0%)	31 (0%)	9%	345 (0%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**
Urban/rural								
Located in 100% urban zip code	188,480 (55%)	60%	48,760 (52%)	16%	123,169 (51%)	74,409 (50%)	24%	311,649 (53%)
Located in 90 - <100% urban zip code	67,603 (20%)	57%	17,307 (18%)	15%	51,636 (21%)	34,329 (23%)	29%	119,239 (20%)
Located in 50 - <90% urban zip code	53,604 (16%)	56%	16,104 (17%)	17%	42,777 (18%)	26,673 (18%)	28%	96,381 (17%)
Located in >0 - <50% urban zip code	8,032 (2%)	55%	2,986 (3%)	20%	6,608 (3%)	3,622 (2%)	25%	14,640 (3%)
Located in 100% rural zip code	5,703 (2%)	58%	2,367 (3%)	24%	4,146 (2%)	1,779 (1%)	18%	9,849 (2%)
Missing	18,626 (5%)	59%	6,159 (7%)	20%	12,899 (5%)	6,740 (5%)	21%	31,525 (5%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**
Primary care HPSA								
Yes (whole or part)	306,394 (90%)	59%	84,684 (90%)	16%	213,814 (89%)	129,130 (88%)	25%	520,208 (89%)
No	35,454 (10%)	56%	8,934 (10%)	14%	27,325 (11%)	18,391 (12%)	29%	62,779 (11%)
Missing	200 (0%)	68%	65 (0%)	22%	96 (0%)	31 (0%)	10%	296 (0%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**

(continued)

Table 8 (continued)
EPs participation status by selected characteristics: January 2011–December 2012

	Not registered or attested		Registered			Attested		Total values and percents
			Registered not attested		Registered ever			
Professional characteristics	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	Count (%)
Column	A	B	C	D	E	F	G	H
Dental HPSA								
Yes (whole or part)	296,380 (87%)	59%	82,094 (88%)	16%	206,476 (86%)	124,382 (84%)	25%	502,856 (86%)
No	45,468 (13%)	57%	11,524 (12%)	14%	34,663 (14%)	23,139 (16%)	29%	80,131 (14%)
Missing	200 (0%)	68%	65 (0%)	22%	96 (0%)	31 (0%)	10%	296 (0%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**
MUA								
Yes	281,942 (82%)	59%	78,242 (84%)	16%	194,759 (81%)	116,517 (79%)	24%	476,701 (82%)
No	27,209 (8%)	58%	6,675 (7%)	14%	20,006 (8%)	13,331 (9%)	28%	47,215 (8%)
Missing	32,897 (10%)	55%	8,766 (9%)	15%	26,470 (11%)	17,704 (12%)	30%	59,367 (10%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**
MUP								
Yes	130,523 (38%)	61%	32,924 (35%)	15%	85,087 (35%)	52,163 (35%)	24%	215,610 (37%)
No	178,628 (52%)	58%	51,993 (55%)	17%	129,678 (54%)	77,685 (53%)	25%	308,306 (53%)
Missing	32,897 (10%)	55%	8,766 (9%)	15%	26,470 (11%)	17,704 (12%)	30%	59,367 (10%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**
EHR adoption								
Yes	82,468 (24%)	54%	26,995 (29%)	18%	70,362 (29%)	43,367 (29%)	28%	152,830 (26%)
No	49,346 (14%)	79%	6,852 (7%)	11%	13,101 (5%)	6,249 (4%)	10%	62,447 (11%)
Missing	210,234 (61%)	57%	59,836 (64%)	16%	157,772 (65%)	97,936 (66%)	27%	368,006 (63%)
Total	**342,048 (100%)**	—	**93,683 (100%)**	—	**241,235 (100%)**	**147,552 (100%)**	—	**583,283 (100%)**

[1] A total of 87 specialties were represented in SK&A dataset; cutoff for inclusion was 10,000 across all categories—not registered, registered, attested; all specialties under 10,000 are "other."

[2] Practice size ranges based on National Ambulatory Medical Care Survey (NAMCS) survey with the exception of 11-20 and 20+ distinctions; CMS considers 20+ large; NAMCS treats 11+ as large.

The most frequent EP participants in the first 2 program years included male professionals, family practitioners and internists, those who were in practices of 3 to 10 professionals, and who treated 1 to 99 patients daily. Two-thirds of all EP attesters (66%) came from 10 specialties (Table 9, Column B subtotal) that attested at a cumulative rate of 35% (Table 9, number of attesters / number of EP specialists), compared to the 25% population average (Table 7, attested percentage). As reported in Table 8, Column F, most attesting professionals (68%) worked in practices that were not owned by hospitals or health systems—an interesting finding given recent trends in hospital acquisitions of physician practices. The majority of attesting EPs were in CMS regions 3 to 5, i.e., mid-Atlantic, southern, and midwestern states, respectively. Most attesting EPs were located in 100% urban zip codes (50%) and medically underserved areas (79%), but only 35% of attesting EPs were located in areas with medically underserved populations. We did not have sufficient data to clearly determine the most common age ranges of attesting EPs, although our limited data indicate that professionals who registered and attested most often were 40 to 59 years old and 11 to 30 years post-degree. Finally, although we have incomplete data, one-quarter or more of professionals across all participation categories reported having an EHR.

Table 9
Top 10 attesting specialist professionals in the Medicare EHR Incentive Program

Specialist	Number of attesters	Percent of all attesters (N1=147,552) (Col A/N1)	Number of EP specialists	Percent of all EPs (N2=583,283) (Col C/N2)	Percent of this specialist attesting (Col A/C)
Column	A	B	C	D	E
Family practice	27,147	18%	81,893	14%	33%
Internists	22,493	15%	63,408	11%	35%
Cardiovascular disease	10,521	7%	25,610	4%	41%
Orthopedic surgeon	8,011	5%	23,825	4%	34%
Gastroenterologists	6,218	4%	13,691	2%	45%
Podiatrists	5,521	4%	13,706	2%	40%
General surgeon	5,006	3%	18,258	3%	27%
Urologists	4,366	3%	10,687	2%	41%
Neurologists	4,109	3%	13,349	2%	31%
Oncologist/ hematologists	3,968	3%	11,135	2%	36%
Subtotal[1]	**97,360**	**66%**	**275,562**	**47%**	**—**

[1] Subtotals may not add up due to rounding.

The specialist professionals listed in Table 8, Column F may simply reflect their frequency in the general population. Therefore, it may be useful to examine these characteristics for the relative frequency of attesters and note those that differ from Column F. As shown in

Table 8, Column G, professionals that attested with higher relative frequency (attested count/total count) were ages 30 to 59, were 11 to 30 years post-degree, and were in IPAs. These professionals were also located in CMS regions 3, 4, 5, and 7 (the mid-Atlantic, southern, midwestern, and central plains states, respectively); were located in 50 to <100% urban zip code areas, and were not in primary care health professional shortage areas (HPSAs), dental HPSAs, or medically underserved areas.

Male professionals, family practitioners, and internists also constituted the largest single proportions of professionals who had neither registered nor attested—although specialists such as anesthesiologists, diagnostic radiologists, emergency medicine physicians, obstetrician/gynecologists, and psychiatrists made up more than one-quarter of nonparticipating professionals in total. Reflecting the concentration of physicians in smaller practices generally, physicians in solo practices and practices of 3 to 5 professionals were least likely to participate, and more than half of professionals practiced in sites that saw less than 50 patients daily (those who saw no patients plus those who saw 1-49 patients) (see Table 8, Column A).

As reported in Table 8, Column A, most nonparticipating EPs were owned by entities other than hospitals, IPAs, or health systems; in highly urban, medically underserved areas; in CMS regions 2, 4, 5, and 9 (New York, New Jersey, Puerto Rico, USVI, and southern, midwestern, and western states). New York was in the top four nonparticipating regions, which is potentially significant given that state's historically high investments in health IT relative to other states. Moreover, nonparticipating professionals appeared to be slightly older, between 40 to 59 years old, but still with 11 to 30 years of practice experience.

The demographics listed in Table 8, Column A in the nonparticipating cohorts may, again, simply reflect their frequency in the general population. Therefore, examining these characteristics and noting differences from Column A may be useful. Table 8, Column B shows that nonparticipating professionals with higher relative frequency (nonparticipating count / total count) were older (ages 60+); had practiced longer (31+ years post-degree); were in either solo, partners, and larger practices (20+ professionals); saw fewer patients (0 or 1 to 49 patients daily); and were in practices owned by hospitals or other (i.e., not health systems, nor IPAs). Professionals with higher relative frequency of nonparticipation were located in CMS regions 2 and 9 (New York, New Jersey, Puerto Rico, USVI, and western states, respectively); were located in 100% urban zip code areas, and were in primary care HPSAs, dental HPSAs, or medically underserved areas.

3.1.2 Eligible Hospitals and CAHs

Consistent with the Medicare EHR Incentive Program eligibility criteria, we bifurcated our hospital analysis into EHs (acute care hospitals) and CAHs. We present the results of each bifurcation below. In summary, however, we estimated a total of over 5,100 hospitals were eligible to participate in the Medicare EHR Incentive Program for the first 2 program years (Table 10). Of these, nearly two-thirds registered (includes registered only and attested), with nearly 30% attesting to Stage 1 meaningful use by the end of second program year (reporting by end of September 2012). For complete data on total hospital participation for both EHs and CAHs combined by selected characteristics, see Appendix B.

Table 10
Total hospital participation status: January 2011–September 2012

Stage 1 Meaningful Use Participation Status	Count	Percent
Not registered or attested	1,898	37%
Registered only	1,700	33%
Attested	1,506	30%
Total	**5,104**	**100%**

3.1.3 Eligible Hospitals

As detailed in Table 11, Column F, the most frequent EH attesters in the first 2 program years included medium-size hospitals (55%); not-for-profit (66%) and nonteaching hospitals (72%); and hospitals not in networks (61%). Most attesting EHs (58%) were in rural locations (i.e., located in >0 - <50% urban and 100% rural zip codes) in CMS regions 4, 5, and 6, i.e., southeastern, midwestern and south-central states, respectively. They were in primary care (73%) and dental HSPAs (68%); in medically underserved areas (64%) but not in areas with medically underserved populations. The most frequently attesting EHs also had a CMI 1.44 or greater (54%).

As reported in Table 11, Column A, the most frequent nonparticipating EHs were those with small bed size (57%); for profit (48%); nonteaching hospitals (87%); and those operating in 100% rural locations (42%). Nonparticipants had SSIs from 0.001 to 0.149 (combined rate of 52%), and were in CMS regions 4 and 6, i.e., southeastern and south-central states, respectively. As with the attesters, the nonparticipants were most frequently in primary care (71%) and dental HSPAs (69%), and in medically underserved areas (66%) but not in areas with medically underserved populations.

The hospital segments listed in both the frequently attesting and frequently nonparticipating cohorts (Table 11, Columns F and A, respectively) may only reflect their frequency in the general population. To identify where to target assistance, examining these characteristics for relative frequency (nonparticipating count / total) of nonparticipation may be useful. As noted in Table 11, Column B, EHs that did not participate with highest relative frequency were those with small bed size; for-profit hospitals, nonteaching hospitals; and hospitals operating in 100% urban locations. Other categories with high relative frequency of nonparticipation were hospitals in CMS regions 4, 6, and 9, i.e., southeastern, south-central, and western states, respectively. Finally, hospitals with SSIs from 0.15 to 0.29 and with a CMI of less than 1.25 also showed high relative frequency of nonparticipation.

Table 11
EHs (non-CAH) participation status by selected characteristics: January 2011–September 2012

Hospital characteristics (Non-CAHs)	Not registered or attested		Registered			Attested		Totals
			Registered but not attested		Registered ever			
	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	
Column	A	B	C	D	E	F	G	H
Hospital bed size								
Small (1-99 beds)	800 (57%)	54%	370 (30%)	25%	692 (29%)	322 (28%)	22%	1,492
Medium (100-399 beds)	525 (37%)	29%	680 (55%)	37%	1,315 (55%)	635 (55%)	35%	1,840
Large (400+ beds)	76 (5%)	17%	185 (15%)	41%	379 (16%)	194 (17%)	43%	455
Missing	—	—	—	—	—	—	—	—
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (100%)**	**1,151 (100%)**	—	**3,787**
Average daily Census (mean, std dev)	86 (130)	—	144 (153)	—	152 (161)	160 (169)	—	128 (154)
Average total inpatient Days (mean, std dev)	31,435 (47,786)	—	52,547 (26,056)	—	55,420 (58,944)	58,560 (61,855)	—	46,547 (56,278)
Average total Medicaid	6,659 (18,008)	—	11,909 (18,120)	—	12,434 (19,139)	13,009 (20,200)	—	10,297 (18,933)
Average total Medicare	14,436 (18,350)	—	24,490 (24,416)	—	25,749 (25,317)	27,117 (26,232)	—	21,564 (23,626)
Ownership type								
Government	149 (11%)	28%	208 (17%)	39%	386 (16%)	178 (15%)	33%	535
For profit	676 (48%)	62%	214 (17%)	19%	423 (18%)	209 (18%)	19%	1,099
Not for profit	576 (41%)	27%	813 (66%)	38%	1,577 (66%)	764 (66%)	35%	2,153
Missing	—	—	—	—	—	—	—	—
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (100%)**	**1,151 (100%)**	—	**3,787**

(continued)

Table 11 (continued)
EHs (non-CAH) participation status by selected characteristics: January 2011–September 2012

Hospital characteristics (Non-CAHs)	Not registered or attested		Registered			Attested		Totals
			Registered but not attested		Registered ever			
	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	
Column	A	B	C	D	E	F	G	H
Hospital type								
Teaching hospital	178 (13%)	22%	297 (24%)	38%	614 (26%)	317 (28%)	40%	792
Critical access hospital	0 (0%)	0%	— (0%)	—	— (0%)	0 (0%)	0%	—
Other	1,223 (87%)	41%	938 (76%)	31%	1,772 (74%)	834 (72%)	28%	2,995
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (100%)**	**1,151 (100%)**	—	**3,787**
Network membership								
Yes	173 (12%)	16%	482 (39%)	44%	921 (39%)	439 (38%)	40%	1,094
No	452 (32%)	24%	738 (60%)	39%	1,439 (60%)	701 (61%)	37%	1,891
Missing	776 (55%)	97%	15 (1%)	2%	26 (1%)	11 (1%)	1%	802
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (63%)**	**1,151 (100%)**	—	**3,787**
Urban/rural								
Located in 100% urban zip code	49 (3%)	56%	16 (1%)	18%	39 (2%)	23 (2%)	26%	88
Located in 90 - <100% urban zip code	96 (7%)	36%	88 (7%)	33%	170 (2%)	82 (7%)	31%	266
Located in 50 - <90% urban zip code	346 (25%)	30%	437 (35%)	38%	800 (7%)	363 (32%)	32%	1,146
Located in >0 - <50% urban zip code	306 (22%)	39%	256 (21%)	32%	484 (34%)	228 (20%)	29%	790
Located in 100% rural zip code	593 (42%)	41%	424 (34%)	29%	857 (20%)	433 (38%)	30%	1,450
Missing	11 (1%)	23%	14 (1%)	30%	36 (36%)	22 (2%)	47%	47
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	2,386 (63%)	**1,151 (100%)**	—	**3,787**

(continued)

Table 11 (continued)
EHs (non-CAH) participation status by selected characteristics: January 2011–September 2012

Hospital characteristics (Non-CAHs)	Not registered or attested		Registered			Attested		Totals
			Registered but not attested		Registered ever			
	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	
Column	A	B	C	D	E	F	G	H
SSI—non-CAH hospitals only								
Zero	13 (1%)	81%	1 (0%)	6%	3 (0%)	2 (0%)	13%	16
0.001 - 0.049	287 (20%)	28%	364 (29%)	35%	741 (31%)	377 (33%)	37%	1,028
0.05 - 0.149	454 (32%)	25%	692 (56%)	39%	1,329 (56%)	637 (55%)	36%	1,783
0.15 - 0.29	156 (11%)	38%	138 (11%)	34%	250 (10%)	112 (10%)	28%	406
>=0.30	33 (2%)	40%	29 (2%)	35%	50 (2%)	21 (2%)	25%	83
Missing	458 (33%)	97%	11 (1%)	2%	13 (1%)	2 (0%)	0%	471
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (100%)**	**1,151 (100%)**	—	**3,787**
Case mix indicator (CMI) – non-CAH hospitals only								
0 - <1.25	290 (21%)	35%	282 (23%)	34%	528 (22%)	246 (21%)	30%	818
1.25 - <1.44	219 (16%)	27%	316 (26%)	39%	586 (25%)	270 (23%)	34%	805
1.44 - <1.64	195 (14%)	24%	299 (24%)	37%	622 (26%)	323 (28%)	40%	817
>= 1.64	235 (17%)	27%	325 (26%)	38%	627 (26%)	302 (26%)	35%	862
Missing	462 (33%)	95%	13 (1%)	3%	23 (1%)	10 (1%)	2%	485
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (100%)**	**1,151 (100%)**	—	**3,787**

(continued)

Table 11 (continued)
EHs (non-CAH) participation status by selected characteristics: January 2011–September 2012

Hospital characteristics (Non-CAHs)	Not registered or attested		Registered			Attested		Totals
			Registered but not attested		Registered ever			
	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	
Column	A	B	C	D	E	F	G	H
Location (CMS region)								
Region 1	53 (4%)	33%	33 (3%)	21%	107 (4%)	74 (6%)	46%	160
Region 2	62 (4%)	26%	79 (6%)	34%	172 (7%)	93 (8%)	40%	234
Region 3	113 (8%)	33%	116 (9%)	34%	232 (10%)	116 (10%)	34%	345
Region 4	339 (24%)	41%	258 (21%)	31%	489 (20%)	231 (20%)	28%	828
Region 5	211 (15%)	33%	221 (18%)	35%	421 (18%)	200 (17%)	32%	632
Region 6	304 (22%)	43%	213 (17%)	30%	405 (17%)	192 (17%)	27%	709
Region 7	41 (3%)	20%	71 (6%)	35%	164 (7%)	93 (8%)	45%	205
Region 8	55 (4%)	39%	51 (4%)	36%	85 (4%)	34 (3%)	24%	140
Region 9	183 (13%)	43%	141 (11%)	33%	238 (10%)	97 (8%)	23%	421
Region 10	40 (3%)	35%	52 (4%)	46%	73 (3%)	21 (2%)	19%	113
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (100%)**	**1,151 (100%)**	—	**3,787**
Primary care HPSA								
Yes (whole or part)	999 (71%)	37%	871 (71%)	32%	1,707 (72%)	836 (73%)	31%	2,706
No	146 (10%)	32%	150 (12%)	33%	306 (13%)	156 (14%)	35%	452
Missing	256 (18%)	41%	214 (17%)	34%	373 (16%)	159 (14%)	25%	629
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (100%)**	**1,151 (100%)**	—	**3,787**

(continued)

Table 11 (continued)
EHs (non-CAH) participation status by selected characteristics: January 2011–September 2012

Hospital characteristics (Non-CAHs)	Not registered or attested		Registered			Attested		Totals
			Registered but not attested		Registered ever			
	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	
Column	A	B	C	D	E	F	G	H
Dental HPSA								
Yes (whole or part)	961 (69%)	37%	817 (66%)	32%	1,605 (67%)	788 (68%)	31%	2,566
No	184 (13%)	31%	204 (17%)	34%	408 (17%)	204 (18%)	34%	592
Missing	256 (18%)	41%	214 (17%)	34%	373 (16%)	159 (14%)	25%	629
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (100%)**	**1,151 (100%)**	—	**3,787**
Medically underserved area (MUA)								
Yes	922 (66%)	38%	783 (63%)	32%	1,524 (64%)	741 (64%)	30%	2,446
No	104 (7%)	35%	97 (8%)	33%	193 (8%)	96 (8%)	32%	297
Missing	375 (27%)	36%	355 (29%)	34%	669 (28%)	314 (27%)	30%	1,044
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (100%)**	**1,151 (100%)**	—	**3,787**
Medically underserved population (MUP)								
Yes	332 (24%)	38%	269 (22%)	31%	543 (23%)	274 (24%)	31%	875
No	694 (50%)	37%	611 (49%)	33%	1,174 (49%)	563 (49%)	30%	1,868
Missing	375 (27%)	36%	355 (29%)	34%	669 (28%)	314 (27%)	30%	1,044
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (100%)**	**1,151 (100%)**	—	**3,787**
EHR adoption								
Yes	325 (23%)	20%	589 (48%)	36%	1,300 (54%)	711 (62%)	44%	1,625
No	1076 (77%)	50%	646 (52%)	30%	1,086 (46%)	440 (38%)	20%	2,162
Total	**1,401 (100%)**	—	**1,235 (100%)**	—	**2,386 (100%)**	**1,151 (100%)**	—	**3,787**

3.1.4 Critical Access Hospitals

During the first 2 program years, a little over one quarter of CAHs attested to Stage 1 meaningful use. As presented in Table 12, Column F, the most frequent CAH attesters in the first 2 program years included small bed size (95%); not-for-profit and government (non-federal) hospitals (98%); hospitals not in networks (62%); and those located in 50 to <90% urban zip code areas (52%). Most CAH attesters were in CMS regions 5 and 7, i.e., midwestern and central plains states, respectively. As with EHs, the frequent CAH attesters were in primary care (79%) and dental HSPAs (66%), and were in medically underserved areas (66%) but not in areas with medically underserved populations.

The most frequent nonparticipating CAH hospitals were those with small bed size (97%); not-for-profit (50%) and government hospitals (43%); nonteaching hospitals (100%); and those operating in 100% urban and 50 to <90% urban locations (44% and 40%, respectively); in CMS regions 5 and 7, i.e., midwestern and central plains states, respectively. As with the attesters, the nonparticipants were most frequently in primary care (81%) and dental HSPAs (68%), and were in medically underserved areas (67%) but not in areas with medically underserved populations.

As mentioned above, examining these characteristics for relative frequency of nonparticipation may be useful. As shown in Table 12, Column B, CAH hospitals that demonstrated highest relative frequency of nonparticipation were for-profit and government hospitals; hospitals operating in >0 to <50% urban zip codes locations; and hospitals in CMS regions 4, 9, and 10, i.e., southeastern, western and pacific northwest states, respectively.

Table 12
CAH participation status by selected characteristics: January 2011–September 2012

Hospital characteristics (CAHs)	Not registered or attested		Registered			Attested		Totals
			Registered but not attested		Registered ever			
	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	
Column	A	B	C	D	E	F	G	H
Hospital bed size								
Small (1-99 beds)	480 (97%)	38%	439 (94%)	35%	778 (95%)	339 (95%)	27%	1,258
Medium (100-399 beds)	17 (3%)	29%	26 (6%)	44%	42 (5%)	16 (5%)	27%	59
Large (400+ beds)	— (0%)	—	— (0%)	—	— (0%)	— (0%)	—	—
Missing	—	—	—	—	—	—	—	—
Total	**497 (100%)**	—	**465 (100%)**	—	**820 (100%)**	**355 (100%)**	—	**1,317**
Average daily census (mean, std dev)	19 (21)	—	20 (28)	—	19 (26)	19 (24)	—	19 (24)
Average total inpatient days (mean, std dev)	6,763 (7,822)	—	7,221 (10,039)	—	7,106 (9,456)	6,957 (8,643)	—	6,977 (8,873)
Average total Medicaid	2,049 (3,815)	—	2,739 (6,254)	—	2,645 (5,905)	2,521 (5,421)	—	2,420 (5,222)
Average total Medicare	2,493 (2,693)	—	2,332 (2,294)	—	2,226 (2,026)	2,087 (1,602)	—	2,327 (2,303)
Ownership type								
Government	216 (43%)	40%	161 (35%)	29%	330 (40%)	169 (48%)	31%	546
For profit	34 (7%)	48%	27 (6%)	38%	37 (5%)	10 (3%)	14%	71
Not for profit	247 (50%)	35%	277 (60%)	40%	453 (55%)	176 (50%)	25%	700
Missing	—	—	—	—	—	—	—	—
Total	**497 (100%)**	—	**465 (100%)**	—	**820 (100%)**	**355 (100%)**	—	**1,317**

(continued)

Table 12 (continued)
CAH participation status by selected characteristics: January 2011–September 2012

	Not registered or attested		Registered					
			Registered but not attested		Registered ever	Attested		
Hospital characteristics (CAHs)	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	Totals
Column	A	B	C	D	E	F	G	H
Hospital type								
Critical access hospital	497 (100%)	38%	465 (100%)	35%	820 (100%)	355 (100%)	27%	1,317
Other	0 (0%)	0%	0 (0%)	0%	— (0%)	0 (0%)	0%	—
Total	**497 (100%)**	—	**465 (100%)**	—	**820 (100%)**	**355 (100%)**	—	**1,317**
Network membership								
Yes	104 (21%)	23%	208 (45%)	47%	341 (42%)	133 (37%)	30%	445
No	134 (27%)	22%	257 (55%)	42%	476 (58%)	219 (62%)	36%	610
Missing	259 (52%)	99%	0 (0%)	0%	3 (0%)	3 (1%)	1%	262
Total	**497 (100%)**	—	**465 (100%)**	—	**820 (100%)**	**355 (100%)**	—	**1,317**
Urban/rural								
Located in 100% urban zip code	220 (44%)	47%	141 (30%)	30%	252 (31%)	111 (31%)	24%	472
Located in 90 - <100% urban zip code	61 (12%)	30%	93 (20%)	46%	143 (17%)	50 (14%)	25%	204
Located in 50 - <90% urban zip code	201 (40%)	33%	223 (48%)	37%	408 (50%)	185 (52%)	30%	609
Located in >0 - <50% urban zip code	14 (3%)	50%	7 (2%)	25%	14 (2%)	7 (2%)	25%	28
Located in 100% rural zip code	1 (0%)	33%	1 (0%)	33%	2 (0%)	1 (0%)	33%	3
Missing	— (0%)	—	0 (0%)	0%	1 (0%)	1 (0%)	100%	1
Total	**497 (100%)**	—	**465 (100%)**	—	**820 (100%)**	**355 (100%)**	—	**1,317**

(continued)

Table 12 (continued)
CAH participation status by selected characteristics: January 2011–September 2012

			Registered					
	Not registered or attested		Registered but not attested		Registered ever	Attested		
Hospital characteristics (CAHs)	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	Totals
Column	A	B	C	D	E	F	G	H
Location (CMS region)								
Region 1	8 (2%)	20%	16 (3%)	40%	32 (4%)	16 (5%)	40%	40
Region 2	5 (1%)	38%	6 (1%)	46%	8 (1%)	2 (1%)	15%	13
Region 3	10 (2%)	26%	16 (3%)	42%	28 (3%)	12 (3%)	32%	38
Region 4	76 (15%)	51%	39 (8%)	26%	74 (9%)	35 (10%)	23%	150
Region 5	97 (20%)	34%	97 (21%)	34%	192 (23%)	95 (27%)	33%	289
Region 6	51 (10%)	28%	80 (17%)	44%	129 (16%)	49 (14%)	27%	180
Region 7	89 (18%)	33%	97 (21%)	36%	177 (22%)	80 (23%)	30%	266
Region 8	74 (15%)	43%	67 (14%)	39%	100 (12%)	33 (9%)	19%	174
Region 9	35 (7%)	55%	20 (4%)	31%	29 (4%)	9 (3%)	14%	64
Region 10	52 (10%)	50%	27 (6%)	26%	51 (6%)	24 (7%)	23%	103
Total	**497 (100%)**	—	**465 (100%)**	—	**820 (100%)**	**355 (100%)**	—	**1,317**
Primary Care HPSA								
Yes (whole or part)	404 (81%)	39%	364 (78%)	35%	644 (79%)	280 (79%)	27%	1,048
No	51 (10%)	33%	53 (11%)	34%	103 (13%)	50 (14%)	32%	154
Missing	42 (8%)	37%	48 (10%)	42%	73 (9%)	25 (7%)	22%	115
Total	**497 (100%)**	—	**465 (100%)**	—	**820 (100%)**	**355 (100%)**	—	**1,317**
Dental HPSA								
Yes (whole or part)	337 (68%)	39%	295 (63%)	34%	528 (64%)	233 (66%)	27%	865
No	118 (24%)	35%	122 (26%)	36%	219 (27%)	97 (27%)	29%	337
Missing	42 (8%)	37%	48 (10%)	42%	73 (9%)	25 (7%)	22%	115
Total	**497 (100%)**	—	**465 (100%)**	—	**820 (100%)**	**355 (100%)**	—	**1,317**

(continued)

Table 12 (continued)
CAH participation status by selected characteristics: January 2011–September 2012

	Not registered or attested		Registered			Attested		
			Registered but not attested		Registered ever			
Hospital characteristics (CAHs)	Count (%)	Rel. freq.	Count (%)	Rel. freq.	Count (%)	Count (%)	Rel. freq.	Totals
Column	A	B	C	D	E	F	G	H
Medically underserved area (MUA)								
Yes	335 (67%)	38%	307 (66%)	35%	542 (66%)	235 (66%)	27%	877
No	45 (9%)	39%	29 (6%)	25%	69 (8%)	40 (11%)	35%	114
Missing	117 (24%)	36%	129 (28%)	40%	209 (25%)	80 (23%)	25%	326
Total	**497 (100%)**	—	**465 (100%)**	—	**820 (100%)**	**355 (100%)**	—	**1,317**
Medically underserved population (MUP)								
Yes	67 (13%)	39%	50 (11%)	29%	105 (13%)	55 (15%)	32%	172
No	313 (63%)	38%	286 (62%)	35%	506 (62%)	220 (62%)	27%	819
Missing	117 (24%)	36%	129 (28%)	40%	209 (25%)	80 (23%)	25%	326
Total	**497 (100%)**	—	**465 (100%)**	—	**820 (100%)**	**355 (100%)**	—	**1,317**
EHR adoption								
Yes	146 (29%)	26%	190 (41%)	34%	417 (51%)	227 (64%)	40%	563
No	351 (71%)	47%	275 (59%)	36%	403 (49%)	128 (36%)	17%	754
Total	**497 (100%)**	—	**465 (100%)**	—	**820 (100%)**	**355 (100%)**	—	**1,317**

3.1.5 Beneficiary Characteristics

To understand the characteristics of Medicare beneficiaries in areas where EPs, EHs, and CAHs are located, and to determine if there was any association between beneficiary characteristics and Medicare EHR Incentive Program participation, we examined data on 100% of the Medicare beneficiary population across a range of demographic and disease characteristics (Table 13). To better understand the geographic distribution of these characteristics, we also segmented these data by CMS regions, as reported in Appendix A.

Table 13
Characteristics of Medicare beneficiaries

Beneficiary characteristics	Total values and percents[1]	
	Count	Percent
Gender		
Male	25,528,300	45%
Female	30,617,428	55%
Total	**56,145,728**	**100%**
Disabled		
No	42,236,533	75%
Yes	13,909,195	25%
Total	**56,145,728**	**100%**
Age		
59 under	7,776,651	14%
60–64	6,132,544	11%
65–74	22,135,690	39%
75–84	13,551,403	24%
85 over	6,549,440	12%
Total	**56,145,728**	**100%**
Race		
0=UNKNOWN	294,240	1%
1=WHITE	45,996,427	82%
2=BLACK	5,842,171	10%
3=OTHER	1,167,813	2%
4=ASIAN	1,151,868	2%
5=HISPANIC	1,450,632	3%
6=NORTH AMERICAN NATIVE	242,033	0%
Missing	544	0%

(continued)

Table 13 (continued)
Characteristics of Medicare beneficiaries

Beneficiary characteristics	Total values and percents[1]	
	Count	Percent
Disease burden (HCCs)		
Diabetes without complication	7,227,850	13%
Chronic obstructive pulmonary disease	6,398,689	11%
Vascular disease	6,329,271	11%
Specified heart arrhythmias	6,069,894	11%
Congestive heart failure	6,010,651	11%
Renal failure	5,228,569	9%
Breast, prostate, colorectal, and other cancers and tumors	3,372,667	6%
Polyneuropathy	3,032,113	5%
Major depressive, bipolar, and paranoid disorders	2,572,435	5%
Angina pectoris/old myocardial infarction	2,492,876	4%
Risk score		
1st decile (0.120 – 0.328)	6,083,066	11%
2nd decile (>0.328 – 0.413)	4,369,752	8%
3rd decile (>0.413 – 0.530)	3,914,660	7%
4th decile (>0.530 – 0.647)	4,465,930	8%
5th decile (>0.647 – 0.807)	4,706,895	8%
6th decile (>0.807 – 1.011)	4,705,510	8%
7th decile (>1.011 – 1.304)	4,694,535	8%
8th decile (>1.304 – 1.766)	4,708,178	8%
9th decile (>1.766 – 2.721)	4,701,980	8%
10th decile (>2.721 – 24.162)	4,704,386	8%
Missing	9,090,836	16%
Total	**56,145,728**	**100%**

[1] Note that the discrepancy between the total counts by CMI region and the overall total is due to missing location values for some beneficiaries.

Beneficiaries were most frequently females aged 65 to 84; their concentration varied widely across the CMS regions. This population was predominantly white and was most frequently not handicapped. More than half of the beneficiaries had one, and often more than one, of five chronic diseases or conditions. Disease burden, as measured by HCCs, fell unequally on the regions, but regions 2 and 4 had the highest level of disease burden for five categories (Table 14), while regions 8 and 10 had the lowest levels (Table 15). Similarly, risk scores showed large regional differences with geographic and urban versus rural variation.

Table 14
CMS regions with highest disease burdens

Disease burdens	CMS regions	Percent burden
Diabetes without complication	4	15%
Chronic obstructive pulmonary disease	4	13%
Vascular disease	2	15%
Specified heart arrhythmias	1,3	12%
Congestive heart failure	2,6	12%
Renal failure	9	11%
Breast, prostate, colorectal, and other cancers and tumors	1,2,3	7%
Poly-neuropathy	2,4,6,9	6%
Major depressive, bipolar, and paranoid disorders	1	6%
Angina pectoris/old myocardial infarction	2,4,6,9	5%

Table 15
CMS regions with lowest disease burdens

Disease burdens	CMS regions	Percent burden
Diabetes without complication	9	10%
Chronic obstructive pulmonary disease	8,10	9%
Vascular disease	10	7%
Specified heart arrhythmias	8	9%
Congestive heart failure	10	8%
Renal failure	1,2,8,10	8%
Breast, prostate, colorectal, and other cancers and tumors	6,8,9,10	5%
Poly-neuropathy	1	4%
Major depressive, bipolar, and paranoid disorders	3,5,6,7,8,10	4%
Angina pectoris/old myocardial infarction	8,10	3%

3.2 Regression Model Results

To identify which characteristics could help explain participation and nonparticipation in the Medicare EHR Incentive Program, we developed a series of regression models. These models include data on professional, hospital and beneficiary characteristics as outlined in Methods section.

3.2.1 EP Regression Results

The EP regression models predict registration and attestation for all professionals and include data on 100% of Medicare beneficiaries. The first model assesses the effects of characteristics on a professional moving from eligible (but nonparticipating) to registered; the second model assesses professionals moving from registration to attestation. Each EP model includes the independent variables shown in Table 16; dependent variables are registration and attestation status. Reference variables and complete odds ratios including confidence intervals for the EP registration and attestation model are included in Appendix C.

Table 16
Independent variables included in the EP regression analysis

Parameter	Definition	Specification
Gender	Professional who was female or male	Indicator variable (0 – 1)
Medically underserved area	Professional who is in a medically underserved area	Indicator variable (0 – 1)
Medically underserved population	Professional who serves a medically underserved population	Indicator variable (0 – 1)
Primary care	Professional who identified as a primary care physician: Family practitioner, Internist, and Pediatrician	Indicator variable (0 – 1)
Specialist with patient contact	Professional who identified as a specialist that had regular contact with patients: anesthesiologist, cardiologist, dermatologist, emergency medicine specialist, gastroenterologist, general surgeon, nephrologist, neurologist, obstetrician/gynecologist, oncologist/hematologist, ophthalmologist, orthopedic surgeon, otolaryngologist, podiatrist, psychiatrist, urologist	Indicator variable (0 – 1)
Specialist without patient contact	Professional who identified as a specialist who did not have regular contact with patients: diagnostic radiologist	Indicator variable (0 – 1)
Hospital owned	Professional or practice owned by a hospital	Indicator variable (0 – 1)
Independent ownership	Professional or practice that is self-owned	Indicator variable (0 – 1)
System ownership	Professional or practice that is part of a larger health care system	Indicator variable (0 – 1)
Rural percent	Percentage of people in rural communities by the zip code of the hospital	Continuous variable (0 – 100%)

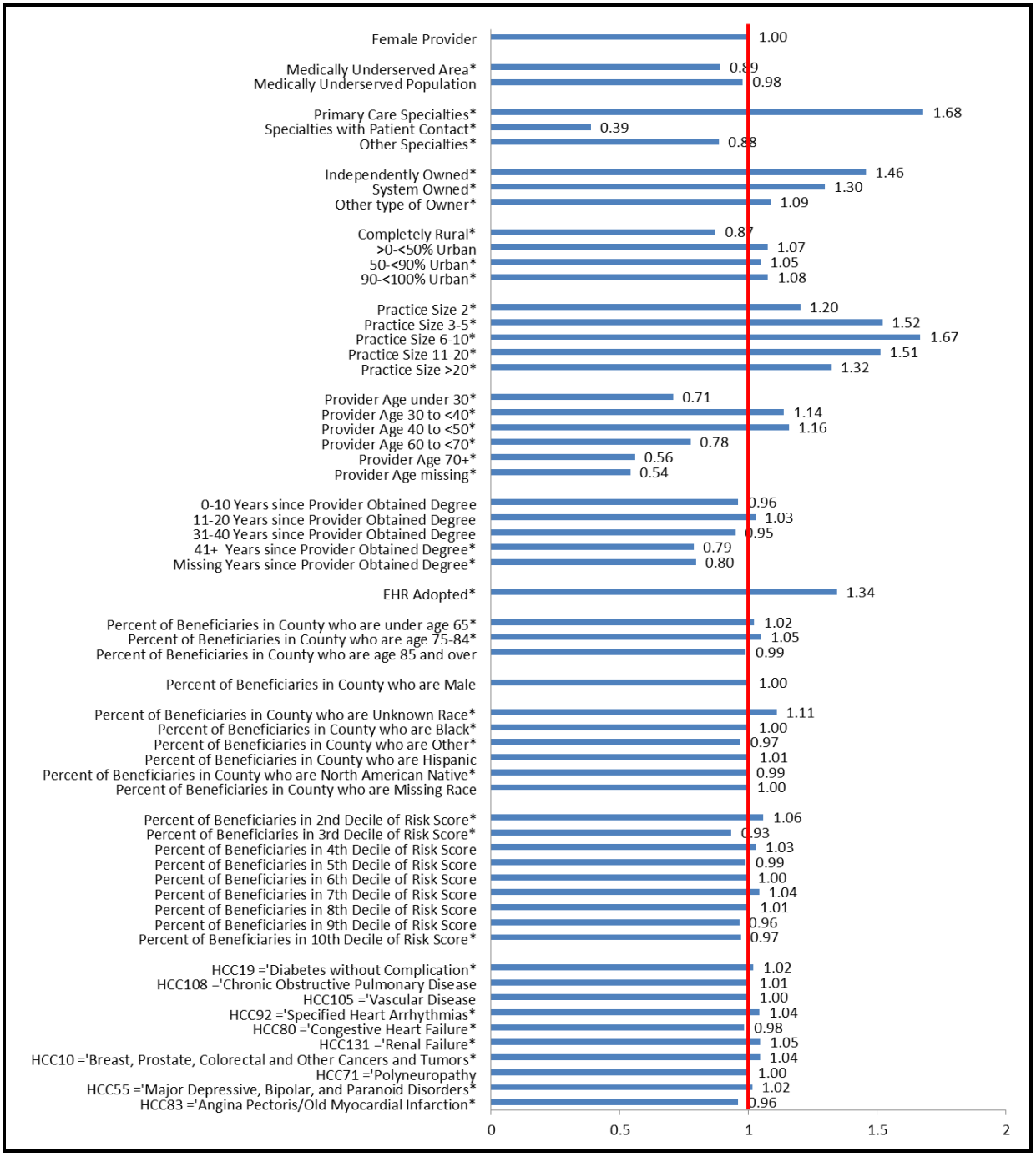
(continued)

Table 16 (continued)
Independent variables included in the EP regression analysis

Parameter	Definition	Specification
Patient volume	Number of patients seen	Continuous variable (no limit)
EHR adoption	Professional indicated they adopted an EHR	Indicator variable (0 – 1)
Professional age	Age of the professional, put into several categories: Professional aged 20–29, professional aged 30–39, Professional aged 40–49, professional aged 50–59, Professional aged 60–69, professional aged 70–79, Professional aged 80–89, and professional aged over 90	Indicator variable (0 – 1)
Years since degree	Number of years since a professional received their medical degree	Continuous variable (no limit)
Beneficiary age	Percentage of the county population in one of four age categories: percent of beneficiaries in county who are aged 85 and over; percent of beneficiaries in county who are aged 75-84; percent of beneficiaries in county who are aged 65-74; and percent of beneficiaries in county who are under age 65	Continuous variable (0 – 100%)
Beneficiary gender	Percentage of the county population that are male	Continuous variable (0 – 100%)
Beneficiary race	Percentage of the county population in one of seven categories: percent of beneficiaries in county who are missing race; percent of beneficiaries in county who are white; percent of beneficiaries in county who are North American Native; percent of beneficiaries in county who are Hispanic; percent of beneficiaries in county who are other; percent of beneficiaries in county who are black; and percent of beneficiaries in county who are unknown race	Continuous variable (0 – 100%)
Beneficiary risk score	Percentage of the county population in one of 10 deciles of risk score	Continuous variable (0 – 100%)
Beneficiary disease burden	Percentage of the county population in one of the top ten disease/condition types: HCC83 =‘angina pectoris/old myocardial infarction; HCC55 =‘major depressive, bipolar, and paranoid disorders; HCC71 =‘polyneuropathy; HCC10 =‘breast, prostate, colorectal and other cancers and tumors; HCC131 =‘renal failure; HCC80 =‘congestive heart failure; HCC92 =‘specified heart arrhythmias; HCC105 =‘vascular disease; HCC108 =‘chronic obstructive pulmonary disease; and HCC19 =‘diabetes without complication	Continuous variable (0 – 100%)

This regression included 583,283 EPs. Figure 2 shows the results of the regression on what factors predicted whether an EP will register for the Medicare EHR Incentive Program. All results are reported as odds ratios, with significant results (p-value of 0.0001) indicated by an asterisk. Reference levels such as 100% Urban are excluded from odds ratios in Figures 2 - 7. See Appendix C for reference variables used in the regression analysis.

Figure 2
Odds ratios for registered EPs



NOTE: (*) indicates significant result.

The model results indicate that professionals in a medically underserved area; specialists without patient contact; rural professionals; professionals under ages 30 or over 60; and professionals who obtained their medical degree 41 or more years ago were *less likely* to register for the Medicare EHR Incentive Program. The likelihood of professionals registering if they were specialists or were aged 70 and older was particularly low relative to other characteristics.

Conversely, the model indicated that EPs with one of the following characteristics was *more likely* to register: between ages 30 to 50, in an urban area, and who had previously adopted an EHR. Two variables—practice ownership and practice size—were predictive of registration for all subcategories (i.e., all ownership types and all practice sizes): professionals in independently owned practices and in practices of 6 to 10 professionals were most likely to register.

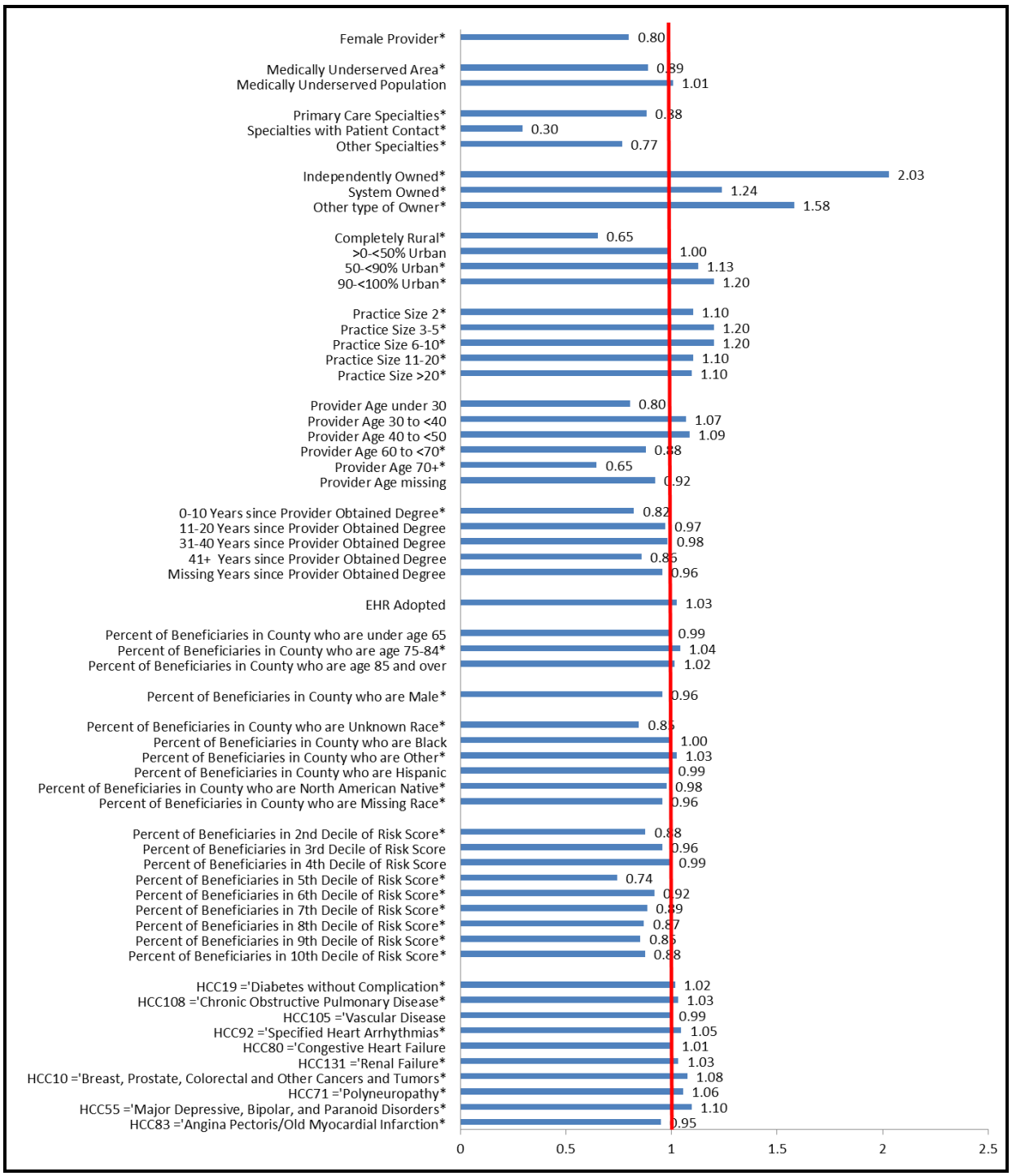
Regarding beneficiary characteristics (age, race, gender, risk scores, and HCCs), several variables were significant but usually with *small to very small effects*. Odds ratios for significant variables typically fell into a range of 0.95 to 1.05, with a few exceptions outside this range noted below. We believe that the general *significance* across many variables was due to the very large datasets modeled (over 550,000 professionals). Given the small effects observed, however, many of these variables are likely not very *important* in terms of explaining EPs' participation or nonparticipation in the Medicare EHR Incentive Program. A few variables were significant for participation and nonparticipation alike, and fell outside the 0.95 to 1.05 range; we discuss these below.

For example, beneficiaries in the third decile of the risk score category were associated with a 7% *less* likelihood of registration, whereas beneficiaries in the second decile of the risk score category were associated with a 6% *greater* likelihood of registration. The largest positive effect on registration was for the Race: Unknown variable, which indicated the professionals located in counties with beneficiaries who shared this characteristic had an 11% greater likelihood of registering.

Disease burden as defined by HCCs was significant, but to a small extent. Almost all HCCs were either positively or negatively predictive of registration, but none were more or less predictive than 5%.

Figure 3 shows the results of the regression model on what factors predict whether or not an EP will attest to Stage 1 meaningful use, once registered. All results are reported as odds ratios, with significant results (p-value of 0.0001) indicated by an asterisk.

Figure 3
Odds ratios for attested EPs



NOTE: (*) indicates significant result.

The model results indicate that female professionals; professionals in a medically underserved area; all professional types (primary care and specialists); rural professionals; professionals 60 years old and older; and professionals who obtained their medical degree between 0-10 years ago were *less likely* to attest for the Medicare EHR Incentive Program, once registered. The likelihood of professionals attesting if they are specialists without patient contact—70% less likely—was particularly low relative to other characteristics.

Conversely, the model indicated that a professional in an urban area was *more likely* to attest. As with the registration model, two variables—practice ownership and practice size—were predictive of attestation for all subcategories (i.e., all ownership types and all practice sizes), with professionals in independently owned practices and practices of 3 to 10 professionals most likely to attest. For practice size, all practices that had more than one professional had a greater likelihood of attesting than solo practices.

Odds ratios for significant variables in the EP attestation model typically fell into a range of 0.95 to 1.05 as well, with a few exceptions outside this range. For example, the Race: Unknown variable was observed to indicate *more likelihood* of EP registration, but *less likelihood* of attestation. Also, we observed one possible trend: higher decile risk scores (i.e., greater risk) were often associated with *lower likelihood* of attestation. Finally, as with the EP registration model, HCCs did not appear to be strongly predictive of either less or more EP participation; the largest HCC odds ratio we found was for HCC55 (Depression − OR = 1.10), associated with an increased likelihood of EP attestation.

3.2.2 EH and CAH Regression Model Results

The EH and CAH regression models predict registration and attestation for all EHs and CAHs, and include data on 100% of Medicare beneficiaries. The first model for EH and CAHs, respectively, assesses the effects of characteristics on moving from eligible (but nonparticipating) to registered; whereas the second model assesses moving from registration to attestation. Each model includes the independent variables shown in Table 17; dependent variables are registration and attestation status. Reference variables and complete odds ratios including confidence intervals for the EH and CAH registration and attestation model are included in Appendix D.

As discussed in the Methods sections, we included two additional variables in the EH regression models: CMI and SSI. These variables are not available for CAHs. Table 17 contains the definitions of each of the variables used in the EH and CAH models.

Table 17
Variables included in the hospital regression models

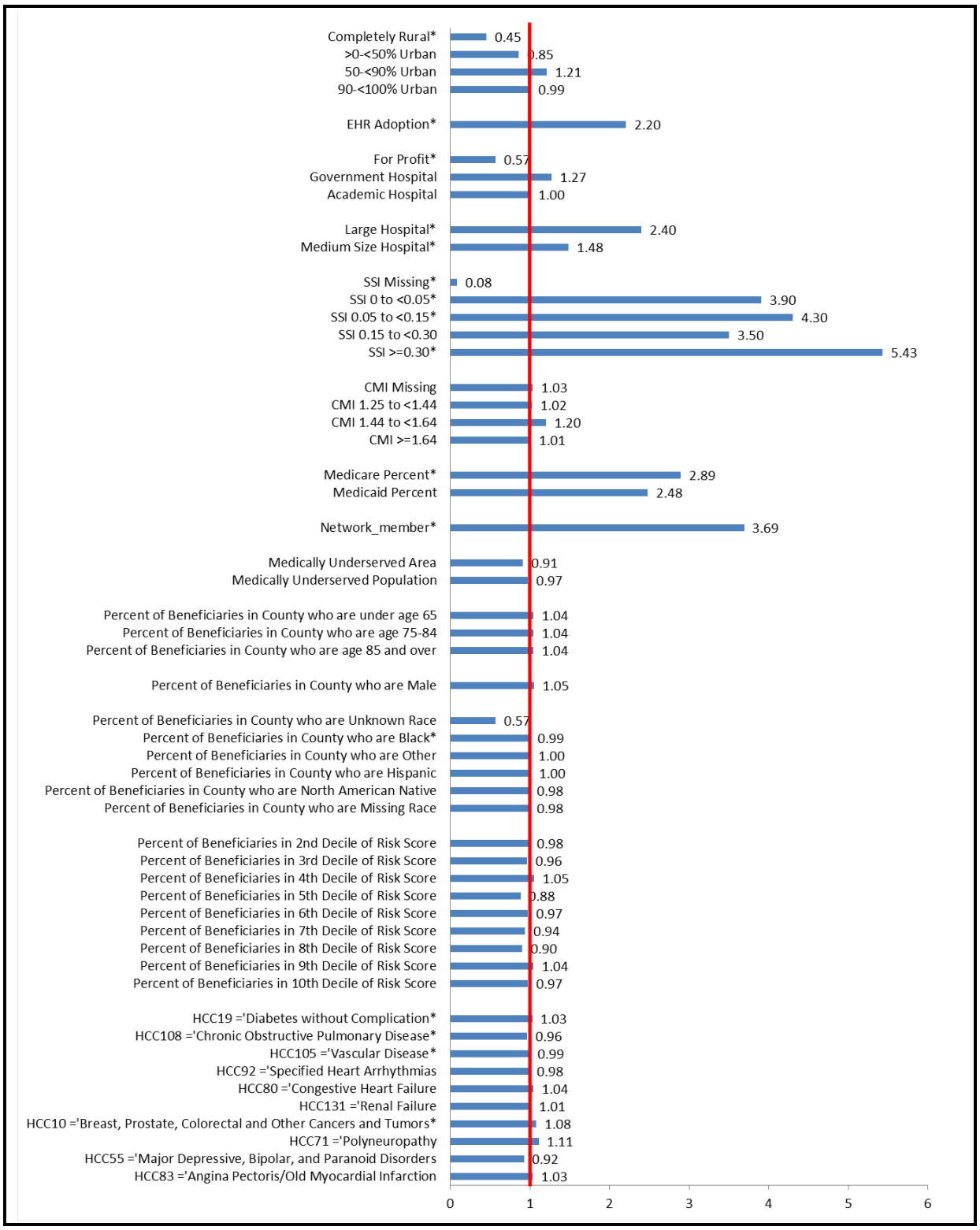
Parameter	Definition	Specification
Percent rural	Percentage of people in rural communities by the zip code of the hospital	Indicator variable with 5 categories (100% rural as the reference group)
Large hospital	Hospital with over 300 beds	Indicator variable (0 – 1)
Medium hospital	Hospital with between 100 and 300 beds	Indicator variable (0 – 1)
EHR adoption	Hospital that has adopted an EHR	Indicator variable (0 – 1)
For-profit hospital	Hospital that has a for-profit ownership type	Indicator variable (0 – 1)
Government-owned hospital	Hospital that has a government ownership type	Indicator variable (0 – 1)
Academic hospital	Hospital that has a residency program	Indicator variable (0 – 1)
Percentage of bed-days for Medicare patients	Percentage of bed-days that were reimbursed by Medicare	Continuous variable (0 – 100%)
Percentage of bed-days for Medicaid patient	Percentage of bed-days that were reimbursed by Medicaid	Continuous variable (0 – 100%)
Network member	Hospital that is part of a larger network of hospitals and/or professionals	Indicator variable (0 – 1)
Medically underserved area	Hospital that is in a medically underserved area	Indicator variable (0 – 1)
Medically underserved population	Hospital that is in a medically underserved population	Indicator variable (0 – 1)
SSI ratio (EH model only)	Ratio of total patient days for patients with supplemental security income to total patient days for Medicare, use to determine is the hospital is a disproportionate share hospital	Indicator variable with 5 categories (100% rural as the reference group)
CMI (EH model only)	Case mix index, used to determine the allocation of resources to care for and/or treat the patients in the group	Indicator variable with 4 categories (100% rural as the reference group)

In the following section we report model results for EHs (first by registration, then attestation), and then for CAHs (by registration and attestation).

3.2.2.1 EH Regression Model Results

This regression included 3,787 hospitals. Figure 4 shows the results of the regression on what factors predict whether or not an EH will register for the Medicare EHR Incentive Program. All results are reported as odds ratios, with significant results (*p*-value of 0.05) indicated by an asterisk.

Figure 4
Odds ratios for eligible (non-CAH) hospital registration



NOTE: (*) indicates significant result.

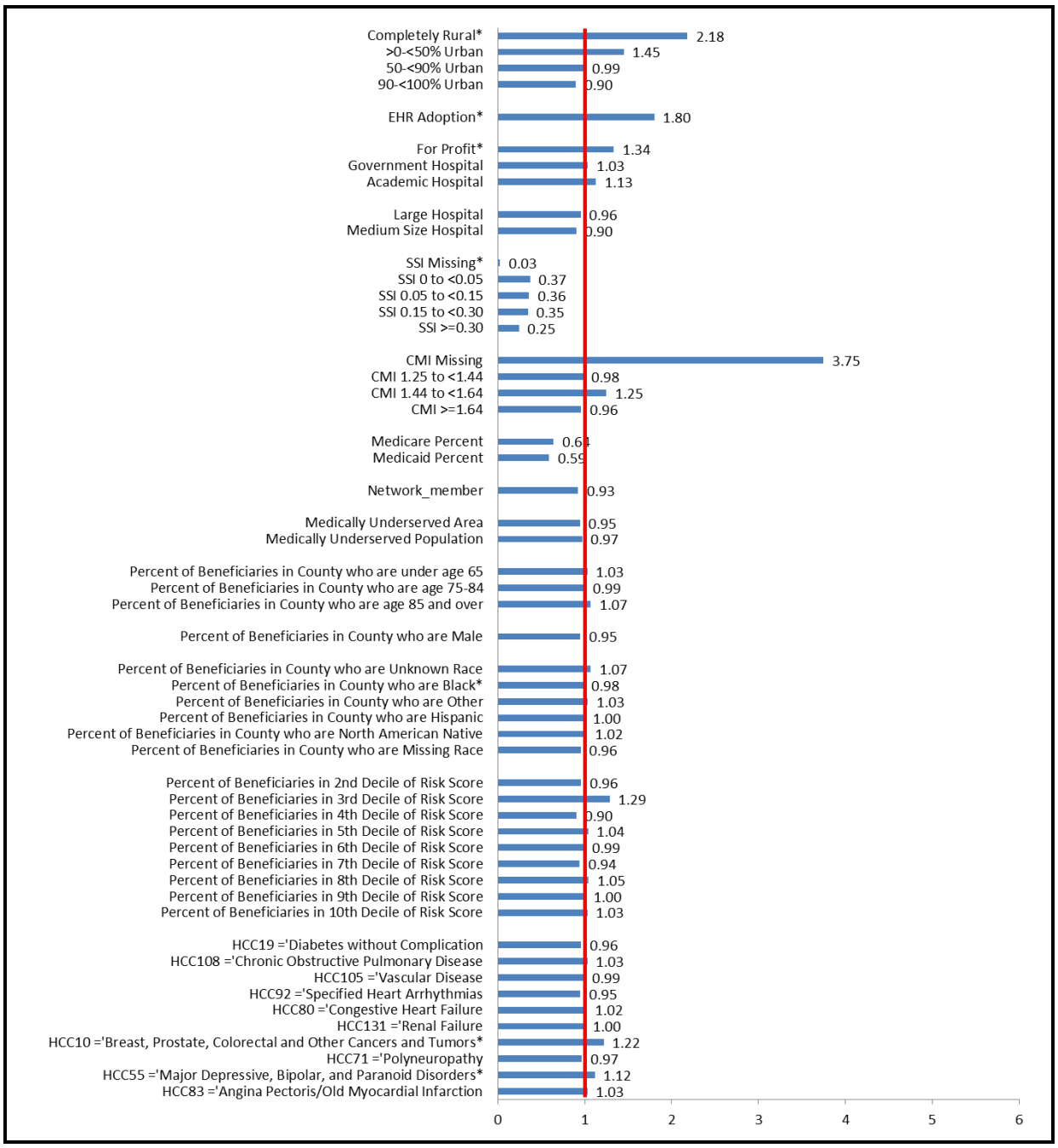
EHs in completely rural settings and in for-profit hospitals were significantly *less likely* to register. A missing SSI was associated with a very high likelihood (92%) that an EH did not register for the Medicare EHR Incentive Program.

Conversely, EHs with prior adoption of an EHR that cared for beneficiaries with an SSI of less than 0.15, were in a large to medium-sized hospital, and saw a relatively greater proportion of Medicare patients were *more likely* to register. The most highly predictive variables were being a network member (over 3 times more likely to register) and seeing beneficiaries with an SSI of 0.30 or greater (over 5 times more likely to register). This finding is potentially very positive, because hospitals that serve relatively lower-income beneficiaries were more likely to register.

As with the EP models, we included hospital characteristics and beneficiary characteristics (age, gender, race, risk scores, top 10 HCCs) and modeled CAH and CAH hospitals separately. For EHs, very few beneficiary variables were significant for registration. Variables that were significant, such as Race: Black, HCCs for diabetes, COPD and vascular disease, had very small effect sizes: all within the range of odds ratios 0.95–1.05. The HCC for breast, prostate, colorectal, and other cancers was most predictive: hospitals operating in counties that had beneficiaries with this diagnosis had an 8% greater likelihood of registering.

We also modeled the results of hospital and beneficiary characteristics on EH attestation. Figure 5 shows the results of the regression on what factors predicted whether an EH will attest to Stage 1 meaningful use, once registered. All results are reported as odds ratios, with significant results (*p*-value of 0.05) indicated by an asterisk.

Figure 5
Odds ratios for eligible (non-CAH) hospital attestation



NOTE: (*) indicates significant result.

For EHs, a missing SSI was the only variable associated with a decreased likelihood of attesting, once registered. Although the effect of this variable was quite pronounced—it was associated with a 97% lower chance of attestation—it may not be particularly meaningful, as the number of EHs with a missing SSI was very low (n =2).

Being a located in a rural area, prior EHR adoption, and being a for-profit hospital were associated with an increased likelihood of EHs attesting to Stage 1 meaningful use, once registered.

For beneficiary characteristics, only one variable was significantly associated with EHs being *less likely* to attest. EHs with a relatively higher proportion of beneficiaries in a county who reported their race as Black had a slight (2%) decreased likelihood of attesting. On the other hand, two HCCs were associated with an increased likelihood of EH attestation. EHs in counties whose beneficiaries had a diagnosis of breast, prostate, colorectal, and other cancers (HCC10) had an over 20% *greater likelihood* of attesting, whereas those with depressive disorders (HCC55) had a 12% increase.

3.2.2.2 CAH Regression Model Results

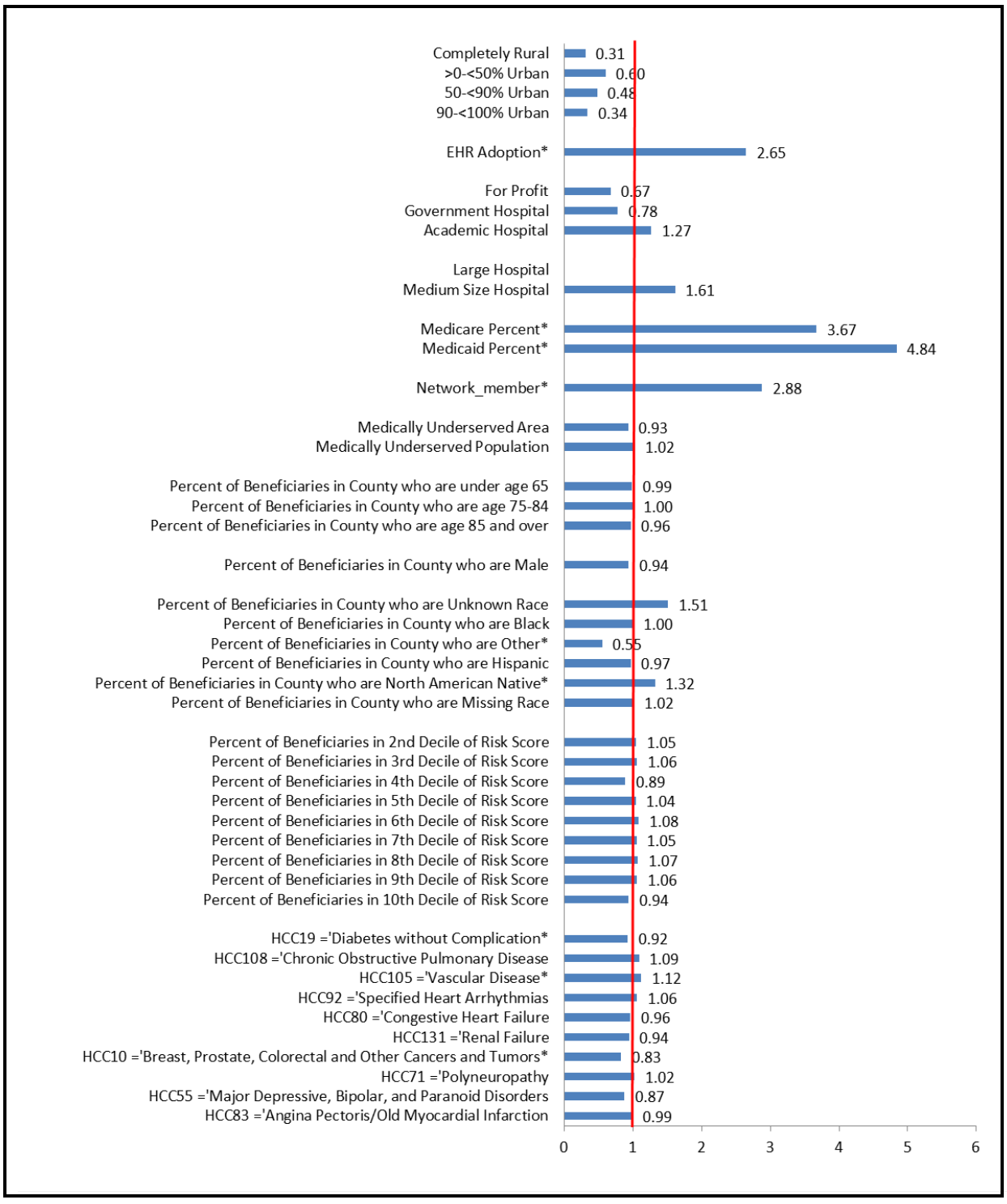
A total of 1,317 hospitals were included in this regression. Figure 6 shows the results of the regression analysis on what factors predicted whether or not a CAH registered for the Medicare EHR Incentive Program. All results are reported as odds ratios, with significant results (*p*-value of 0.05) indicated by an asterisk.

CAHs with a relatively greater proportion of patients whose race was identified as Other and CAHs that treated a relatively greater proportion of diabetes patients without complication (HCC19) and beneficiaries with cancer (HCC10) were *less likely* to register.

Conversely, CAHs with prior adoption of an EHR, that were network members, and that treated a relatively greater proportion of vascular disease patients (HCC105) were *more likely* to register. The most highly predictive variable was seeing a relatively greater proportion of Medicare (over 3 times more likely to register) or Medicaid patients (over 4 times more likely to register).

For CAHs, several beneficiary variables were significant for registration. Race: Other was most predictive with a 45% greater likelihood of not registering, whereas the HCC for vascular disease was predictive, with hospitals operating in counties that had beneficiaries with this diagnosis had a 12% greater likelihood of registering.

Figure 6
Odds ratios CAH registration



NOTE: (*) indicates significant result.

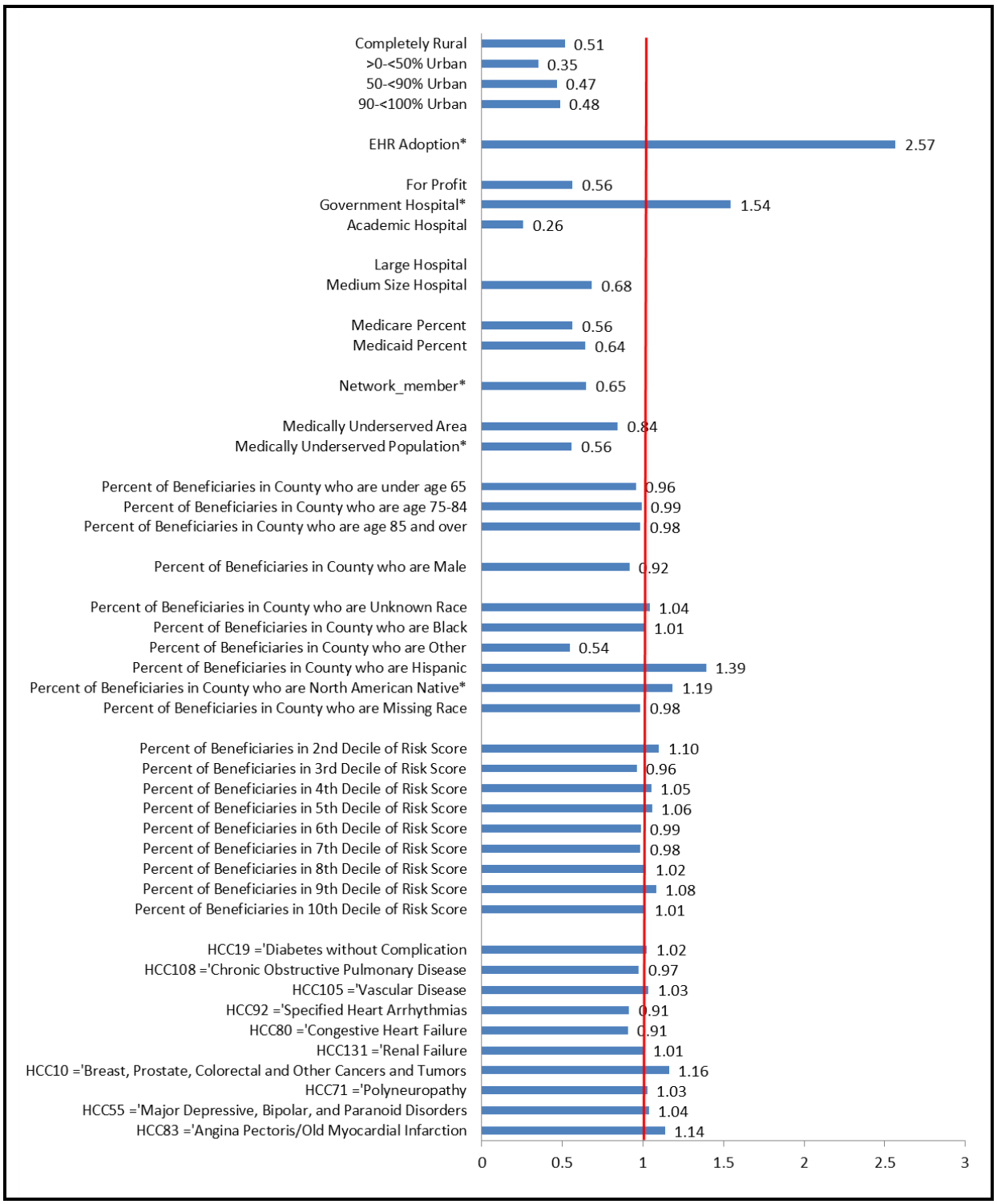
Figure 7 shows the results of the regression analysis on what factors predicted whether or not a CAH will attest to Stage 1 meaningful use once registered. All results are reported as odds ratios, with significant results (*p*-value of 0.05) indicated by an asterisk.

CAHs that were members of a network, and CAHs that operated in areas with medically underserved populations were *less likely* to attest.

On the other hand, CAHs that saw a relatively greater proportion of patients who were Native Americans, and CAHs that were government hospitals were *more likely* to attest. Prior adoption of an EHR was most highly predictive (over 2 times more likely to attest).

For CAHs, with the exception of Race: Native American, no other beneficiary variables were significant for attestation.

Figure 7
Odds ratios CAH attestation



NOTE: (*) indicates significant result.

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SECTION 4
DISCUSSION

OMH's primary objective for this analysis was to identify which EPs, EHs and CAHs are participating in the Medicare EHR Incentive Program, which are not, and what factors are associated with participation and nonparticipation. To ensure patients and their professionals are not being left behind as EHRs are deployed nationally, important secondary objectives focused on understanding participation rates and factors for EPs, EHs and CAHs that operate in medically underserved areas and medically underserved populations. OMH was also interested in the characteristics of Medicare beneficiaries served by EPs, EHs and CAHs that did and did not participate in the Medicare EHR Incentive Program, and whether or not these characteristics affected program participation.

Relative to OMH's primary objective, the analysis of descriptive statistics showed who was and was not participating, while the regression analyses identified characteristics associated with these same aspects. The sets of descriptive statistics (counts and percents) reporting *lower* levels of registration and attestation, and regression model results indicating *less* likelihood of participation, suggest what types of EPs, EHs, and CAHs may need additional support and where these entities may be located. We note these below, and discuss implications for providing support to nonparticipating entities.

4.1 Analysis of EP, EH, and CAH Program Participation

Eligible Professionals

Across both the registration and attestation, additional assistance may be needed for EPs with the following characteristics:

- Practice types
  - Small practices
  - Independently owned practices
  - Lower visit volume (less than 50 patients daily)
- Professional types
  - Younger and older professionals
  - Specialists without patient contact
  - Female professionals (attestation only)
- Location
  - Medically underserved areas/populations
  - Rural care settings

- In CMS regions 2, 4, 5, and 9 (New York, New Jersey, Puerto Rico, USVI, and southern, midwestern, and western states)

Also, further consideration of two professional types may be warranted even though they do not appear within those listed above. Family practice professionals and internists are overrepresented in the EP population in their rates of registration and attestation, yet because of their numbers within the total provider community, they constitute more than 20% of the professionals who do not participate (i.e., register).

Eligible Hospitals

In considering the descriptive data and regression model results on EH participation, additional assistance for both registration and attestation may be needed for EHs with:

- Small to medium bed size
- For-profit status (registration only)
- Lower or missing SSI ratios
- Rural location
- Based in CMS regions 4, 5, 6, and 9 (midwestern, southeastern, south-central, and western states)
- Primary care and dental HPSAs and medically underserved areas

Critical Access Hospitals

Similarly, in considering the descriptive data and regression model results on CAH participation, additional assistance for both registration and attestation may be needed for those CAHs with:

- Small bed size
- Not-for-profit status
- Network membership (attestation only)
- Medically underserved populations
- More urban locations
- Based in CMS regions 5 and 7 (midwestern and central plains states)
- Primary care and dental HPSAs and medically underserved areas

These characteristics are applicable to most all CAHs, with the exception of urban location and in CMS regions 5 and 7.

For both EHs and CAHs, prior EHR adoption is a significant predictor of greater likelihood to register and greater likelihood to attest after registration. Conversely, this predictor may suggest that late adopters of EHR technology will require greater support to guide system implementations that enable attestation. The dichotomy between early and late adopters has been studied; for example, Menachemi reported results indicating that "EHR systems used by recent adopters, when compared with early adopters, appear to be missing key patient safety and cost control functions (Menachemi 2007)."

In reviewing the results, we saw more similarities in characteristics related to lower rates and less likelihood of registration and attestation than clear differences. It is true that certain characteristics were found to be significant for EHR registration but not attestation, such as for profit status for EHs, and vice versa, such as network membership for CAHs. However, these instances appeared to be more the exception than rule.

However, even though the characteristics associated with more limited registration and attestation may be similar, the reasons for not registering are likely very different from those for not attesting. An older, more rural specialist without patient contact may not register due to lack of time and interest, whereas other registered specialists without patient contact may have difficulty being able to report on all required Stage 1 measures. Moreover, there are likely different reasons for nonparticipation within EPs, EHs and CAHs. For example, some EPs who are part of a more urban for-profit hospital chain may not register due to lack of support from upper management or a company policy to delay participation. An older, more rural, solo EP, on the other hand, may not have enough time or resources to implement certified EHR technologies. The implication for the next phase of this research, then, is to identify cohorts in nonregistered and nonattested categories, respectively; determine the specific reasons for nonparticipation; and then develop target support strategies that address those reasons. Reviewing the most current literature, and conducting discussions with RECs designated to support EPs and CAHs, will be an important first step. Focusing on CMS regions 4 and 5, as these were noted across professional and hospital types, may be warranted.

The sets of descriptive statistics reporting *higher* levels of registration and attestation, and regression model results indicating *greater* likelihood of participation, indicate the characteristics of successful participants – for example, large, urban, high-volume EHs with prior EHR adoption, located in CMS region 1. Identifying what organizational, community, technological, geographic, and other factors enabled their participation may not be useful to developing support for nonparticipants, since these factors may be unrealistic or highly impractical to emulate. A large, well-capitalized, urban hospital that has attested to Stage 1 meaningful use since 2011 likely has financial capital, technical acumen, robust infrastructure, and strong leadership—qualities hard to provide to smaller, rural care settings. Instead, understanding why EPs, EHs, and CAHs in regions with low participation, with the same characteristics as nonparticipants and that were able to register and attest, will likely yield more useful information for developing assistance support for nonparticipants. In short, examining successful peer organizations in the same region, and with the same characteristics, should be a focus for additional research.

Further, although this study did not examine what types of assistance are needed, sources suggest nonparticipants would benefit from both implementation expertise and financial support (Kissam, et al., 2012). The predominance of rural, smaller practices in medically underserved areas may imply the absence of dedicated IT staff and lesser access to support resources. The Menachemi paper cited above was a study of physician practices, so it may apply to EPs; however, the odds ratio for prior EHR adoption was significant only for registration and not for attestation.

4.2 Analysis of Beneficiary Data

Relative to OMH's secondary objectives, the beneficiary analysis did not identify many significant variables related to EP, EH, and CAH participation. For EPs, we saw more overall significance for beneficiary characteristics (age, race, gender, risk scores, and HCCs) relative to EP program participation, but usually with small to very small effects. As noted in the Result section, odds ratios for significant variables typically fell into a range of 0.95 to 1.05, with a few exceptions outside this range. We believe that the general significance across many variables was due to the very large datasets being modeled. Given the small effects observed, however, many of these variables are likely not very important in explaining EP's participation or nonparticipation in the Medicare EHR Incentive Program. HCCs, for instance, did not appear to strongly predict either less or more EP participation—the strongest was for HCC55, Depression, which increased an EP's likelihood of attestation by 10%. Therefore, for the county-based analysis as conducted, a limited association appears to exist between beneficiaries' age, gender, race, location, and conditions and a professional's participation in the Medicare EHR Incentive Program. There may not be any disparities in patients of professionals who participate versus those who do not, but our methods were not able to determine this conclusively.

We observed one possible trend for EPs, however: higher decile risk scores (i.e., greater risk) were often associated with *lower likelihood* of attestation. One implication, then, may be to identify EPs serving Medicare beneficiaries with higher decile risk scores and assess these professionals' needs for technical assistance.

For EHs and CAHs, risk scores were not significant—using the available data, we did not observe any significant associations between Medicare beneficiaries' risk of medical expenditure and a hospital's participation (or nonparticipation) in the Medicare EHR Incentive Program. Moreover, HCCs were not very significant, with a few exceptions noted in the Results section. Generally, HCC10 (Cancers) was the most consistently significant HCC. HCC10 was associated with non-CAHs being *more likely* to register and attest; and with CAHs being *less likely* to register. This finding requires more investigation, but it may suggest targeting nonregistered CAHs in regions (counties) with greater numbers of Medicare beneficiaries who have a cancer diagnosis included in HCC10. As with EPs, a limited relationship appears to exist between beneficiaries' age, gender, race, location, and conditions and hospital's participation in the Medicare EHR Incentive Program. Our analyses were not able to identify disparities in patients of hospitals that participate versus those that do not.

4.3 Limitations

Our data and analysis have a few important limitations.

The data for professional age and number of years since award of the medical degree are largely missing. In particular for nonparticipating professionals, only 12% reported these data. As such, these characteristics may be more important in explaining participation and nonparticipation than presently reported.

In addition, data for an important variable, professional race, were not available and could not be included in our analysis. This characteristic may be important to explaining either participation or nonparticipation, but we were unable to make this assessment.

Finally, the beneficiary analysis did not yield much useful information. The inability to directly link beneficiaries with EPs, EHs, and CAHs, and the modeling of data at the county level, meant that some associations between sicker beneficiaries and nonparticipating professionals and hospitals could have gone undetected. Accordingly, the beneficiary analysis results should not be considered conclusive.

4.4 Conclusions

Realizing the promise of EHRs as a tool to help transform the U.S. health care system—improving quality and safety and making care more effective while controlling costs—begins with system adoption and use. Ensuring that all patients receive the benefits of a more efficient and equitable health care system enabled by technology is tied, in part, to the ability of professionals and hospitals to participate in the Medicare EHR Incentive Program. This analysis characterizes who is and is not participating in this program and the factors associated with participation and nonparticipation. In a more limited way, this analysis also begins the process of assessing to what extent professionals and hospitals that do and do not participate also serve beneficiaries who are more or less ill or are at greater or lesser risk of becoming so. Developing targeted and effective means of support for all EPs, EHs, and CAHs who want to participate in the Medicare EHR Incentive Program should be informed by the results of this analysis.

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APPENDIX A
CHARACTERISTICS OF MEDICARE BENEFICIARIES

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Beneficiary Characteristics

Disease burden as measured by HCCs falls unequally on the CMS regions. Region 2, which corresponds to New York, New Jersey, Puerto Rico, and USVI, carried the highest level of disease burden for five of the HCC categories, whereas regions 5, 7, and 10, corresponding to the midwestern, central plains, and Pacific northwestern states, respectively, did not have the highest level of disease burden for any of these categories. Conversely, regions 8 and 10, corresponding to the mountain and Pacific northwestern states, respectively, had the lowest disease burden in six each of the HCC categories, while region 4, which corresponds to the southeastern states, failed to rank lowest in any of the HCC categories.

Examining the risk scores by CMS region shows that CMS regions 8 and 10, i.e., the mountain and Pacific northwestern states, respectively, had the highest percentage of beneficiaries in the first decile, and the lowest percentage of beneficiaries in the tenth decile. On the contrary, CMS regions 2 and 4, i.e., New York, New Jersey, Puerto Rico and USVI, and the southeastern states, respectively, had the lowest percentage of beneficiaries in the first decile and the highest percentage of beneficiaries in the tenth decile, along with regions 3, 5, and 6 (the mid-Atlantic, midwestern, and south-central states, respectively).

The highest proportion of older patients (aged 75 and older), 38%, was in CMS regions 1 and 7, i.e., the northeastern and the central plains states, respectively. The lowest proportion of the older patients, 33%, was in CMS regions 4 and 6, i.e., southeastern and the south-central states, respectively.

The highest proportion of younger patients (aged 60 and younger); 27%, was in CMS regions 4 and 6, i.e., the southeastern and the south-central states, respectively. The lowest proportion of the younger patients, 22%, was in CMS region 9 (the western states).

The highest proportion (27%) of disabled patients was in CMS regions 4 and 6, i.e., the southeastern and the south-central states, respectively. The lowest proportion of disabled patients was in CMS regions 8 and 9 with 23% and 22%, respectively. CMS region 8 corresponds to the mountain states while region 9 corresponds to the western states. Tables A-1 and A-2 are on the following pages.

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Table A-1
CMS regions 1–5

Beneficiary characteristics	Total values and percents[1]		CMS region 1		CMS region 2		CMS region 3		CMS region 4		CMS region 5	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Gender												
Male	25,528,300	45%	1,258,173	45%	2,573,400	44%	2,525,869	45%	5,389,244	45%	4,285,192	45%
Female	30,617,428	55%	1,551,782	55%	3,218,131	56%	3,107,310	55%	6,466,192	55%	5,219,351	55%
Total	**56,145,728**	100%	**2,809,955**	100%	**5,791,531**	100%	**5,633,179**	100%	**11,855,436**	**100%**	**9,504,543**	**100%**
Disabled												
No	42,236,533	75%	2,110,793	75%	4,388,067	76%	4,250,778	75%	8,662,459	73%	7,158,907	75%
Yes	13,909,195	25%	699,162	25%	1,403,464	24%	1,382,401	25%	3,192,977	27%	2,345,636	25%
Total	**56,145,728**	100%	**2,809,955**	100%	**5,791,531**	100%	**5,633,179**	100%	**11,855,436**	**100%**	**9,504,543**	**100%**
Age												
59 under	7,776,651	14%	411,090	15%	793,840	14%	774,821	14%	1,818,661	15%	1,326,688	14%
60–64	6,132,544	11%	288,072	10%	609,624	11%	607,580	11%	1,374,316	12%	1,018,948	11%
65–74	22,135,690	39%	1,048,076	37%	2,219,539	38%	2,180,303	39%	4,704,052	40%	3,664,901	39%
75–84	13,551,403	24%	685,047	24%	1,426,614	25%	1,383,387	25%	2,749,857	23%	2,330,064	25%
85 over	6,549,440	12%	377,670	13%	741,914	13%	687,088	12%	1,208,550	10%	1,163,942	12%
Total	56,145,728	100%	2,809,955	100%	5,791,531	100%	5,633,179	100%	11,855,436	100%	9,504,543	100%
Race												
0=Unknown	294,240	1%	21,453	1%	45,401	1%	28,085	0%	45,466	0%	49,692	1%
1=White	45,996,427	82%	2,558,334	91%	4,401,943	76%	4,649,703	83%	9,471,162	80%	8,285,504	87%
2=Black	5,842,171	10%	115,947	4%	692,749	12%	782,864	14%	1,929,566	16%	905,153	10%
3=Other	1,167,813	2%	43,714	2%	186,302	3%	67,583	1%	109,764	1%	100,667	1%
4=Asian	1,151,868	2%	28,977	1%	138,976	2%	67,049	1%	69,836	1%	77,354	1%
5=Hispanic	1,450,632	3%	38,931	1%	319,827	6%	35,628	1%	214,285	2%	64,987	1%
6=North American Native	242,033	0%	2,597	0%	6,327	0%	2,267	0%	15,343	0%	21,180	0%
Missing	544	0%	2	0%	6	0%	—	0%	14	0%	6	0%
Total	**56,145,728**	100%	**2,809,955**	100%	**5,791,531**	100%	**5,633,179**	100%	**11,855,436**	**100%**	**9,504,543**	**100%**

(continued)

Table A-1 (continued)
CMS regions 1–5

Beneficiary characteristics	Total values and percents[1]		CMS region 1		CMS region 2		CMS region 3		CMS region 4		CMS region 5	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Disease burden (HCCs)												
Diabetes without complication	7,227,850	13%	312,208	11%	758,758	13%	760,974	14%	1,733,672	15%	1,323,581	14%
Chronic obstructive pulmonary disease	6,398,689	11%	300,371	11%	651,426	11%	634,597	11%	1,578,658	13%	1,118,179	12%
Vascular disease	6,329,271	11%	307,747	11%	896,615	15%	718,015	13%	1,321,945	11%	1,075,753	11%
Specified heart arrhythmias	6,069,894	11%	333,833	12%	636,524	11%	653,114	12%	1,317,932	11%	1,070,272	11%
Congestive heart failure	6,010,651	11%	276,937	10%	685,832	12%	606,225	11%	1,335,706	11%	1,076,973	11%
Renal failure	5,228,569	9%	230,970	8%	490,937	8%	506,711	9%	1,218,422	10%	865,475	9%
Breast, prostate, colorectal, and other cancers and tumors	3,372,667	6%	195,286	7%	396,693	7%	370,659	7%	749,289	6%	570,953	6%
Polyneuropathy	3,032,113	5%	117,781	4%	332,696	6%	266,589	5%	715,634	6%	435,218	5%
Major depressive, bipolar, and paranoid disorders	2,572,435	5%	160,780	6%	295,500	5%	243,845	4%	559,893	5%	405,587	4%
Angina pectoris/ old myocardial infarction	2,492,876	4%	115,441	4%	299,570	5%	227,822	4%	615,184	5%	382,257	4%
Risk score												
1st decile (0.120–0.328)	6,083,066	11%	318,085	11%	572,203	10%	623,035	11%	1,210,242	10%	1,025,013	11%
2nd decile (>0.328–0.413)	4,369,752	8%	215,463	8%	398,342	7%	444,612	8%	863,633	7%	742,034	8%

(continued)

Table A-1 (continued)
CMS regions 1–5

Beneficiary characteristics	Total values and percents[1]		CMS region 1		CMS region 2		CMS region 3		CMS region 4		CMS region 5	
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
3rd decile (>0.413–0.530)	3,914,660	7%	186,670	7%	370,530	6%	394,597	7%	794,173	7%	670,102	7%
4th decile (>0.530–0.647)	4,465,930	8%	224,907	8%	438,499	8%	451,094	8%	895,834	8%	772,848	8%
5th decile (>0.647–0.807)	4,706,895	8%	235,434	8%	474,976	8%	471,817	8%	1,002,342	8%	805,456	8%
6th decile (>0.807–1.011)	4,705,510	8%	242,581	9%	495,946	9%	477,824	8%	1,017,754	9%	810,184	9%
7th decile (>1.011–1.304)	4,694,535	8%	242,781	9%	515,439	9%	480,071	9%	1,033,459	9%	796,845	8%
8th decile (>1.304–1.766)	4,708,178	8%	240,268	9%	536,169	9%	472,872	8%	1,042,563	9%	784,644	8%
9th decile (>1.766–2.721)	4,701,980	8%	233,585	8%	540,933	9%	464,056	8%	1,060,587	9%	783,806	8%
10th decile (>2.721–24.162)	4,704,386	8%	232,117	8%	537,053	9%	481,515	9%	1,043,302	9%	813,188	9%
Missing	9,090,836	16%	438,064	16%	911,441	16%	871,686	15%	1,891,547	16%	1,500,423	16%
Total	**56,145,728**	**100%**	**2,809,955**	**100%**	**5,791,531**	**100%**	**5,633,179**	**100%**	**11,855,436**	**100%**	**9,504,543**	**100%**

[1] Note that the discrepancy between the total counts by CMI region and the overall total is due to missing location values for some beneficiaries.

Table A-2
CMS regions 6–10

	CMS region 6		CMS region 7		CMS region 8		CMS region 9		CMS region 10	
Beneficiary characteristics	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Gender										
Male	2,803,830	46%	1,176,468	45%	776,119	47%	3,423,791	46%	1,055,399	47%
Female	3,280,084	54%	1,426,480	55%	884,333	53%	3,990,492	54%	1,189,347	53%
Total	**6,083,914**	**100%**	**2,602,948**	**100%**	**1,660,452**	**100%**	**7,414,283**	**100%**	**2,244,746**	**100%**
Disabled										
No	4,463,262	73%	1,969,777	76%	1,276,518	77%	5,760,040	78%	1,696,455	76%
Yes	1,620,652	27%	633,171	24%	383,934	23%	1,654,243	22%	548,291	24%
Total	**6,083,914**	**100%**	**2,602,948**	**100%**	**1,660,452**	**100%**	**7,414,283**	**100%**	**2,244,746**	**100%**
Age										
59 under	928,733	15%	362,039	14%	199,468	12%	859,353	12%	287,227	13%
60–64	691,919	11%	271,132	10%	184,466	11%	794,890	11%	261,064	12%
65–74	2,445,957	40%	991,822	38%	685,390	41%	3,028,602	41%	925,707	41%
75–84	1,412,804	23%	649,945	25%	400,986	24%	1,825,120	25%	510,762	23%
85 over	604,501	10%	328,010	13%	190,142	11%	906,318	12%	259,986	12%
Total	**6,083,914**	**100%**	**2,602,948**	**100%**	**1,660,452**	**100%**	**7,414,283**	**100%**	**2,244,746**	**100%**
Race										
0=Unknown	20,644	0%	11,127	0%	9,237	1%	43,302	1%	14,113	1%
1=White	4,830,893	79%	2,392,101	92%	1,536,003	93%	5,431,680	73%	2,040,897	91%
2=Black	738,040	12%	151,808	6%	29,290	2%	438,185	6%	42,534	2%
3=Other	88,800	1%	17,286	1%	21,547	1%	431,196	6%	43,350	2%
4=Asian	63,775	1%	12,096	0%	12,751	1%	592,285	8%	50,696	2%
5=Hispanic	261,511	4%	11,821	0%	28,393	2%	425,671	6%	21,992	1%
6=North American Native	80,247	1%	6,708	0%	23,230	1%	51,952	1%	31,164	1%
Missing	4	0%	1	0%	1	0%	12	0%	—	0%

(continued)

Table A-2 (continued)
CMS regions 6–10

	CMS region 6		CMS region 7		CMS region 8		CMS region 9		CMS region 10	
Beneficiary characteristics	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Disease burden (HCCs)										
Diabetes without complication	810,999	13%	343,408	13%	175,016	11%	765,866	10%	240,509	11%
Chronic obstructive pulmonary disease	708,895	12%	302,681	12%	152,463	9%	753,778	10%	196,431	9%
Vascular disease	669,924	11%	289,085	11%	125,526	8%	757,995	10%	165,182	7%
Specified heart arrhythmias	631,417	10%	297,015	11%	154,226	9%	741,440	10%	232,583	10%
Congestive heart failure	704,074	12%	274,739	11%	150,891	9%	707,845	10%	190,039	8%
Renal failure	549,916	9%	222,877	9%	130,231	8%	832,042	11%	179,597	8%
Breast, prostate, colorectal, and other cancers and tumors	332,929	5%	149,819	6%	91,105	5%	399,996	5%	114,903	5%
Polyneuropathy	381,548	6%	122,122	5%	82,739	5%	465,107	6%	111,996	5%
Major depressive, bipolar, and paranoid disorders	259,630	4%	116,782	4%	64,867	4%	378,898	5%	86,146	4%
Angina pectoris/old myocardial infarction	287,668	5%	95,881	4%	52,814	3%	338,486	5%	77,077	3%
Risk score										
1st decile (0.120– 0.328)	664,873	11%	287,210	11%	210,715	13%	812,134	11%	285,693	13%
2nd decile (>0.328–0.413)	467,810	8%	214,386	8%	152,510	9%	583,030	8%	204,153	9%
3rd decile (>0.413–0.530)	429,488	7%	192,607	7%	127,254	8%	507,748	7%	169,805	8%
4th decile (>0.530–0.647)	468,636	8%	216,834	8%	141,217	9%	580,646	8%	188,380	8%
5th decile (>0.647–0.807)	503,122	8%	225,454	9%	139,779	8%	618,791	8%	189,596	8%
6th decile (>0.807–1.011)	494,015	8%	224,665	9%	131,918	8%	615,724	8%	182,931	8%

(continued)

Table A-2 (continued)
CMS regions 6–10

	CMS region 6		CMS region 7		CMS region 8		CMS region 9		CMS region 10	
Beneficiary characteristics	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
7th decile (>1.011–1.304)	494,891	8%	220,817	8%	125,380	8%	611,018	8%	172,110	8%
8th decile (>1.304–1.766)	499,218	8%	217,551	8%	124,341	7%	623,371	8%	165,753	7%
9th decile (>1.766–2.721)	513,275	8%	213,203	8%	120,756	7%	612,979	8%	157,649	7%
10th decile (>2.721–24.162)	531,954	9%	200,852	8%	108,989	7%	608,031	8%	146,501	7%
Missing	1,016,632	17%	389,369	15%	277,593	17%	1,240,811	17%	382,175	17%
Total	**6,083,914**	**100%**	**2,602,948**	**100%**	**1,660,452**	**100%**	**7,414,283**	**100%**	**2,244,746**	**100%**

APPENDIX B
COMBINED CHARACTERISTICS OF ALL HOSPITALS (EHs AND CAHs)

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Table B-1
Combined characteristics of all hospitals (EHs and CAHs)

Hospital characteristics	Not registered or attested		Registered				Attested		Total values and percents	
			Registered not attested		Registered ever					
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Hospital bed size										
Small (1-99 beds)	1,280	67%	809	48%	1,470	46%	661	44%	2,750	54%
Medium (100-399 beds)	542	29%	706	42%	1,357	42%	651	43%	1,899	37%
Large (400+ beds)	76	4%	185	10%	379	12%	194	13%	455	9%
Missing	—	—	—	—	—	—	—	—	—	—
Total	**1,898**	**100%**	**1,700**	**100%**	**3,206**	**100%**	**1,506**	**100%**	**5,104**	**100%**
	Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev	Mean	Std dev
Average daily Census (mean, std dev)	69	117	110	143	118	151	127	160	100	142
Average total inpatient days (mean, std dev)	24,974	42,649	40,149	52,137	43,063	55,252	46,352	58,412	36,336	51,672
Average total Medicaid	5,452	15,724	9,401	16,306	9,930	17,313	10,528	18,371	8,265	16,878
Average total Medicare	11,309	16,673	18,429	23,066	19,733	24,155	21,204	25,255	16,600	22,054
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Ownership type	365	19%	369	22%	716	22%	347	23%	1,081	21%
Government										
For profit	710	37%	241	14%	460	14%	219	15%	1,170	23%
Not for profit	823	43%	1,090	64%	2,030	63%	940	62%	2,853	56%
Missing	—	—	—	—	—	—	—	—	—	—
Total	**1,898**	**100%**	**1,700**	**100%**	**3,206**	**100%**	**1,506**	**100%**	**5,104**	**100%**

(continued)

Table B-1 (continued)
Combined characteristics of all hospitals (EHs and CAHs)

Hospital characteristics	Not registered or attested		Registered				Attested		Total values and percents	
			Registered not attested		Registered ever					
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Hospital type										
Teaching hospital	180	9%	300	18%	618	19%	318	21%	798	16%
Critical access hospital	497	26%	465	27%	819	26%	354	24%	1,317	26%
Other	1,221	64%	935	55%	1,769	55%	834	55%	2,989	59%
Network membership										
Yes	277	31%	690	41%	1,262	39%	572	38%	1,539	30%
No	586	15%	995	59%	1,915	60%	920	61%	2,501	49%
Missing	1,035	55%	15	1%	29	1%	14	1%	1,064	21%
Total	**1,898**	**100%**	**1,700**	**100%**	**3,206**	**100%**	**1,506**	**100%**	**5,104**	**100%**
Urban/rural										
Located in 100% urban zip code	269	14%	127	7%	261	8%	134	9%	560	11%
Located in 90% - <100% urban zip code	157	8%	181	11%	313	10%	132	9%	470	9%
Located in 50% - <90% urban zip code	547	29%	660	39%	1,208	38%	548	36%	1,755	34%
Located in >0% - <50% urban zip code	320	17%	263	15%	498	16%	235	16%	818	16%
Located in 100% rural zip code	594	31%	425	25%	859	27%	434	29%	1,453	28%
Missing	11	1%	44	3%	67	2%	23	2%	48	1%
Total	**1,898**	**100%**	**1,700**	**100%**	**3,206**	**100%**	**1,506**	**100%**	**5,104**	**100%**

(continued)

Table B-1 (continued)
Combined characteristics of all hospitals (EHs and CAHs)

Hospital characteristics	Not registered or attested		Registered				Attested		Total values and percents	
			Registered not attested		Registered ever					
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Location (CMS region)										
Region 1	61	3%	49	3%	139	4%	90	6%	200	4%
Region 2	67	4%	85	5%	180	6%	95	6%	247	5%
Region 3	123	6%	132	8%	260	8%	128	8%	383	8%
Region 4	415	22%	297	17%	563	18%	266	18%	978	19%
Region 5	308	16%	318	19%	613	19%	295	20%	921	18%
Region 6	355	19%	293	17%	534	17%	241	16%	889	17%
Region 7	130	7%	168	10%	341	11%	173	11%	471	9%
Region 8	129	7%	118	7%	185	6%	67	4%	314	6%
Region 9	218	11%	161	9%	267	8%	106	7%	485	10%
Region 10	92	5%	79	5%	124	4%	45	3%	216	4%
Total	**1,898**	**100%**	**1,700**	**100%**	**3,206**	**100%**	**1,506**	**100%**	**5,104**	**100%**
Primary care HPSA										
Yes (whole or part)	1,403	74%	1,235	73%	2,351	73%	1,116	74%	3,754	74%
No	197	10%	203	12%	409	13%	206	14%	606	12%
Missing	298	16%	262	15%	446	14%	184	12%	744	15%
Total	**1,898**	**100%**	**1,700**	**100%**	**3,206**	**100%**	**1,506**	**100%**	**5,104**	**100%**
Dental HPSA										
Yes (whole or part)	1,298	68%	1,112	65%	2,133	67%	1,021	68%	3,431	67%
No	302	16%	326	19%	627	20%	301	20%	929	18%
Missing	298	16%	262	15%	446	14%	184	12%	744	15%
Total	**1,898**	**100%**	**1,700**	**100%**	**3,206**	**100%**	**1,506**	**100%**	**5,104**	**100%**

(continued)

Table B-1 (continued)
Combined characteristics of all hospitals (EHs and CAHs)

Hospital characteristics	Not registered or attested		Registered				Attested		Total values and percents	
			Registered not attested		Registered ever					
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
Medically underserved area (MUA)										
Yes	1,257	66%	1,090	64%	2,066	64%	976	65%	3,323	65%
No	149	8%	126	7%	262	8%	136	9%	411	8%
Missing	492	26%	484	29%	878	27%	394	26%	1,370	27%
Total	**1,898**	**100%**	**1,700**	**100%**	**3,206**	**100%**	**1,506**	**100%**	**5,104**	**100%**
Medically underserved population (MUP)										
Yes	399	21%	319	19%	648	20%	329	22%	1,047	21%
No	1,007	53%	897	53%	1,680	52%	783	52%	2,687	53%
Missing	492	26%	484	28%	878	27%	394	26%	1,370	27%
Total	**1,898**	**100%**	**1,700**	**100%**	**3,206**	**100%**	**1,506**	**100%**	**5,104**	**100%**
Disproportionate share hospital (DSH)										
Yes	943	50%	1,224	72%	2,373	74%	1,149	76%	3,316	65%
No	—	—	—	—	—	—	—	—	—	—
Missing	955	50%	476	28%	833	26%	357	24%	1,788	35%
Total	**1,898**	**100%**	**1,700**	**100%**	**3,206**	**100%**	**1,506**	**100%**	**5,104**	**100%**
Case mix index (CMI)—non-CAH hospitals only										
Yes	939	49%	1,222	72%	2,363	74%	1,141	76%	3,302	65%
No	—	—	—	—	—	—	—	—	—	—
Missing	959	51%	478	28%	843	26%	365	24%	1,802	35%
Total	1,898	100%	1,700	100%	3,206	100%	1,506	100%	5,104	100%

(continued)

Table B-1 (continued)
Combined characteristics of all hospitals (EHs and CAHs)

Hospital characteristics	Not registered or attested		Registered				Attested		Total values and percents	
			Registered not attested		Registered ever					
	Count	Percent	Count	Percent	Count	Percent	Count	Percent	Count	Percent
SSI	13	1%	1	0%	3	0%	2	0%	16	0%
Zero										
0.001–0.499	287	20%	364	29%	741	31%	377	33%	1,028	27%
0.05–0.149	454	32%	692	56%	1,329	56%	637	55%	1,783	47%
0.15–0.299	156	11%	138	11%	250	10%	112	10%	406	11%
0.30+	33	2%	29	2%	50	2%	21	2%	83	2%
Missing	458	33%	11	1%	13	1%	2	0%	471	12%
Total	1,401	100%	1,235	100%	2,386	100%	1,151	100%	3,787	100%
Case mix indicator (CMI)—non-CAH hospitals only	290	21%	282	23%	528	22%	246	21%	818	22%
0 - <1.25										
1.25 - <1.44	219	16%	316	26%	586	25%	270	23%	805	21%
1.44 - <1.64	195	14%	299	24%	622	26%	323	28%	817	22%
>= 1.64	235	17%	325	26%	627	26%	302	26%	862	23%
Missing	462	33%	13	1%	23	1%	10	1%	485	13%
Total	1,401	100%	1,235	100%	2,386	100%	1,151	100%	3,787	100%
EHR adoption	471	25%	779	46%	1,717	54%	938	62%	2,188	43%
Yes										
No	1,427	75%	921	54%	1,489	46%	568	38%	2,916	57%
Total	1,898	100%	1,700	100%	3,206	100%	1,506	100%	5,104	100%

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APPENDIX C
TABLE OF ODDS RATIOS, CONFIDENCE INTERVALS, AND REFERENCE VARIABLES FOR EP REGRESSION ANALYSES

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Table C-1
Table of odds ratios, confidence intervals, and reference variables for EP regression analyses

Professional characteristics	EP registration				EP attestation			
	OR	CI		Signif	OR	CI		Signif
Age								
20–29	0.707	0.63	0.8	*	0.803	0.68	0.95	NS
30–39	1.137	1.09	1.19	*	1.069	1.01	1.14	NS
40–49	1.157	1.11	1.2	*	1.085	1.03	1.14	NS
50–59	REF	REF	REF	NS	REF	REF	REF	NS
60–69	0.775	0.74	0.81	*	0.878	0.82	0.94	*
70+	0.559	0.51	0.62	*	0.646	0.56	0.75	*
Missing	0.542	0.53	0.56	*	0.922	0.88	0.96	NS
Gender								
M	REF	REF	REF	NS	REF	REF	REF	NS
F	1.002	0.99	1.02	NS	0.799	0.78	0.82	*
Years since award of degree								
0 to 10	0.96	0.91	1.01	NS	0.823	0.77	0.88	*
11 to 20	1.026	0.99	1.07	NS	0.972	0.92	1.03	NS
21 to 30	REF	REF	REF	NS	REF	REF	REF	NS
31 to 40	0.949	0.91	1	NS	0.982	0.92	1.05	NS
41+	0.787	0.73	0.85	*	0.859	0.76	0.97	NS
Missing	0.795	0.77	0.82	*	0.958	0.92	1	NS
Medical specialty								
Primary care	1.679	1.66	1.7	*	0.881	0.86	0.9	*

(continued)

Table C-1 (continued)
Table of odds ratios, confidence intervals, and reference variables for EP regression analyses

Professional characteristics	EP registration				EP attestation			
	OR	CI		Signif	OR	CI		Signif
Specialties with patient contact	REF	REF	REF		REF	REF	REF	
Specialties without patient contact	0.388	0.37	0.4	*	0.295	0.28	0.32	*
Other specialties	0.884	0.87	0.9	*	0.766	0.75	0.78	*
Practice size								
Solo	REF	REF	REF	NS	REF	REF	REF	NS
Partner	1.201	1.18	1.23	*	1.104	1.07	1.14	*
3 to 5	1.52	1.5	1.55	*	1.201	1.17	1.23	*
6 to 10	1.667	1.64	1.7	*	1.202	1.17	1.24	*
11 to 20	1.512	1.48	1.54	*	1.104	1.07	1.14	*
21+	1.323	1.3	1.35	*	1.095	1.06	1.13	*
TOTAL	—	—	—	—	—	—	—	—
Average daily patient volume per site								
0	NI	NI	NI	NI	NI	NI	NI	NI
1 to 49	NI	NI	NI	NI	NI	NI	NI	NI
50 to 99	NI	NI	NI	NI	NI	NI	NI	NI
100 to 199	NI	NI	NI	NI	NI	NI	NI	NI
200+	NI	NI	NI	NI	NI	NI	NI	NI
TOTAL	NI	NI	NI	NI	NI	NI	NI	NI
Practice ownership								
Hospital	REF	REF	REF	NS	REF	REF	REF	NS
Independent Practice Association (IPA)	1.455	1.41	1.51	*	2.029	1.92	2.14	*

(continued)

Table C-1 (continued)
Table of odds ratios, confidence intervals, and reference variables for EP regression analyses

Professional characteristics	EP registration				EP attestation			
	OR	CI		Signif	OR	CI		Signif
Health system	1.296	1.27	1.33	*	1.239	1.2	1.28	*
Other	1.086	1.06	1.11	*	1.581	1.53	1.63	*
Location (CMS region)								
Region 1	NI	NI	NI	NI	NI	NI	NI	NI
Region 2	NI	NI	NI	NI	NI	NI	NI	NI
Region 3	NI	NI	NI	NI	NI	NI	NI	NI
Region 4	NI	NI	NI	NI	NI	NI	NI	NI
Region 5	NI	NI	NI	NI	NI	NI	NI	NI
Region 6	NI	NI	NI	NI	NI	NI	NI	NI
Region 7	NI	NI	NI	NI	NI	NI	NI	NI
Region 8	NI	NI	NI	NI	NI	NI	NI	NI
Region 9	NI	NI	NI	NI	NI	NI	NI	NI
Region 10	NI	NI	NI	NI	NI	NI	NI	NI
Urban/rural	NI	NI	NI	NI	NI	NI	NI	NI
Located in 100% urban zip code	REF	REF	REF	NS	REF	REF	REF	NS
Located in 90% - <100% urban zip code	1.075	1.06	1.09	*	1.202	1.18	1.23	*
Located in 50% - <90% urban zip code	1.047	1.03	1.07	*	1.126	1.09	1.16	*
Located in >0% - <50% urban zip code	1.073	1.03	1.11	NS	0.996	0.94	1.06	NS
Located in 100% rural zip code	0.871	0.83	0.91	*	0.651	0.61	0.7	*
Primary care HPSA								
Y (whole or part)	NI	NI	NI	NI	NI	NI	NI	NI
N	NI	NI	NI	NI	NI	NI	NI	NI

(continued)

Table C-1 (continued)
Table of odds ratios, confidence intervals, and reference variables for EP regression analyses

Professional characteristics	EP registration				EP attestation			
	OR	CI		Signif	OR	CI		Signif
Dental HPSA								
Y (whole or part)	NI	NI	NI	NI	NI	NI	NI	NI
N	NI	NI	NI	NI	NI	NI	NI	NI
MUA								
Yes	0.889	0.88	0.9	*	0.890	0.87	0.91	*
No	REF	REF	REF	NS	REF	REF	REF	NS
MUP								
Yes	0.978	0.97	0.99	NS	1.009	0.99	1.03	NS
No	REF	REF	REF	NS	REF	REF	REF	NS
EHR adoption								
Y	1.344	1.33	1.36	*	1.025	1.01	1.04	
N	REF	REF	REF	NS	REF	REF	REF	NS
Beneficiary characteristics	—	—	—	—	—	—	—	—
Age								
Percent of beneficiaries in county who are under age 65	1.022	1.02	1.03	*	0.990	0.98	1	NS
Percent of beneficiaries in county who are aged 66–74	REF	REF	REF	NS	REF	REF	REF	NS
Percent of beneficiaries in county who are aged 75–84	1.049	1.04	1.06	*	1.042	1.03	1.06	*
Percent of beneficiaries in county who are aged 85 and over	0.99	0.98	1	NS	1.016	1.01	1.03	NS

(continued)

Table C-1 (continued)
Table of odds ratios, confidence intervals, and reference variables for EP regression analyses

Professional characteristics	EP registration				EP attestation			
	OR	CI		Signif	OR	CI		Signif
Gender								
Percent of beneficiaries in county who are female	REF	REF	REF	NS	REF	REF	REF	NS
Percent of beneficiaries in county who are male	1.001	1	1.01	NS	0.958	0.95	0.97	*
Race								
Percent of beneficiaries in county who are unknown race	1.109	1.07	1.15	*	0.847	0.8	0.9	*
Percent of beneficiaries in county who are white	REF	REF	REF	NS	REF	REF	REF	NS
Percent of beneficiaries in county who are black	1.003	1	1	*	0.999	1	1	NS
Percent of beneficiaries in county who are other	0.969	0.96	0.97	*	1.026	1.02	1.04	*
Percent of beneficiaries in county who are Hispanic	1.006	1	1.01	NS	0.990	0.98	1	NS
Percent of beneficiaries in county who are North American Native	0.994	0.99	1	*	0.977	0.97	0.98	*
Percent of beneficiaries in county who are missing race	0.997	0.99	1	NS	0.957	0.95	0.96	*
Disease risk								
Percent of beneficiaries in 1st decile of risk score	REF	REF	REF	NS	REF	REF	REF	NS
Percent of beneficiaries in 2nd decile of risk score	1.057	1.04	1.08	*	0.877	0.85	0.91	*
Percent of beneficiaries in 3rd decile of risk score	0.933	0.91	0.95	*	0.958	0.93	0.99	NS
Percent of beneficiaries in 4th decile of risk score	1.029	1.01	1.05	NS	0.994	0.97	1.02	NS
Percent of beneficiaries in 5th decile of risk score	0.989	0.97	1.01	NS	0.743	0.72	0.77	*
Percent of beneficiaries in 6th decile of risk score	0.998	0.98	1.02	NS	0.920	0.89	0.95	*
Percent of beneficiaries in 7th decile of risk score	1.041	1.02	1.06	NS	0.886	0.86	0.92	*

(continued)

Table C-1 (continued)
Table of odds ratios, confidence intervals, and reference variables for EP regression analyses

Professional characteristics	EP registration				EP attestation			
	OR	CI		Signif	OR	CI		Signif
Percent of beneficiaries in 8th decile of risk score	1.007	0.99	1.03	NS	0.870	0.84	0.9	*
Percent of beneficiaries in 9th decile of risk score	0.964	0.94	0.98	NS	0.853	0.83	0.88	*
Percent of beneficiaries in 10th decile of risk score	0.97	0.96	0.98	*	0.875	0.86	0.89	*
Chronic conditions (HCCs)								
HCC10 = Breast, prostate, colorectal and other cancers and tumors	1.044	1.03	1.06	*	1.076	1.06	1.09	*
HCC19 = Diabetes without complication	1.019	1.01	1.02	*	1.018	1.01	1.03	*
HCC55 = Major depressive, bipolar, and paranoid disorders	1.015	1.01	1.02	*	1.096	1.09	1.11	*
HCC71 = Polyneuropathy	0.998	0.99	1.01	NS	1.056	1.04	1.07	*
HCC80 = Congestive heart failure	0.984	0.98	0.99	*	1.007	1	1.02	NS
HCC83 = Angina pectoris/old myocardial infarction	0.96	0.95	0.97	*	0.951	0.94	0.96	*
HCC92 = Specified heart arrhythmias	1.043	1.04	1.05	*	1.047	1.03	1.06	*
HCC105 = Vascular disease	1.004	1	1.01	NS	0.994	0.99	1	NS
HCC108 = Chronic obstructive pulmonary disease	1.006	1	1.01	NS	1.031	1.02	1.04	*
HCC130 = Dialysis status	1.046	1.04	1.05	*	1.033	1.03	1.04	*

OR= Odds Ratio, CI = Confidence Interval, REF = Reference Variable, Signif and * = statistically significant at p of .0001, NS = not significant, NI = Not included in model.

No REF for HCCs as these are independent measures.

Practice size ranges based on NAMCS survey with the exception of 11–20 and 20+ distinctions; CMS considers 20+ large; NAMCS treats 11+ as large.

APPENDIX D
TABLE OF ODDS RATIOS, CONFIDENCE INTERVALS, AND REFERENCE VARIABLES FOR EH AND CAH REGRESSION ANALYSES

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Table D-1
Table of odds ratios, confidence intervals, and reference variables for EH and CAH regression analyses

	EH registration				EH attestation				CAH registration				CAH attestation			
Effect	OR	CI		Signif	OR	CI		Signif	OR	CI		Signif	OR	CI		Signif
Urban/rural																
Completely rural	0.448	0.244	0.824	*	2.18	1.014	4.686	*	0.514	0.04	7.002	NS	0.308	0.03	3.151	NS
>0 - <50% urban	0.853	0.554	1.313	NS	1.45	0.912	2.306	NS	0.351	0.03	4.916	NS	0.601	0.058	6.247	NS
50 - <90% urban	1.209	0.899	1.626	NS	0.989	0.732	1.335	NS	0.466	0.03	6.37	NS	0.478	0.047	4.886	NS
90 - <100% urban	0.994	0.771	1.281	NS	0.899	0.693	1.165	NS	0.484	0.03	8.391	NS	0.339	0.028	4.131	NS
Completely urban	REF	REF	REF	c	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS
EHR adoption																
Yes	2.202	1.841	2.634	*	1.8	1.507	2.15	*	2.566	1.87	3.515	*	2.649	2.021	3.473	*
No	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS
Non-profit	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS
For profit	0.567	0.458	0.701	NS	1.337	1.043	1.713	*	0.563	0.25	1.288	NS	0.673	0.383	1.182	NS
Government hospital	1.269	0.976	1.65	NS	1.034	0.802	1.334	NS	1.544	1.11	2.157	*	0.78	0.59	1.03	NS
Academic hospital	0.997	0.772	1.287	NS	1.128	0.884	1.438	NS	0.257	0.02	2.906	NS	1.267	0.199	8.062	NS
Small hospital	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS
Large hospital	2.396	1.614	3.557	*	0.956	0.649	1.407	NS	—	—	—	—	—	—	—	—
Medium size hospital	1.48	1.186	1.847	*	0.904	0.705	1.158	NS	0.683	0.32	1.464	NS	1.613	0.828	3.14	NS
Medicare percent	2.889	1.358	6.145	*	0.642	0.274	1.503	NS	0.563	0.25	1.266	NS	3.673	1.725	7.819	*
Medicaid percent	2.477	0.975	6.295	*	0.592	0.219	1.602	NS	0.643	0.2	2.058	NS	4.839	1.761	13.299	*
Network member																
Yes	3.69	2.973	4.579	*	0.925	0.775	1.105	NS	0.649	0.47	0.899	*	2.878	2.145	3.863	*
No	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS

(continued)

Table D-1 (continued)
Table of odds ratios, confidence intervals, and reference variables for EH and CAH regression analyses

	EH registration				EH attestation				CAH registration				CAH attestation			
Effect	OR	CI		Signif	OR	CI		Signif	OR	CI		Signif	OR	CI		Signif
Medically underserved area																
Yes	0.91	0.748	1.108	NS	0.945	0.774	1.153	NS	0.843	0.59	1.197	NS	0.93	0.691	1.252	NS
No	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS
Medically underserved population																
Yes	0.972	0.782	1.209	NS	0.972	0.785	1.203	NS	0.557	0.34	0.907	*	1.02	0.685	1.52	NS
No	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS
Supplemental Security Income (SSI)																
SSI 0	REF	REF	REF	NS	REF	REF	REF	NS	NI	NI	NI	NI	NI	NI	NI	NI
SSI 0.001 to 0.049	3.903	1.011	15.07	*	0.372	0.03	4.587	NS	NI	NI	NI	NI	NI	NI	NI	NI
SSI 0.05 to 0.149	4.302	1.116	16.586	*	0.359	0.029	4.46	NS	NI	NI	NI	NI	NI	NI	NI	NI
SSI 0.15 to <0.29	3.497	0.89	13.737	NS	0.346	0.027	4.407	NS	NI	NI	NI	NI	NI	NI	NI	NI
SSI >=0.30	5.43	1.262	23.366	*	0.245	0.017	3.426	NS	NI	NI	NI	NI	NI	NI	NI	NI
SSI missing	0.084	0.016	0.446	*	0.026	0.001	0.638	*	NI	NI	NI	NI	NI	NI	NI	NI
Case mix index (CMI)																
CMI 0 - <1.25	REF	REF	REF	NS	REF	REF	REF	NS	NI	NI	NI	NI	NI	NI	NI	NI
CMI 1.25 - <1.44	1.021	0.789	1.323	NS	0.979	0.742	1.292	NS	NI	NI	NI	NI	NI	NI	NI	NI
CMI 1.44 - <1.64	1.199	0.896	1.605	NS	1.248	0.915	1.704	NS	NI	NI	NI	NI	NI	NI	NI	NI
CMI >=1.64	1.005	0.737	1.37	NS	0.958	0.68	1.349	NS	NI	NI	NI	NI	NI	NI	NI	NI
CMI missing	1.03	0.362	2.934	NS	3.747	0.947	14.829	NS	NI	NI	NI	NI	NI	NI	NI	NI
Percent of beneficiaries in county who are under age 65	1.041	0.988	1.096	NS	1.03	0.976	1.086	NS	0.955	0.88	1.041	NS	0.987	0.924	1.053	NS

(continued)

Table D-1 (continued)
Table of odds ratios, confidence intervals, and reference variables for EH and CAH regression analyses

Effect	EH registration				EH attestation				CAH registration				CAH attestation			
	OR	CI		Signif	OR	CI		Signif	OR	CI		Signif	OR	CI		Signif
Percent of beneficiaries in county who are aged 65-74	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS
Percent of beneficiaries in county who are aged 75-84	1.04	0.925	1.169	NS	0.993	0.88	1.12	NS	0.992	0.86	1.148	NS	1.003	0.893	1.126	NS
Percent of beneficiaries in county who are aged 85 and over	1.038	0.946	1.14	NS	1.072	0.975	1.179	NS	0.983	0.87	1.118	NS	0.964	0.874	1.063	NS
Percent of beneficiaries in county who are male	1.054	0.976	1.139	NS	0.951	0.878	1.031	NS	0.917	0.81	1.041	NS	0.936	0.848	1.034	NS
Percent of beneficiaries in county who are female	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS
Percent of beneficiaries in county who are unknown race	0.566	0.304	1.055	NS	1.07	0.572	2.002	NS	1.041	0.42	2.567	NS	1.508	0.721	3.152	NS
Percent of beneficiaries in county who are white	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS
Percent of beneficiaries in county who are black	0.987	0.976	0.998	*	0.982	0.97	0.994	*	1.008	0.98	1.036	NS	0.997	0.977	1.018	NS
Percent of beneficiaries in county who are other*	0.996	0.915	1.085	NS	1.034	0.951	1.124	NS	0.544	0.28	1.053	NS	0.553	0.333	0.918	*
Percent of beneficiaries in county who are Hispanic	1.004	0.936	1.077	NS	0.997	0.926	1.073	NS	1.392	0.82	2.352	NS	0.967	0.68	1.376	NS
Percent of beneficiaries in county who are North American Native*	0.979	0.942	1.018	NS	1.021	0.978	1.066	NS	1.185	1.02	1.379	*	1.32	1.155	1.509	*
Percent of beneficiaries in county who are missing race	0.984	0.955	1.015	NS	0.956	0.906	1.009	NS	0.984	0.93	1.038	NS	1.015	0.987	1.043	NS

(continued)

Table D-1 (continued)
Table of odds ratios, confidence intervals, and reference variables for EH and CAH regression analyses

	EH registration				EH attestation				CAH registration				CAH attestation			
Effect	OR	CI		Signif	OR	CI		Signif	OR	CI		Signif	OR	CI		Signif
Percent of beneficiaries in 1st decile of risk score	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS	REF	REF	REF	NS
Percent of beneficiaries in 2nd decile of risk score	0.978	0.736	1.299	NS	0.96	0.704	1.308	NS	1.099	0.84	1.441	NS	1.046	0.846	1.293	NS
Percent of beneficiaries in 3rd decile of risk score	0.96	0.731	1.259	NS	1.287	0.954	1.738	NS	0.96	0.73	1.272	NS	1.059	0.851	1.318	NS
Percent of beneficiaries in 4th decile of risk score	1.049	0.804	1.368	NS	0.902	0.681	1.195	NS	1.052	0.81	1.361	NS	0.889	0.725	1.091	NS
Percent of beneficiaries in 5th decile of risk score	0.879	0.671	1.151	NS	1.041	0.778	1.393	NS	1.056	0.82	1.367	NS	1.037	0.853	1.261	NS
Percent of beneficiaries in 6th decile of risk score	0.971	0.742	1.271	NS	0.989	0.745	1.313	NS	0.985	0.76	1.271	NS	1.083	0.891	1.316	NS
Percent of beneficiaries in 7th decile of risk score	0.938	0.712	1.235	NS	0.94	0.699	1.264	NS	0.983	0.75	1.293	NS	1.05	0.849	1.3	NS
Percent of beneficiaries in 8th decile of risk score	0.903	0.69	1.182	NS	1.047	0.787	1.392	NS	1.019	0.78	1.335	NS	1.069	0.866	1.319	NS
Percent of beneficiaries in 9th decile of risk score	1.038	0.805	1.339	NS	1.004	0.768	1.312	NS	1.082	0.82	1.434	NS	1.058	0.85	1.317	NS
Percent of beneficiaries in 10th decile of risk score	0.97	0.797	1.18	NS	1.03	0.828	1.281	NS	1.014	0.76	1.361	NS	0.938	0.747	1.178	NS
HCC19 ='Diabetes without complication	1.028	0.967	1.093	*	0.959	0.899	1.022	NS	1.023	0.93	1.128	*	0.924	0.855	0.998	*
HCC108 ='Chronic obstructive pulmonary disease	0.962	0.904	1.023	*	1.033	0.967	1.104	NS	0.973	0.87	1.091	*	1.087	0.996	1.188	NS
HCC105 ='Vascular disease	0.988	0.936	1.044	*	0.986	0.934	1.042	NS	1.034	0.96	1.119	*	1.118	1.041	1.2	*

(continued)

Table D-1 (continued)
Table of odds ratios, confidence intervals, and reference variables for EH and CAH regression analyses

	EH registration				EH attestation				CAH registration				CAH attestation			
Effect	OR	CI		Signif	OR	CI		Signif	OR	CI		Signif	OR	CI		Signif
HCC92 ='Specified heart arrhythmias	0.977	0.874	1.092	NS	0.952	0.849	1.066	NS	0.913	0.78	1.068	NS	1.06	0.938	1.199	NS
HCC80 ='Congestive heart failure	1.043	0.947	1.147	NS	1.023	0.929	1.127	NS	0.905	0.78	1.044	NS	0.961	0.861	1.073	NS
HCC131 ='Renal failure	1.011	0.943	1.084	NS	0.995	0.929	1.065	NS	1.006	0.9	1.125	NS	0.941	0.862	1.029	NS
HCC10 ='Breast, prostate, colorectal and other cancers and tumors	1.078	0.926	1.254	*	1.219	1.045	1.421	*	1.162	0.95	1.417	*	0.828	0.702	0.977	*
HCC71 ='Polyneuropathy	1.108	1.004	1.222	NS	0.969	0.879	1.068	NS	1.027	0.87	1.217	NS	1.022	0.887	1.177	NS
HCC55 ='Major depressive, bipolar, and paranoid disorders	0.923	0.841	1.013	NS	1.118	1.014	1.231	*	1.037	0.86	1.244	NS	0.874	0.752	1.016	NS
HCC83 ='Angina pectoris/old myocardial infarction	1.03	0.944	1.124	NS	1.03	0.946	1.121	NS	1.136	0.98	1.318	NS	0.993	0.886	1.113	NS

OR = Odds Ratio, CI = Confidence Interval, REF = Reference Variable, Signif and * = statistically significant at p of .05, NS = not significant.

No REF for HCCs as these are independent measures.