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Skilled Nursing Facility Readmission Measure (SNFRM) NQF #2510: All-Cause Risk-Standardized Readmission Measure

Draft Technical Report

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SKILLED NURSING FACILITY READMISSION MEASURE (SNFRM) NQF #2510: ALL-CAUSE RISK-STANDARDIZED READMISSION MEASURE
DRAFT TECHNICAL REPORT

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SECTION 1
INTRODUCTION

Hospital readmissions of Medicare beneficiaries discharged from a hospital to a skilled nursing facility (SNF) are common, and prior studies suggest that a large proportion of readmissions are preventable (Mor et al., 2010). Hospital readmissions also put beneficiaries at risk for complications (Ouslander et al., 2011). Analyses suggest there is opportunity for reducing hospital readmissions among SNF patients (Li et al., 2012; Mor et al., 2010), and multiple studies suggest SNF structural and process characteristics impact readmission rates (Coleman et al., 2004; MedPAC, 2011).

There are significant geographic differences in hospital readmission rates for SNF patients. Across the 50 states, readmission rates range from a low of 15.1 percent in Utah to a high of 28.1 percent in Mississippi. Within that range, nine states have readmission rates below 17 percent, and nine states have rates above 25 percent (Mor et al., 2010). These differences are not aligned with income: the state with the highest 2006 median income, New Jersey, has a readmission rate of 26.1 percent, while the poorest state, Mississippi, has a similarly high readmission rate of 28.1 percent (Mor et al., 2010).

In addition to geographic variation, readmission rates vary by facility characteristics. Facility characteristics that increase the likelihood of readmission include larger bed size, free-standing status (as opposed to hospital-based SNFs), a higher percentage of Medicaid patients, and for-profit status (Li et al., 2012). More hours per resident day of registered nurses, licensed practical nurses, and certified nurse aides are associated with a decrease in the rate of potentially avoidable readmissions (MedPAC 2011).

Hospital readmissions from SNFs are also expensive. According to Mor et al. (2010), based on an analysis of SNF data from 2006 Medicare claims merged with the Minimum Data Set (MDS), 23.5 percent of SNF stays resulted in a rehospitalization within 30 days of the initial hospital discharge. The average Medicare payment for each readmission was $10,352 per hospitalization, for a total of $4.34 billion. Of these rehospitalizations, 78 percent were deemed potentially avoidable. Applying this figure to the aggregate cost indicates that avoidable hospitalizations resulted in an excess cost of $3.39 billion (78 percent of $4.34 billion) to Medicare (Mor et al., 2010).

In an analysis of the 2008 MDS and the Online, Survey, Certification, and Reporting file, Li and colleagues (2012) found that hospital readmission rates varied by patient volume, with a 16.4 percent readmission rate for low-volume SNFs (≤45 annual SNF admissions), 15.9 percent for medium-volume SNFs (45–107 annual SNF admissions), and 14.3 percent for high-volume SNFs (≥108 annual SNF admissions) ($p<0.0001$). In addition to being costly, readmission to the hospital interrupts the SNF patient's therapy and care plan, causes anxiety and discomfort, and exposes the patient to hospital-acquired adverse events such as loss of functional status, health-care-associated infections, and medication errors (Covinsky et al., 2003; Boockvar et al., 2004; Ouslander et al., 2011).

In response to these issues, the Centers for Medicare & Medicaid Services (CMS) contracted with RTI International to develop the Skilled Nursing Facility 30-Day All-Cause

Readmission Measure (SNFRM). The goal of this measure is to measure facility-level readmission rates among beneficiaries utilizing SNF. This measure was designed using fee-for-service (FFS) Medicare claims and harmonizes with CMS's current Hospital-Wide All-Cause Unplanned Readmission Measure (HWR) measure (National Quality Forum [NQF] #1789) and readmission measures being developed for other post-acute care (PAC) settings (e.g.., inpatient rehabilitation facilities [IRF], long-term care hospitals [LTCH], home health agencies, and end-stage renal dialysis [ESRD] facilities). The harmonization is intended to promote shared accountability and to improve care transitions across all settings.

The intent of the SNFRM is to encourage SNF providers to monitor and reduce hospital readmissions, thereby reducing costs and improving the quality of care Medicare beneficiaries receive during their SNF stay. For example, SNF providers may use the SNFRM to track their readmissions to the hospital to enhance internal quality improvement efforts. Public reporting of this measure will provide information about facilities' readmission rates, allowing beneficiaries and their families to make informed choices about their SNF care. The SNFRM was endorsed by the NQF in December 2014.

This report summarizes the measure development and details the technical specifications, including the risk-adjustment models developed for the SNFRM and results of reliability and validity testing. Specifically, ***Section 2*** reports the methods used, including an overview of the measure and definitions of outcomes and eligible admissions, the inclusion/exclusion criteria, model development, data sources, risk adjustment, and statistical approaches. ***Section 3*** summarizes analytic results for this measure including model validation, reliability and validity testing, and results of bootstrapping to estimate confidence intervals for facilities' readmission rates. ***Section 4***, the final section, details the current status of this measure and provides a summary.

SECTION 2
MEASURE DEVELOPMENT

2.1 Measure Overview

The SNFRM estimates the risk-standardized rate of all-cause, unplanned hospital readmissions for SNF Medicare FFS beneficiaries within 30 days of discharge from their prior proximal short-stay acute hospital discharge. The SNF admission must have occurred within 1 day after discharge from the prior proximal hospital stay. The prior proximal hospital stay is defined as an inpatient admission to an inpatient prospective payment system (IPPS) hospital, critical access hospital (CAH), or PPS-exempt psychiatric or cancer hospitals. This measure is based on data for 12 months of SNF admissions. Because the measure denominator is based on SNF admissions, it is possible that Medicare beneficiaries with more than one eligible admission may be included in the measure multiple times within a given year.

The SNFRM excludes certain SNF stays. Specifically, the SNFRM excludes SNF stays for which the patient had one or more intervening PAC admissions occurring either between the prior proximal hospital discharge and SNF admission or after the SNF discharge. To ensure sufficient time to observe patient comorbidities, the measure excludes those who did not have at least 12 months of FFS Part A Medicare enrollment before the proximal hospital discharge. Additionally, the measure excludes patients who did not have FFS Part A Medicare enrollment for the entire 30-day risk window. The measure also excludes patients whose prior proximal hospitalization was for the medical (nonsurgical) treatment of cancer or who were receiving rehabilitation care or prostheses fitting. SNF stays in which the patients was discharged from the SNF against medical advice are also excluded.

We used the Agency for Healthcare Research and Quality (AHRQ) Clinical Classification System (CCS) single-level codes to categorize patients' primary reason for their prior proximal hospitalization. The CCS collapses more than 14,000 diagnosis codes and 4,000 procedure codes from the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM) into a clinically meaningful, mutually exclusive set of 280 condition categories and 231 procedure categories (HCUP CCS, 2015).

The SNFRM produces a risk-adjusted readmission rate for each facility, excluding planned readmissions from the SNF. The measure is computed by calculating the standardized risk ratio (SRR): the predicted number of readmissions at the facility divided by the expected number of readmissions for the same patients if these patients had been treated at the average SNF. The magnitude of the risk-standardized ratio is the indicator of a facility's effect on readmission rates. After computing the SRR, the SRR is then multiplied by the mean rate of readmission in the population (i.e., all Medicare FFS patients included in the measure) to generate the facility-level standardized readmission rate, referred to as the Risk-Standardized Readmission Rate or RSRR.

The SNFRM measure specifications are designed to harmonize with CMS's Hospital-Wide All-Cause Unplanned Readmission (HWR) measure to the greatest extent possible. The HWR (NQF #1789) estimates the hospital-level, risk-standardized rate of unplanned, all-cause readmissions within 30 days of a hospital discharge (Horwitz et al., 2012) and uses the same 30-

day risk window as the SNFRM. There are many methodological similarities in the two measures.

2.2 Outcome Definition

This measure is designed to capture the outcome of unplanned all-cause hospital readmissions (IPPS or CAH) of SNF patients occurring within 30 days of discharge from the patient's prior proximal acute hospitalization.

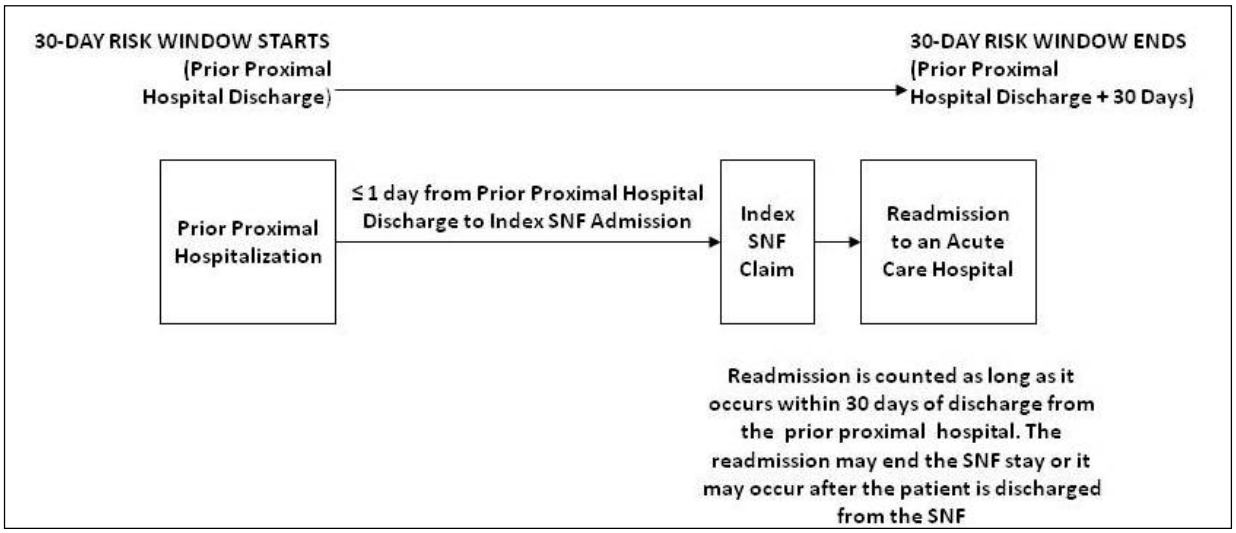
The numerator is more specifically defined as the risk-adjusted estimate of the number of SNF stays with unplanned readmissions that occurred within 30 days of discharge from the prior proximal acute hospitalization. The numerator is mathematically related to the number of SNF stays where there was hospitalization readmission. The measure does not have a simple form for the numerator and denominator—that is, the risk adjustment method used does not make the observed number of readmissions the numerator and a predicted number the denominator. The numerator, as defined, includes risk adjustment for patient characteristics and a statistical estimate of the facility effect beyond patient mix.

Hospital readmissions that occur within the stay or after discharge from the SNF stay but within 30 days of the proximal hospitalization are included in the numerator. This measure does not include observation stays as a readmission (see ***Appendix A***). Readmissions identified as being planned using the CMS Planned Readmission Algorithm plus additional procedures specific to PAC are excluded from the numerator (see ***Section 2.2.3*** and ***Appendix B***).

2.2.1 Thirty-Day Readmission Window

The all-cause SNFRM is evaluated on a 1-year cycle. The SNFRM numerator time window is 30 days after discharge from the prior proximal hospitalization. To be included in the denominator, a patient must have a SNF admission within 1 day after being discharged from the prior proximal hospital stay, and that SNF admission must occur within the target 12-month period. ***Figure 1*** depicts the SNFRM's 30-day risk window starting from the prior proximal hospitalization discharge date. If the readmission occurred during the SNF stay within the 30-day risk window, or after the SNF stay but still within the 30-day risk window, it is counted in the numerator.

Figure 1
Risk Window for the SNF Readmission Measure



2.2.2 Planned Readmissions

The SNFRM used a modified version of CMS's Planned Readmissions Algorithm (CMS, 2014) to identify readmissions that are classified as planned, and should therefore not be included in the numerator. Planned readmissions should not be counted against facilities because, as stated in the documentation for the HWR measure, "…planned readmissions are not a signal of quality of care." (NQF #1789, p. 35). According to the algorithm, a planned readmission is defined as any non-acute readmission in which one of a set of typically planned procedures or diagnoses occurred. If any of the procedures denoted as planned occur in conjunction with a diagnosis that disqualifies a readmission from being considered planned, the readmission will be considered unplanned. The planned readmission algorithm is based on two main principles:

1. Planned readmissions are those in which one of a pre-specified list of procedures took place or readmissions for one of the following took place: bone marrow, kidney, or other transplants. Planned diagnosis categories include maintenance chemotherapy and rehabilitation. Pregnancy diagnoses and procedures such as normal pregnancy, Cesarean section; forceps delivery, vacuum, and breech delivery are also considered planned. Readmissions to psychiatric hospitals or units are also classified as planned readmissions.

2. Admissions for acute illness or for complications of care are not classified as "planned" Even a typically planned procedure performed during an admission for an acute illness would not likely have been planned. We used the principal diagnosis and all of the procedure codes from the readmission to identify planned readmissions.

Unless a readmission met the algorithm definition of planned, it was considered unplanned and counted as a readmission in the measure.

The algorithm developed to identify planned readmissions uses procedure codes and discharge diagnosis categories for each readmission coded using the AHRQ CCS software.

We added procedures to the CMS Planned Readmission Algorithm that were specific to PAC settings based on feedback from a technical expert panel convened by RTI. These additional procedures were codified by a certified nosologist before use. These procedures and diagnoses are currently defined by ICD-9 procedure and diagnosis codes grouped by the AHRQ's CCS, where large clusters were appropriate, and by individual codes, if necessary.

Appendix B provides a flowchart for how the planned readmission algorithm was programmed and lists the planned procedures and diagnoses for both CMS's Planned Readmission Algorithm and the additional PAC procedures added by RTI for this measure. Note this algorithm was refined in the fiscal year 2015 IPPS/LTCH PPS Final Rule (79 Federal Register 50211 through 50216), and the technical documentation can be found at http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/HospitalQualityInits/Measure-Methodology.html.

At the time of the SNFRM development, ICD-9 codes were used. This measure will be transitioned to ICD-10 in the future, including the planned readmission lists. We prepared a provisional mapping of these ICD-9s to ICD-10s for planned readmissions as part of our NQF submission; however, please note this mapping will be finalized at a future date.

In 2011, there were 2,215,398 SNF stays, of which 467,107 included an unplanned hospital readmission (21.1%). An additional 1.3 percent of SNF stays (or 27,956 stays) ended with readmissions that were classified as planned and not included in the numerator of the measure. These planned readmissions represented only 5.6 percent of all readmissions.

2.3 Definition of Eligible Admissions

Similar to CMS's HWR, we defined eligible SNF stays as those for which we could attribute a prior proximal hospital discharge with no intervening PAC admissions between the prior proximal hospital discharge and SNF admission or after the SNF discharge and with sufficient FFS data to identify readmissions and risk-adjust the measure. We also evaluated whether the procedures and diagnoses during the prior proximal hospitalization were for acute care or rehabilitation services (e.g., prostheses fitting) and whether the reasons for readmission to hospital were for the medical treatment of cancer or were planned readmissions. This measure does not count observation stays as eligible hospital readmissions, as described in **Appendix A**.

2.3.1 Inclusion and Exclusion Criteria

The denominator includes all patients who have been admitted to a SNF within 1 day of discharge from a prior proximal hospitalization, taking denominator exclusions into account. Patients with SNF stays in swing bed facilities are included in the measure. The prior proximal hospitalization includes admissions to an IPPS acute-care hospital, CAH, psychiatric, or cancer hospital. The following SNF stays are excluded from the denominator:

1. SNF stays where the patient had one or more intervening PAC admissions (IRF or LTCH) that occurred either between the prior proximal hospital discharge and SNF admission or after the SNF discharge within the 30-day risk window. Also excluded are SNF admissions where the patient had multiple SNF admissions after the prior proximal hospitalization within the 30-day risk window. We used Medicare Provider Analysis and Review (MedPAR) files to evaluate this exclusion.

   Rationale: Patients who have IRF or LTCH admissions before their first SNF admission are starting their SNF admission later in the 30-day risk window and receiving other additional types of services as compared to patients admitted directly to the SNF from the prior proximal hospitalization. They are clinically different, and their risk for readmission is different from the rest of SNF admissions. Additionally, when patients have multiple PAC or SNF admissions, evaluating quality of care coordination is confounded and even controversial in terms of attributing responsibility for a readmission among multiple PAC or SNF providers.

2. SNF stays with a gap of greater than 1 day between discharge from the prior proximal hospitalization and the SNF admission. We used MedPAR files to evaluate this exclusion.

   Rationale: These patients are starting their SNF admissions later in the 30-day risk window than patients admitted directly to the SNF from the prior proximal hospitalization. They are likely clinically different, and their risk for readmission is different from the rest of SNF admissions.

3. SNF stays where the patient did not have at least 12 months of FFS Part A Medicare enrollment before the proximal hospital discharge (measured as enrollment during the month of proximal hospital discharge and the 11 months before that month). We used the Medicare Denominator file to evaluate this exclusion.

   Rationale: FFS Medicare hospital claims are used to identify comorbidities during the 12-month period before the proximal hospital discharge for risk adjustment. Multiple studies have shown that using lookback scans of a year or more of claims data provide superior predictive power for outcomes, including rehospitalization, as compared to using data from a single hospitalization (e.g., Klabunde et al., 2000; Preen et al., 2006; Zhang et al., 1999).

4. SNF stays in which the patient did not have FFS Part A Medicare enrollment for the entire risk period (measured as enrollment during the month of proximal hospital discharge and the month after the month of discharge). We used the Medicare Denominator file to evaluate this exclusion.

   Rationale: Readmissions occurring within the 30-day risk window when the patient does not have FFS Medicare coverage cannot be detected using claims.

5. SNF stays in which the principal diagnosis for the prior proximal hospitalization was for the medical treatment of cancer. See ***Table 1*** for the cancer discharge condition

categories excluded from the measure. We used MedPAR files for the prior proximal hospitalization to evaluate this exclusion.

Patients with cancer whose principal diagnosis from the prior proximal hospitalization was for other diagnoses or had surgical treatment of their cancer remain in the measure.

Rationale: These admissions have a very different mortality and readmission risk from the rest of the Medicare population, and outcomes for these admissions do not correlate well with outcomes for other admissions, as determined in the development of the HWR measure.

6. SNF stays where the patient was discharged from the SNF against medical advice. We used MedPAR files to evaluate this exclusion.

   Rationale: The SNF was not able to complete care as needed.

7. SNF stays in which the principal diagnosis for the prior proximal hospitalization was for "rehabilitation care; fitting of prostheses and for the adjustment of devices." We used MedPAR files for the prior proximal hospitalization to evaluate this exclusion.

   Rationale: Hospital admissions for these conditions are not for acute care.

8. SNF stays in which the prior proximal hospitalization was for pregnancy.

   Rationale: This is a very atypical reason for beneficiaries to be admitted to SNFs.

9. SNF stays in which data were missing on any covariate or variable used in the SNFRM construction.

   Rationale: These patients have incomplete information on which to base risk adjustment.

Table 1
Cancer discharge condition categories excluded from the measure
(Medicare FFS data, 2011)

AHRQ CCS	Description	Number of Admissions
42	Secondary malignancies	9,638
19	Cancer of bronchus; lung	5,941
44	Neoplasms of unspecified nature or uncertain behavior	2,100
45	Maintenance chemotherapy; radiotherapy	1,953
38	Non-Hodgkin`s lymphoma	1,837
17	Cancer of pancreas	1,380
14	Cancer of colon	1,324
39	Leukemias	1,309
40	Multiple myeloma	1,258
35	Cancer of brain and nervous system	1,200
11	Cancer of head and neck	839
16	Cancer of liver and intrahepatic bile duct	686
15	Cancer of rectum and anus	646
13	Cancer of stomach	599
12	Cancer of esophagus	567
18	Cancer of other gastrointestinal organs; peritoneum	554
29	Cancer of prostate	530
24	Cancer of breast	528
27	Cancer of ovary	415
43	Malignant neoplasm without specification of site	396
33	Cancer of kidney and renal pelvis	385
32	Cancer of bladder	366
25	Cancer of uterus	267
21	Cancer of bone and connective tissue	196
23	Other non-epithelial cancer of skin	147
41	Cancer; other and unspecified primary	145
28	Cancer of other female genital organs	95
26	Cancer of cervix	94
37	Hodgkin`s disease	74
20	Cancer; other respiratory and intrathoracic	63
36	Cancer of thyroid	49
34	Cancer of other urinary organs	46
22	Melanomas of skin	43
31	Cancer of other male genital organs	19
30	Cancer of testis	2
	Total	35,691

SOURCE: RTI Analysis of Medicare Claims (output: readmit139_cancers_excl_2011.xls)

Table 2 summarizes the frequency of exclusions from the denominator of this measure using the MedPAR claims and Denominator data for 2011. For each analysis, RTI identified SNF admissions preceded by an acute-care hospitalization (IPPS, CAH, psychiatric, or cancer hospital) for each file year. Before applying exclusion criteria, the initial analytic file for 2011 included 2,115,398 index SNF stays in 16,656 SNFs.

To examine the impact of exclusion criteria on the denominator specification of the SNFRM, RTI calculated the overall proportion of SNF stays excluded on the basis of each exclusion criteria. The distribution of exclusions across facilities shows whether some facilities are disproportionately impacted by each exclusion. Additionally, for the exclusions that apply to patients who received PAC between the prior proximal hospital discharge and their SNF admission, or after their SNF discharge but within the 30-day risk window, we compared patient characteristics between patients who were included and excluded from the measure.

Table 2
Frequency of denominator exclusions

Individual exclusions (not mutually exclusive)	Frequency	Percentage
Exclusion 1*:* Intervening PAC stays (between prior proximal hospital discharge and SNF admission, or after SNF discharge but before the end of the 30-day risk period)	232,687	8.4
Exclusion 2*:* Gap of greater than 1 day between prior proximal hospital discharge and SNF admission[1]	156,246	5.6
Exclusion 3*:* Not continuously enrolled in Medicare FFS for the full year before prior proximal hospital discharge	160,403	5.8
Exclusion 4*:* Discharged from SNF against medical advice	9,686	0.4
Exclusion 5*:* Principal diagnosis in prior proximal hospitalization for medically treated cancer	35,691	1.3
Exclusion 6*:* Principal diagnosis in prior proximal hospitalization for rehabilitation care	2,119	0.1
Exclusion 7*:* Not enrolled in Medicare FFS for the month of the prior proximal hospitalization and the 1 month after the hospitalization	150,815	5.4
Total excluded for any reason[2]	538,306	19.7

1 This exclusion covers cases with PAC or SNF stays occurring in the gap between the prior acute hospital discharge and the SNF admission

2 Exclusions shown in this table are not mutually exclusive. Patients may be counted in more than one excluded category.

SOURCE: RTI analysis of 2011 MedPAR data (output: idxSNF03_lk_all_yrs_001_2011.xls)

We also examined the impact of applying measure exclusions on facility measure scores. For each criterion, we examined the absolute difference in facilities' risk-standardized readmission rates (RSRRs) calculated with and without each exclusion (applying all other

exclusions except the one of interest). We also examined facility rank change across quintiles of RSRR calculated with and without the exclusion of interest applied. These analyses included all facilities regardless of facility sample size.

We did not do this analysis for the exclusion criteria pertaining to data availability (i.e., patients not enrolled in Medicare FFS for the month of the prior proximal hospitalization or the 1 month after the hospitalization). Because these exclusions are largely based on data limitations that would prevent proper analysis, no further analyses were conducted to assess the impacts of these exclusions. In many cases, the lack of available claims data meant that further analysis was not feasible.

We further detail each of the measure exclusions below and, where relevant, summarize the relevant analyses conducted.

Exclusion 1[1] *- SNF stays where the patient had one or more intervening PAC stays (IRF or LTCH) that occurred either between the prior proximal hospital discharge and SNF admission, or after the SNF stay but within the 30-day risk window. Also excluded are any stays in which the patient had multiple SNF admissions after the prior proximal hospitalization*

Exclusion 2 *- SNF stays with a gap of greater than 1 day between discharge from the prior proximal hospitalization and the SNF admission.*

RTI conducted analyses to evaluate whether patients with gaps of more than 1 day between their prior proximal hospitalization and their index SNF admission and patients with an intervening PAC admission (from an IRF, LTCH, and/or another SNF) before their index SNF admission in the 30-day risk window are similar to those who are discharged from the hospital directly to a SNF with no additional PAC stays after their index SNF.

Focusing on gaps due to intervening IRF and LTCH admissions, we found that most (89.5%) of the 2011 index SNF stays (2011 MedPAR file) were transfers from the prior proximal acute hospitalization directly to a SNF with no gap or intervening PAC admission (***Table 3***, group 1). Approximately 2 percent had no intervening PAC admission yet had a gap of greater than 1 day between discharge from the prior proximal hospital and SNF admission (group 2), 3.7 percent had one SNF admission with a gap due to intervening IRF and LTCH admission(s) (group 3), and 4.8 percent had multiple SNF admissions with or without intervening IRF/LTCH admissions (group 4) (***Table 3***).

[1] We describe the first two exclusions together here because of the overlap in the two groups of patients.

Table 3
Evaluating gap and intervening IRF or LTCH admissions between prior proximal hospitalization discharge and SNF admission, 2011

Gap and Intervening PAC stay categories	Frequency (%)	Readmission rate (%)
No intervening IRF/LTCH/SNF and no gap (group 1)	2,492,388 (89.5)	21.8
No intervening IRF/LTCH/SNF and a gap (group 2)	54,345 (2.0)	15.4
Intervening IRF/LTCH (One SNF) (group 3)	104,119 (3.7)	8.6
Multiple SNFs (Could also be intervening IRF/LTCH) (group 4)	134,717 (4.8)	13.2

SOURCE: RTI analysis of 2011 MedPAR data (output: idxSNF02_lk_all_yrs_013b.xls)

Examining the 2011 file, only 30 facilities out of 16,656 SNFs had an absolute change in RSRR of more than 1 percentage point when patients with a gap of greater than 1 day were not excluded, but 1,593 (9.6%) changed quintiles of ranking.[2] When patients with intervening PAC stays were not excluded from the measure, only 16 facilities had an absolute change in RSRR of more than 1 percentage point, and only 279 changed facility quintile ranking.[3]

We excluded patients who have IRF or LTCH admissions before their first SNF admission and patients with gaps greater than 1 day between their SNF admission and discharge from the prior proximal hospitalization. These patients start their SNF admission later in the 30-day risk window and receive other additional types of services as compared with patients admitted directly to the SNF from the prior proximal hospitalization. They are also clinically different, and their risk for readmission is different from the rest of SNF admissions. Consistent with this hypothesis, readmission rates varied across these groups. Those with one SNF and intervening IRF/LTCH admissions (***Table 3***, group 3) had the lowest rates of readmission (8.6%) as compared with the other three groups. Of those with no gap and no intervening PAC admission (***Table 3***, group 1), 21.8 percent were readmitted. For those with a gap and no intervening PAC admission (***Table 3***, group 2), 15.4 percent were readmitted. Finally, of those with multiple SNF admissions with or without IRF/LTCH admissions (***Table 3***, group 4), 13.2 percent were readmitted.

Additionally, we compared these four groups by potential predictors of readmission, including age, sex, Medicare disability status, ESRD, number of IPPS stays in preceding 12 months, whether they had surgery during the prior proximal hospitalization, and selected comorbidities (congestive heart failure, arrhythmias, diabetes with complications, gastrointestinal hemorrhage, chronic obstructive pulmonary disease, acute renal failure, urinary

[2] Source: RTI analysis of 2011 MedPAR data (output: readmit142_idxSNF02_HLMFinal_exclOth_RiskComp_keepDG.xls)
[3] Source: RTI analysis of 2011 MedPAR data (output: readmit142_idxSNF02_HLMFinal_exclOth_RiskComp_keepDPI.xls)

tract infection, electrolyte imbalance, acute myocardial infarction, cellulitis, shock, septicemia, and pneumonia). These groups looked very similar (with ***Table 3***, group 3 having slightly lower frequencies of comorbidities overall), with the exception of proximal hospitalization length of stay and having had a surgical procedure during their prior proximal hospitalization. Those with one SNF and intervening IRF/LTCH admissions (***Table 3***, group 3) had longer hospital lengths of stay than those in the other three groups. This group also had the highest percent of prior proximal hospitalizations involving surgical procedures (40.7%) as compared with those with no gap and no intervening PAC admission (27.1%, group 1), those with a gap and no intervening PAC admission (15.7%, group 2) and those with multiple SNF admissions with or without IRF/LTCH admissions (24.6%, ***Table 3***, group 4). The readmission rate for patients who had surgery during their prior proximal hospitalization was lowest in those with only one SNF and intervening IRF/LTCH stays (8.1%, group 3), compared with those with those who had no gaps or intervening PAC stays (18.2%, group 1), those with a gap and no intervening PAC admission (14.8%, group 2), and those with multiple SNF admissions, with or without IRF/LTCH admissions (11.8%, group 4) (***Table 3***).[4] This observation supports the rationale that patients who had intervening IRF/LTCH stays are entering the SNF at a later stage of their recovery and are therefore at a different risk for readmission than patients who were admitted directly to the SNF from their prior proximal hospitalization.

To examine whether certain SNFs are disproportionately impacted by these exclusions, we also explored the facility-level distribution of SNF admissions that had a gap of greater than 1 day between SNF admission and discharge from the prior proximal hospital and/or intervening PAC admissions using the 2011 MedPAR data file. The facility mean and median number of SNF stays for those with no gap and no intervening PAC admissions (***Table 3***, group 1) was 149.3 and 107 stays respectively, with an interquartile range of 146. The corresponding means and medians were 3.3 and 2 stays, with an interquartile range of 4, for group 2; 6.2 and 3 stays, with an interquartile range of 6, for group 3; and 8.1 and 5 stays, with an interquartile range of 6, for group 4 (***Table 3***).[5]

Combined, these analyses provide justification that excluding SNF admissions with intervening IRF or LTCH admissions or with multiple SNF stays will not have a detrimental or substantial effect on the SNFRM. The patients with multiple PAC stays after a prior proximal hospitalization are not systematically different from those with only one SNF stay with regard to comorbidities but are very different with regard to readmission risk. Additionally, concerns about attribution, given the mix of providers these patients have received services from during the risk period, argue for the appropriateness of excluding these patients. Lastly, patients with multiple PAC stays do not cluster in a small group of facilities, so no facilities are disproportionately impacted by these exclusions.

Exclusion 3 *- SNF stays where the patient did not have at least 12 months of FFS Part A Medicare enrollment before the proximal hospital discharge (measured as enrollment during the month of proximal hospital discharge and the 11 months before that discharge).*

[4] Source: RTI analysis of 2009 MedPAR data (output: idxSNF02_lk_all_yrs_015b.xls)

[5] Source: RTI analysis of 2011 MedPAR data (output: idxSNF02_lk_all_yrs_019_2011.xls)

Using the 2011 MedPAR data, 160,403 (5.8%) of the stays were excluded because the patient was not enrolled for least 11 months of FFS Medicare before their prior proximal hospitalization. Of the patients excluded for insufficient months of FFS Medicare enrollment, 21.5 percent were readmitted, compared to 20.7 percent of patients with sufficient months of enrollment.[6]

Exclusion 4 *- SNF stays in which the patient did not have FFS Medicare enrollment for the entire risk period, that is, the 30 days after discharge from the prior proximal hospitalization (measured as enrollment during the month of proximal hospital discharge and the month following the month of discharge).*

Using 2011 MedPAR data, 140,971 patients were excluded because they were not enrolled in FFS Medicare during the full 30 days after discharge from their prior proximal hospitalization. Of these, 29.8 percent were readmitted, compared to 20.2 percent of patients who were enrolled in FFS Medicare.[7]

Excluded patients were evenly distributed across facilities. Looking at facility distributions of patients excluded for insufficient FFS enrollment in the months before hospitalization combined with those who did not have FFS Medicare enrollment for the entire risk period, we found a fairly even impact of the exclusion across facilities. There is a narrow interquartile range, with an absolute difference of 3.9 percentage points between the 25th and 75th percentile. However, 5 percent of facilities had 15.2 percent or more of their patients excluded for not having sufficient months of FFS Medicare enrollment.[8] Analyses of 2009 data that looked at these two groups of patients separately also showed relatively even distributions of these patients across facilities. Regardless of these results it would be inappropriate to include these patients because readmissions occurring during the 30 day risk period but when patients were not enrolled would not be detected.

Exclusion 5 *- SNF stays in which the prior proximal hospitalization was for the medical treatment of cancer.*

Only 35,691 or 1.3 percent of the 2011 MedPAR stays were excluded because the patient's prior hospitalization involved the medical treatment of cancer; 25.7 percent of these patients were readmitted within 30 days, compared to 20.7 percent of patients without a diagnosis of medical treatment of cancer.[9] The proportions of excluded patients across facilities were uniformly low, with only 5 percent of SNFs having 3.6 percent or more of their patients excluded for the medical treatment of cancer.[10]

Examining the 2011 file, only 23 facilities had an absolute change in RSRR of more than 1 percentage point, and only 1,004 changed quintile of facility ranking when patients with a prior

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6 Source: RTI analysis of 2011 MedPAR data (output: idxSNF03_lk_all_yrs_001_2011.xls)
7 Source: RTI analysis of 2011 MedPAR data (output: idxSNF03_lk_all_yrs_001_2011.xls)
8 Source: RTI analysis of 2011 MedPAR data (output: readmit094_idxSNF02_FacilityExcl_02_2011.xls)
9 Source: RTI analysis of 2011 MedPAR data (output: idxSNF03_lk_all_yrs_001_2011.xls)
10 Source: RTI analysis of 2011 MedPAR data (output: readmit094_idxSNF02_FacilityExcl_02_2011.xls)

proximal hospital diagnosis of medical treatment of cancer were not excluded.[11] The exclusion of the group of patients who had non-surgical cancer treatment in the prior acute stay was based on the work done in developing the HWR measure (NQF #1789). Their post-discharge trajectory of readmissions was not consistent with other patient groups. The observed clustering of these patients in a few facilities, and facility rank change of a quintile or more for just over a thousand facilities, suggests that the exclusion of these patients is appropriate. These findings are consistent with the rationale given for this exclusion from the HWR that patients with a diagnosis of medical treatment of cancer have very different risk for readmission than other patients, and should therefore be excluded from the SNFRM to allow fair assessment of facilities.

Exclusion 6 *- SNF stays where the patient was discharged from the SNF against medical advice.*

Based on 2011 MedPAR data, less than 1 percent of patients (n=7,653 [0.4%]) were discharged from the SNF against medical advice, and of these, 21.0 percent were readmitted within 30 days, compared to 20.7 percent of patients who were not discharged from the SNF against medical advice.[12] The facility distribution did not suggest any clustering of excluded patients in facilities. SNFs at the 95th percentile had only 1.7 percent of their patients excluded for leaving the SNF against medical advice.[13]

Examining the 2011 file, only 24 facilities had an absolute change in RSRR of more than 1 percentage point and only 317 changed quintile of facility ranking when patients discharged from the SNF against medical advice were not excluded.[14]

Exclusion 7 *- SNF stays where the patient's principal diagnosis during their proximal hospitalization was for "rehabilitation care; fitting of prostheses and for the adjustment of devices."*

Very few patients' prior proximal hospitalization involved rehabilitation care (n=1,770 [0.08%]). Of those patients, 16.5 percent were readmitted within 30 days, compared with 20.7 percent of patients without a principal diagnosis of rehabilitation care.[15] These patients were so few in number that a facility analysis was not informative.[16]

Examining the 2011 file, only 2 facilities had an absolute change in RSRR of more than 1 percentage point, and only 56 changed quintile of facility rank when patients with a prior proximal hospital diagnosis of rehabilitation care were not excluded.[17]

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[11] Source: RTI analysis of 2011 MedPAR data (output: readmit142_idxSNF02_HLMFinal_exclOth_RiskComp_keepDCA.xls)
[12] Source: RTI analysis of 2011 MedPAR data (output: idxSNF03_lk_all_yrs_001_2011.xls)
[13] Source: RTI analysis of 2011 MedPAR data (output: readmit094_idxSNF02_FacilityExcl_02_2011.xls)
[14] Source: RTI analysis of 2011 MedPAR data (output: readmit142_idxSNF02_HLMFinal_exclOth_RiskComp_keepDA.xls)
[15] Source: RTI analysis of 2011 MedPAR data (output: idxSNF03_lk_all_yrs_001_2011.xls)
[16] Source: RTI analysis of 2009 MedPAR data (output: readmit112_idxSNF02_FacilityExcl_01.lst, readmit094_idxSNF02_FacilityExcl_02_2009.xls)
[17] Source: RTI analysis of 2011 MedPAR data (output: readmit142_idxSNF02_HLMFinal_exclOth_RiskComp_keepDR.xls)

Exclusion 8 *- SNF stays in which the prior proximal hospitalization was for pregnancy.*

Very few patients' prior proximal hospitalization was for pregnancy (n=17). These were excluded given that this is a very atypical reason for beneficiaries to be admitted to SNFs.

Exclusion 9 *- SNF stays in which data were missing on any covariate or variable used in the SNFRM construction.*

Very few patients were missing data on any variables used for the construction of the SNFRM. After applying all other exclusions, there were 2,215,562 records in the 2011 dataset. Of these, 164 (0.007%) were missing any data. Specifically, these patients were missing data on ESRD status, leaving a total of 2,215,398 in the 2011 model.[18]

In summary, based on the results reported above, we conclude that all exclusions appeared to have little impact on absolute facility RSRRs. Those exclusions focusing on prior proximal diagnosis of rehabilitation, discharge from SNF against medical advice, and intervening PAC stays appeared to have little impact on facility ranking. The inclusion of very small facilities in the exclusion analyses may have exaggerated the impact of exclusions on facility RSRRs. For the two exclusions with the largest impact on facility ranking, patients with a SNF admission gap greater than 1 day and patients with a prior proximal hospital diagnosis of medical treatment of cancer, shifts in decile rank occurred in the middle of the distribution. Facilities with the smallest sample size tended to have RSRRs closer to the mean, because of shrinkage, and would have been most impacted by a change in raw readmissions of only one or two patients. Given that this measure utilizes administrative claims data, we have no concerns about missing data distorting provider performance.

2.4 Data Sources and Sample Sizes

2.4.1 Data Sources

This measure is for Medicare beneficiaries and uses the data in the Medicare eligibility files and inpatient claims data. The eligibility files provide information on date of birth, sex, reasons for Medicare eligibility, periods of Part A coverage, and enrollment periods in the FFS program. The data elements from the Medicare FFS claims are those basic to the operation of the Medicare payment systems and include date of admission, date of discharge, diagnoses, procedures, indicators for use of dialysis services, and indicators of whether the Part A benefit is exhausted. The inpatient claims data files contain beneficiary-level SNF and other hospital records. No data beyond the bills submitted in the normal course of business are required from the providers for the calculation of this measure.

The measure uses 1 year of data to calculate the measure rate for the SNFRM, which we believe is sufficient to calculate this measure in a statistically reliable manner. This is because the reliability of a SNF's measure rate is related to its sample size.

[18] Source: RTI analysis of 2011 MedPAR data (output:readmit113_idxSNF02_UniVar_Descript_Model_2011.xls)

Following are the specific files used and links to the documentation:

- **Medicare inpatient claims**—MedPAR (short stay, long stay) files (2007-2012), index SNF claims from SNF MedPAR files (2009-2011). Documentation for the Medicare claims data is provided online by the CMS contractor, Research Data Assistance Center (ResDAC) at the University of Minnesota. The following web page includes data dictionaries for these files: MedPAR: http://www.resdac.org/cms-data/files/medpar-rif/data-documentation

- **Medicare Enrollment Database (EDB)**. Information about the Enrollment Database may be found here: http://aspe.hhs.gov/datacncl/datadir/cms.htm.

- **Medicare Denominator files** (2009-2011). Documentation available at http://www.cms.gov/Research-Statistics-Data-and-Systems/Files-for-Order/IdentifiableDataFiles/DenominatorFile.html.

- **AHRQ CCS groupings of ICD-9 codes**. Documentation available at http://www.hcup-us.ahrq.gov/toolssoftware/ccs/ccs.jsp.

- **CMS's hierarchical condition category (HCC) mappings of ICD-9 codes**. Mappings are included in the software at the following website: http://www.cms.gov/Medicare/Health-Plans/MedicareAdvtgSpecRateStats/Risk-Adjustors.html.

2.4.2 Final Sample Sizes

To develop the risk-adjustment model for this measure, we analyzed Medicare claims, Denominator, and EDB files for 2009, 2010, and 2011, and identified SNF admissions preceded by an acute-care hospitalization (IPPS, CAH, psychiatric, or cancer hospitals).

After applying the exclusion criteria detailed above, the final analytic files included the following counts of stays and facilities:

2009: 2,191,546 index SNF stays in 16,713 SNFs

2010: 2,200,685 index SNF stays in 16,671 SNFs

2011: 2,215,398 index SNF stays in 16,656 SNFs

2.5 Risk Adjustment

In this section, we describe the steps we went through to develop our final risk-adjustment model, including selection of covariates and approaches to case mix adjustment.

2.5.1 Covariate Selection—Conceptual Rationale

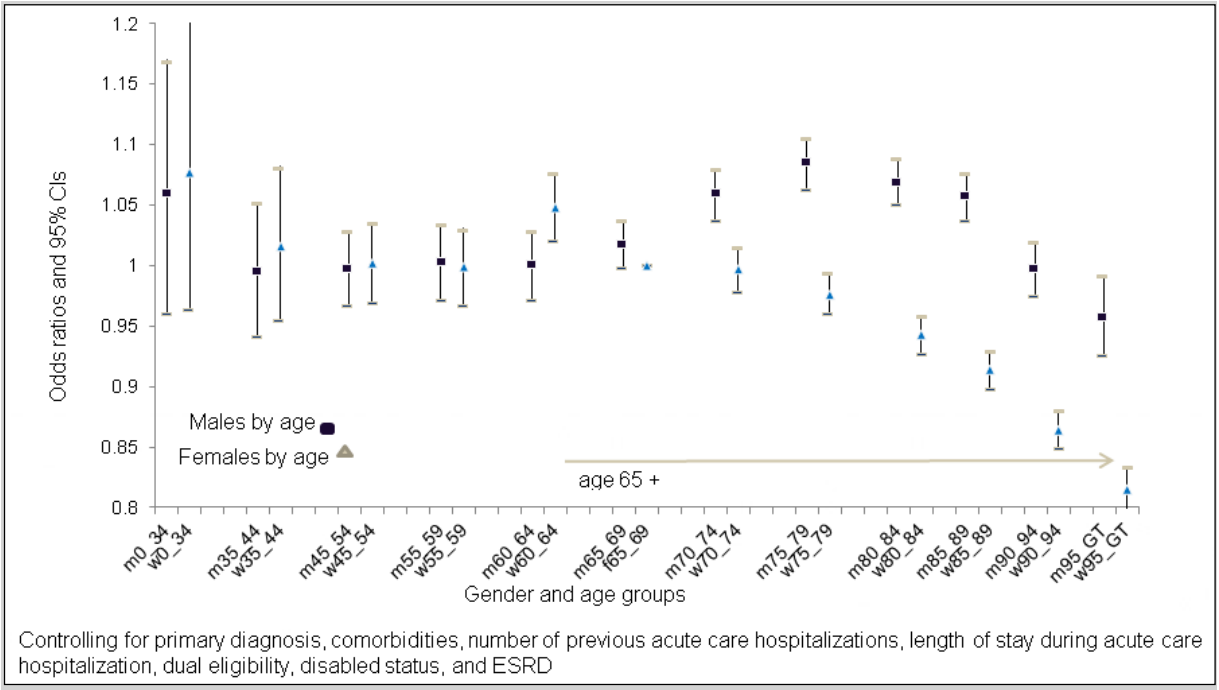
The risk-adjustment model for SNFRM accounts for variation across SNFs in case-mix and patient characteristics predictive of readmission using hierarchical logistic regression. The

goal of risk adjustment is to account for differences across SNFs in patient demographic and clinical characteristics that might be related to the outcome but pre-exist the admission to the SNF. For this reason, patient acuity (case mix) was taken into account by including patients' hospital principal diagnosis and comorbidities in the predictive models. In addition, we included the demographic variables (i.e., age and sex), and other health service factors, such as length of stay during the patient's prior proximal hospitalization and number of prior hospitalizations in the previous 365 days. ***Table 4*** below details the rationale for each covariate. We report the counts and unadjusted readmission rates by patient characteristic for our final selected set of covariates in ***Appendix C Table C1***.

This measure was submitted to the NQF in February 2014. At that time, NQF guidelines regarding disparities in care quality stated that socioeconomic status, sex, race, and ethnicity should not be included as adjustment variables in models because the standards of care should not vary across demographic markers for vulnerability to disparities in health outcomes and receipt of quality care. However, the issue of adjusting for socio-economic or socio-demographic status is being reconsidered at the time of this report (see ***Section 4*** for the current status of this issue). Therefore, the discussion below refers to the rationale for these decisions at the time of NQF submission. It is possible that the specific risk-adjustment model described below will be revised pending further testing.

Despite prior NQF guidance, for some outcomes, an argument can be made that certain potential markers of vulnerability for disparities (i.e., sex and age) are also associated with demonstrated clinical/physiologic differences that can determine risk at the time the patient enters the SNF. Our analyses indicate that readmission risk does vary by sex, but what we observe is inconsistent with the overall gender disparities literature examining patient outcomes and receipt of quality care for other patient populations and settings. This literature tends to focus on women and girls as being disproportionately vulnerable to poorer health outcomes compared with men and boys. In our analyses of SNF readmission data, we found a statistically significant association between higher readmission rates and being male when comparing male and female SNF patients ages 70 and older (see ***Figure 2*** below). On the other hand, we found that rates of readmission were not statistically different for male and female SNF patients under age 70. These findings were consistent with evidence from prior published research that readmission rates among SNF patients aged 75 and older do vary by sex, with higher rates of readmission among male SNF patients (O'Malley, Caudry, and Grabowski 2011). Given our findings, which suggest patterns of readmissions inconsistent with evidence of gender disparities, but consistent with potential clinical differences in risk for readmission based on patient sex, we included sex in our models.

Figure 2
Odds ratios for sex by age readmission analysis with 95 percent confidence intervals



Controlling for primary diagnosis, comorbidities, number of previous acute care hospitalizations, length of stay during acute care hospitalization, dual eligibility, disabled status, and ESRD

Table 4
Covariates used in the models

Variable	Rationale	Supporting Literature
Age*	Demographic characteristic that is often important for readmission and associated with higher frailty and increasing number of comorbidities.	Several studies found a correlation between age and higher risk of readmission. Compared to patients less than 55 years of age, risk of readmission increased starting at age 70 and continued increasing with each 5-year increment until age 89 (Jencks et al., 2009). In a study of risk factors for hospitalization in patients 65 and older, being 75 years of age or older was found to increase risk of hospitalization (Silverstein et al., 2008).
Sex*	Demographic characteristic that is important for predicting readmission for the SNF population.	Male sex was found to be associated with an increased risk of hospitalization in several studies (Jencks et al., 2009; Li et al. 2011; Kind et al., 2007; Bernheim et al., 2012; Ouslander 2011). Other research on cross-setting PAC patients found male sex to be a factor that decreased risk of readmission (Gage et al., 2012). Although these results are mixed, they indicate that sex is an important factor to consider.
Length of stay during prior proximal hospitalization	Patients who are hospitalized for longer periods of time may require more complex care because they are often sicker. In addition, bed rest from prolonged hospitalizations often leads to deconditioning and functional impairment.	Several studies indicate that Medicare beneficiaries with long lengths of hospitalization increase the risk of a readmission (Jencks et al., 2009; Kind et al., 2007). Long lengths of stay, combined with the number of previous hospitalizations and reason for hospitalization, had more impact on the risk of readmission than demographic factors (Jencks et al., 2009).
Any time spent in the intensive care unit (ICU) during the prior proximal hospitalization	ICU stays are an important indicator of medical severity and a predictor of PAC resource use.	RTI analyses of PAC populations found that number of days spent in the ICU was an important indicator of resource use, which reflects overall medical complexity of the patient (Gage et al., 2012).
Disabled as original reason for Medicare coverage	This is an indicator of overall patient complexity, as qualification for Medicare because of disability requires the presence of serious chronic medical conditions that limit the ability to work.	Jencks et al. (2009) found that disability as a reason for Medicare coverage increased the risk of readmission by 13 percent. In studies of PAC, patients with lower functional abilities are more likely to be readmitted (Gage et al. 2012; Dombrowski et al., 2012).
ESRD	This factor is often important in other risk-adjustment work RTI does and has been identified as a risk factor for readmission in prior studies.	ESRD increased the risk of readmission by 14-35 percent (Berheim et al., 2012; Jencks et al., 2009). In the post-acute-care population, the presence of renal failure increased the likelihood of readmission by 30 percent overall, and by an even greater margin in certain subpopulations (Gage et al., 2012).
Number of acute care hospitalizations in the 365 days before the prior proximal hospitalization	More hospitalizations in the previous year may be associated with declining health and increased complexity of care.	In the Medicare population, the number of previous hospitalizations, combined with length of stay and the reason for the hospitalization, had more impact on the risk of readmission than any other patient characteristic (Jencks et al., 2009).

(continued)

Table 4 (continued)
Covariates used in the models

Variable	Rationale	Supporting Literature
Principal diagnosis as categorized using AHRQ's single-level CCS	First diagnosis from the Medicare claim corresponding to the prior proximal hospitalization as coded by AHRQ's CCS; use of CCS categories to group principal diagnoses also harmonizes with the HWR.	Many readmissions are complications or recurrences of the prior proximal hospitalization (62%, Dombrowski et al., 2012). Some conditions are associated with a greater incidence of readmission: pneumonia, congestive heart failure, and urinary tract infection (Ouslander et al., 2011; Dombrowski et al., 2012). Also, the 100 most frequent readmission disease-related groups accounted for 73.2 percent of all readmissions, indicating that certain diagnoses are significant predictors (Jencks et al., 2009).
System-specific surgical indicators	Surgical patients differ from medical patients and often are not as medically acute. However, surgical procedures place patients at risk for potential additional complications, such as surgical site infection, retention of a foreign body, or allergic reaction to anesthesia. In other cases, such as orthopedic procedures, the presence of a surgical indicator may indicate that the patient is otherwise relatively healthy.	Research indicates that readmission rates vary by reason for prior proximal hospital stay, with the presence of surgical indicators contributing to both higher and lower readmission rates (Gage et al., 2012). In kidney, cardiac, and vascular patients, a surgical indicator as opposed to a medical indicator increased the likelihood of a readmission, whereas in orthopedic patients, the surgical indicator was associated with a lower risk of readmission (Gage et al., 2012).
Individual comorbidities as grouped by CMS's HCCs or other comorbidity indices	Comorbidities provide indicators of case mix and severity of the patient's health. Use of HCCs to categorize comorbidities also harmonizes with the HWR.	Multiple studies find that the presence of certain comorbidities raises the risk of readmission. Common comorbidities found to especially increase the risk of readmission include ESRD, diabetes, heart failure (Bernheim et al. 2012, Gage et al., 2012), and pressure ulcers (Dombrowski et al., 2012). Researchers at the University of Colorado used the Charlson/Deyo comorbidity index, which groups 17 ICD-9 disease condition categories for risk adjustment when calculating SNF readmission rates (Min et al., 2011).
Multiple comorbidities, modeled using (1) the count of HCCs if count is >2, and (2) the square of this count	Patients with multiple comorbidities will tend to be frailer, putting them at increased risk for readmission. This counter captures case complexity beyond the linear additivity of the individual comorbidities.	In a study of SNF readmission, one of the factors significantly associated with readmission was higher scores on the Charlson Comorbidity Index (Dombrowski et al., 2012), which is calculated using both the number and seriousness of comorbidities (Charlson et al., 1987).

*Age and sex are included in the model as an interaction, recognizing that the impact of sex on readmission varies over patient age (see **Figure 2** above).

To capture comorbidities, we used the secondary medical diagnoses listed on the patient's prior proximal hospital claim as well as all diagnoses listed on acute care hospitalizations that occurred in the prior 12 months. We classified these comorbidities using the HCCs that RTI

developed for CMS (Pope et al., 2000). The HCCs were developed by grouping the 14,000+ ICD-9 codes into approximately 800 diagnosis groupings, which were then grouped into about 200 hierarchical condition categories. The categories were based on clinical and Medicare cost criteria.

Other facility characteristics associated with higher readmission rates included being a for-profit facility (as opposed to government-run or not-for-profit facility), being a free-standing facility (as opposed to a hospital-based facility), and having a larger proportion of stays funded by Medicaid (Li, 2011). RTI did not adjust for being a for-profit or free-standing facility in the model. The standard of care should not depend on variables such as facility ownership or source of payer.

2.5.2 Specific Approach to Case Mix Adjustment Using the Comorbid Risk Variables

Our selection of comorbid risk variables differed from the process used for the HWR, which built on previous work done for the development of condition-specific hospital readmission measures. As the HWR population and treatments are different from the SNFRM population and treatments, this necessitated different approaches to stratification, risk adjustment, and the exclusion of planned readmissions; however, the overall analytic approach was harmonized as much as possible. The HWR measure created cohorts based on the principal diagnosis, which corresponded to hospital care teams. We evaluated the final comorbid risk variables used for the HWR as a starting point, and initially tested cohort-based models, using cohorts appropriate to the SNF population developed in consultation with our TEP and clinical experts. However, we did not find that cohorts improved the fit and calibration of the risk adjustment model, so we did not apply them in our final model. The SNFRM used the secondary diagnoses coded for the prior proximal hospitalization as well as all the diagnoses from hospitalizations that occurred in the 12 months before the index SNF stay to adjust for patient acuity and illness severity. This is consistent with the HWR strategy for identifying comorbidities.

We used a full year of MedPAR claims from 2009, with 12 months history data, to develop the risk-adjustment model and select risk variables. We constructed analytic files for 2010 and 2011 using MedPAR data to validate the performance and assess the reliability of the measure.

Below we describe the steps we employed for variable selection and development with regard to principal diagnoses (measured using AHRQ CCS) and comorbidities (measures using HCCs), which were included in our final risk adjustment model.

2.5.3 Principal Diagnosis

To capture patients' primary reason for their prior proximal hospitalization, we aggregated the principal discharge diagnosis and all the procedures from the prior proximal hospitalization using the AHRQ CCS single-level code groupings. The current SNFRM uses AHRQ's CCS codes for ICD-9-CM, and we plan to use the same CCS groupings in our models after the transition to ICD-10. AHRQ has a beta version of the mapping between ICD-10

procedure codes and the CCS codes on their website (http://www.hcup-us.ahrq.gov/toolssoftware/beta/icd_10_beta.jsp). The final grouper was expected in October 2014. We will continue to monitor and review these mappings of CCS codes to ICD-10 to identify any potential changes that may impact this measure.

1. Initially we ran a logistic regression model that included all of the AHRQ CCS categories, the demographic and clinical covariates listed in ***Table 4***, and all individual HCCs. Osteoarthritis was selected as the referent category for the principal diagnosis, because it was protective (i.e., associated with lower odds of readmission) and had high prevalence.

2. This initial model kept all CCS categories ungrouped, but we noted that some CCS categories had very low prevalence in our population, and individually, these ungrouped diagnoses were not adding to model prediction. We chose to combine these codes into two groups: five codes that reduced the risk of readmission (***Table 5***) and 29 codes (***Table 6***) that increased the risk of readmission.

Table 5
Non-significant CCS with protective effects grouped in final model (N=5), 2009 data

CCS	N with CCS	% with CCS	N readmitted	% readmitted
10 Immunizations and screening for infectious disease	52	<0.01%	5	9.62%
56 Cystic fibrosis	14	<0.01%	1	7.14%
86 Cataract	11	<0.01%	1	9.09%
652 Attention-deficit/conduct/ disruptive behavior disorders	501	0.02%	57	11.38%
656 Impulse control disorders	285	0.01%	34	11.93%
Total	863	0.04%	98	11.36%

SOURCE: RTI Analysis of 2009 MedPAR data (output: readmit107_idxSNF02_BiVar_Descript_Model_nomiss_2009.xls)

Table 6
Non-significant CCS with effects indicating increased risk grouped in final model (N=29), 2009 data

CCS	N with CCS	% with CCS	N readmitted	% readmitted
9 Sexually transmitted infections (not HIV or hepatitis)	256	0.01%	40	15.63%
20 Cancer; other respiratory and intrathoracic	25	<0.01%	6	24.00%
22 Melanomas of skin	111	0.01%	22	19.82%
26 Cancer of cervix	90	<0.01%	24	26.67%
31 Cancer of other male genital organs	35	<0.01%	6	17.14%
36 Cancer of thyroid	83	<0.01%	17	20.48%
45 Maintenance chemotherapy; Radiotherapy	43	<0.01%	10	23.26%
46 Benign neoplasm of uterus	96	<0.01%	15	15.63%
53 Disorders of lipid metabolism	24	<0.01%	5	20.83%
87 Retinal detachments; defects; vascular occlusion; and retinopathy	90	<0.01%	19	21.11%
88 Glaucoma	31	<0.01%	5	16.13%
92 Otitis media and related conditions	224	0.01%	54	24.11%
124 Acute and chronic tonsillitis	20	<0.01%	7	35.00%
169 Endometriosis	16	<0.01%	4	25.00%
171 Menstrual disorders	53	<0.01%	17	32.08%
172 Ovarian cyst	99	<0.01%	17	17.17%
206 Osteoporosis	94	<0.01%	21	22.34%
208 Acquired foot deformities	497	0.02%	41	8.25%
216 Nervous system congenital anomalies	39	<0.01%	9	23.08%
247 Lymphadenitis	74	<0.01%	15	20.27%
258 Other screening for suspected conditions (not mental disorders or infectious disease)	120	0.01%	24	20.00%
650 Adjustment disorders	296	0.01%	37	12.50%
658 Personality disorders	110	0.01%	17	15.46%
662 Suicide and intentional self-inflicted injury	12	<0.01%	4	33.33%
Total**	2548	0.12%	439	17.23%

**10 beneficiaries were included in this category from five CCS: 30 Cancer of testis; 181 Other complications of pregnancy; 195 Other complications of birth, puerperium affecting management of mother; 255 Administrative/social admission; 256 Medical examination/evaluation.

SOURCE: RTI Analysis of 2009 MedPAR data (output: readmit107_idxSNF02_BiVar_Descript_Model_nomiss_2009.xls)

2.5.4 Comorbidities

To select comorbidities, we ran the model controlling for the demographic and clinical factors, the individual CCS and the two groups of CCS, and evaluated the HCCs individually

instead of as groupings.[19] We reviewed the beta coefficients and p-values for the three model years (2009, 2010, and 2011) and for each of the HCCs to determine whether to include the individual HCC, an HCC grouping, or to exclude the HCC from the final model. We gave consideration to the consistency of effect patterns across the years and the number of patients with the comorbidity. We selected the final set of HCC variables based on the following principles:

i. We excluded HCCs that were not consistently significant across all three years.

ii. We excluded HCC groupings that were predominantly protective and likely reflected coding practices, rather than patient clinical condition. It is possible certain comorbidities (e.g., osteoporosis and other bone/cartilage disorders [HCC 43]) appeared to be protective because they were coded more often in healthier patients who had fewer severe comorbidities than sicker patients who had more competing comorbidities to include on the billing form.

Our review indicated that we should include 70 individual HCCs and two groupings of HCCs.

Additionally, we needed to take into account potential non-linear effects of multiple comorbidities. RTI considered various options for accounting for the total patient burden of comorbidities in the final model, including interactions among the HCCs or including a variable that counts the number of HCCs each patient had over the previous 12 month period. We evaluated these different approaches, including modeling two-way interactions among HCCs with larger predictive effects, and found that using counts in the model had more consistent and significant predictive effects. We further evaluated the functional form of the variable, allowing for the possibility of a non-linear relationship between the count of comorbidities and risk for readmission. We tested a continuous form with a quadratic term to handle nonlinearity, and a categorical variable with cut points selected based on an examination of rates of readmission by count of comorbidities. Our final model uses a continuous variable starting with two HCCs and the square of this variable. See ***Appendix C Table C1*** for the results from our final model for the SNFRM.

We conducted preliminary analyses to compare hierarchical logistic regression model estimates with single-level logistic regression model estimates and found the coefficients were very close across the two models. Thus we felt comfortable building the initial risk adjustment models using logistic regression, reducing the need for greater computational intensity of hierarchical modeling while model building.

[19] Two HCC groupings were retained from our prior cohort modeling work, because of small numbers for some component HCCs: Advanced Chronic Kidney Disease and Dialysis (134,135,136,137), and Cerebral Hemorrhage, Ischemic or Unspecified /Stroke (99, 100)

2.6 Statistical Approach to Measure Calculation

2.6.1 Model Development

For model development, we used logistic regression models with a logistic link function, with outcome Y_i for the i^{th} patient equal to 1 if the patient was readmitted within 30 days of discharge and 0 otherwise (Horwitz et al., 2012). In contrast to the final models described below for calculating the measure, logistic regression models are substantially less computationally intensive, and development using models with fully specified error structures would have taken a very long time. Also, by using logistic regression models, we were able to assess risk factors and model performance without having to deal with variation in performance across SNFs.

For our final models we added an error term to the logistic regression models in addition to the error term associated with the individual observations. Because of the natural clustering of observations within SNFs, we used hierarchical logistic regression to model the log-odds of readmission for each index SNF stay. We modeled readmission within 30 days as a function of patient-level demographic and clinical characteristics with a random SNF-level intercept. This accounts for within-SNF correlation of the observed outcomes as well as the underlying differences in quality among the SNF facilities being evaluated.

Specifically, we estimated a hierarchical logistic regression model as follows. Let Y_{ij}, denote the outcome (equal to 1 if $patient_i$ is readmitted within 30 days, zero otherwise) for a patient i at SNF_j; Z_{ij} denotes a set of risk factors. We assume the outcome is related linearly to the covariates via a logit function with dispersion:

$$\text{logit}(\text{Prob}(Y_{ij}=1)) = \alpha_j + \beta * Z_{ij} + \varepsilon_{ij} \quad (1)$$

$$\alpha_j = \mu + \omega_j \,;\, \omega_j \sim N(0, \tau^2)$$

where $Z_{ij} = (Z_1, Z_2, \ldots Z_k)$ is a set of *k* patient-level covariates. α_j represents the SNF specific intercept; μ is the adjusted average outcome over all SNFs; and τ^2 is the between SNF variance component and $\varepsilon \sim N(0,\sigma^2)$ captures any over- or under-dispersion.

The hierarchical logistic regression model was estimated using the SAS software (SAS GLIMMIX: SAS/STAT User's Guide, SAS Institute Inc.).

2.6.2 Calculating the Standardized Risk Ratio (SRR) and Risk-Standardized Readmission Rate (RSRR)

We specified and estimated the risk adjustment model using hierarchical logistic regression to calculate a standardized risk ratio (SRR) for each SNF.(Horwitz et al., 2012) We used the results from the hierarchical logistic regression model to calculate the predicted and the expected number of readmissions for each SNF. The predicted number of readmissions for each SNF was calculated as the sum of the predicted probability of readmission for each patient in the facility, including the SNF-specific (random) effect.

Using the notation of the previous section, the risk standardized readmission rate for each SNF is calculated as follows. To calculate the predicted number of readmissions $pred_j$ for index SNF stays at SNF*j*, we used

$$pred_j = \Sigma logit^{-1}(\mu + \omega_i + \beta * Z_{ij}) \quad (2)$$

where the sum is over all stays in SNF*j*, and ω_i is the random intercept. To calculate the expected number exp_j we used

$$exp_j = \Sigma logit^{-1}(\mu + \beta * Z_{ij}) \quad (3)$$

As a measure of excess or reduced readmissions among index stays at SNF*j*, we calculated the standardized risk ratio SRR_j as

$$SRR_j = pred_j/exp_j \quad (4)$$

This value, SRR_j, is the standardized risk ratio for SNF*j*. The standardized risk ratio, SRR_j, is multiplied by the overall national raw readmission rate for all SNF stays, $\bar{Y}$, to produce the risk-standardized readmission rate ($RSRR_j$).

$$RSRR_j = SRR_j * \bar{Y} \quad (5)$$

2.6.3 Creating Interval Estimates

Because the RSRR statistic described in Equation (5) is a complex function with no analytical form for the interval of uncertainty, bootstrapping was used to derive interval estimates for the final risk-standardized rate to characterize the uncertainty around each of the SNFs' RSRRs. The list of SNFs was repeatedly sampled with replacement to produce 2,000 bootstrap samples of facilities and their patients for this analysis. Each sample produced an estimate of the RSRR for each included facility. The estimates were ordered and the values delimiting the upper and lower 2.5 percent of the estimates demark the 95 percent confidence interval for the full sample RSRR.

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SECTION 3
RESULTS

This section presents results of the analyses conducted for the SNFRM, including facilities' readmission rates, reliability and validity testing.

3.1 Final Model Results

We used hierarchical, multivariate risk-adjustment models to derive the facility-level 30-day readmission rate. The measure is not an estimate based on samples; rather it includes all SNF patients nationwide who meet the inclusion criteria. As such, the measure is valid in terms of discriminating performance and can be used for inter-facility comparisons. Full model results are included in ***Appendix C***. The model yielded an overall C-statistic of 0.67. Below we report the results of analyses on facilities' readmission rates.

3.1.1 Distribution of Unadjusted and Adjusted Readmission Rates

The distribution of the RSRR is shown in ***Table 7***. The unadjusted readmission rates range from 0.0 percent to 63.5 percent, with a median of 20.0 percent and an interquartile range of 15.6 percent to 24.5 percent. The RSRR, compared to the observed unadjusted rate, had a narrower range, from 11.9 percent to 41.7 percent, with a slightly higher median of 21.0 percent and a tighter interquartile range of 19.4 percent to 22.9 percent. The mean RSRR (21.3%) was also slightly higher than the unadjusted rate (20.3%) and the scores had a much smaller standard deviation (2.7% vs. 7.0%).[20] The RSRR had a mean of 21.3 percent (SD: 2.7) and a range from 11.9 percent to 41.7 percent, with a slightly lower median of 21.0 percent and an interquartile range of 3.5 percent. Facilities with fewer than 25 stays (2037, or 12.2% of SNFs) were excluded from this model summary, because of instability in their observed readmission rates.

There was no evidence of a ceiling effect for this measure. The interquartile range shows that there was clustering in the middle of the distribution. This is in part attributable to the shrinkage of RSRR scores towards the mean, though the risk adjustment itself can reduce the spread. The distribution of the unadjusted and SNF-level RSRR is also illustrated in ***Figures 3*** and ***4***, respectively, where the vertical axis indicates the percentage of SNFs and the horizontal axis the RSRR.

[20] SOURCE: RTI International analysis of 2011 MedPAR data. (output: readmit110_HLMFinal_RiskEstDescript01_2011.xls)

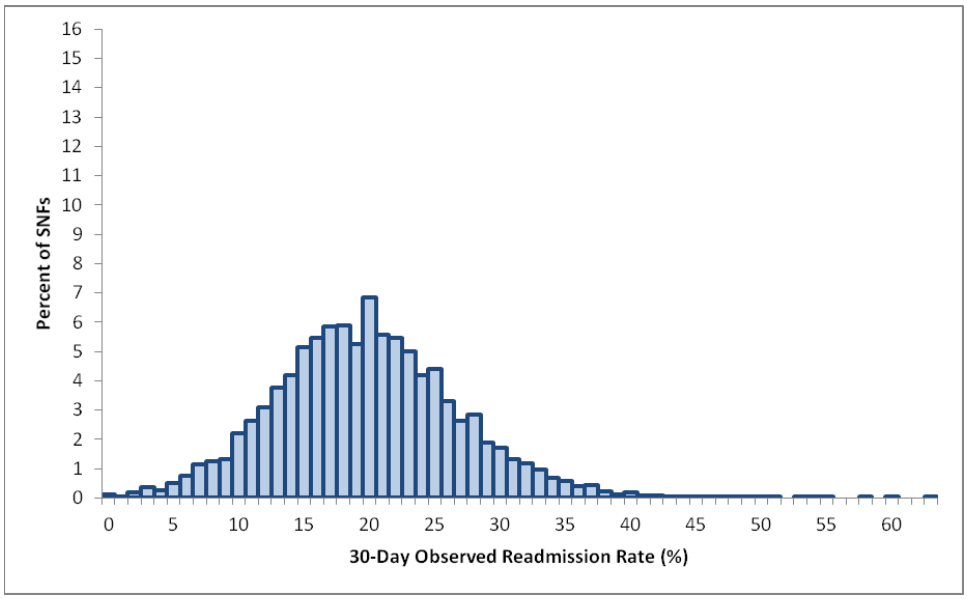
Table 7
Distribution of unadjusted and risk-standardized readmission rates among SNFs with at least 25 index stays, 2011

	Mean	Std Dev	Min	10th Pctl	25th Pctl	Median	75th Pctl	90th Pctl	Max
Unadjusted	20.3	7.0	0.0	11.7	15.6	20.0	24.5	29.1	63.5
Risk-standardized	21.3	2.7	11.9	18.1	19.4	21.0	22.9	24.8	41.7
Count of SNF stays	148.7	133.0	25	38	60.5	108	190	309	1,912

NOTE: N (facilities) = 14,720

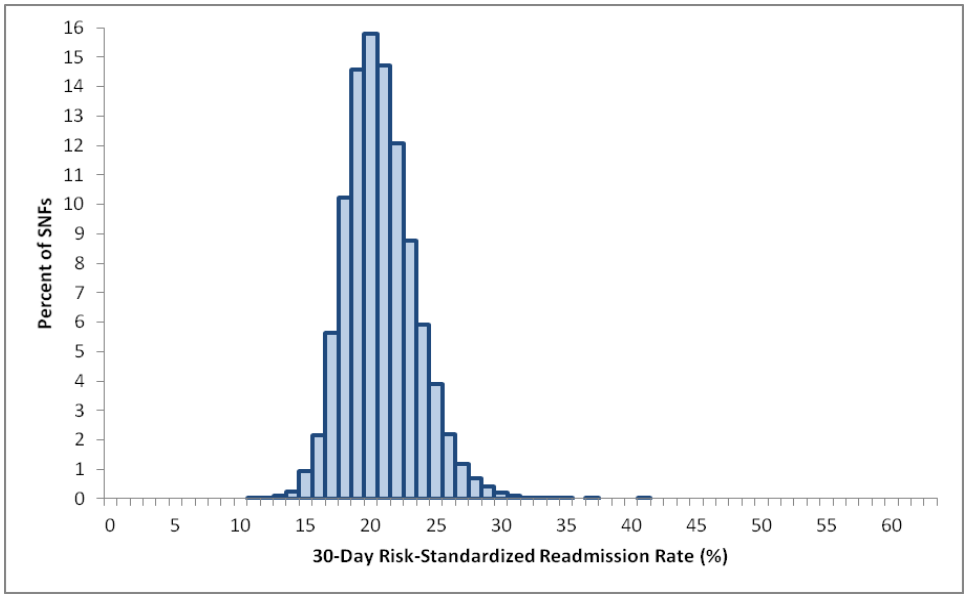
SOURCE: RTI International analysis of 2011 MedPAR data. (output: readmit110_HLMFinal_RiskEstDescript01_2011.xls)

Figure 3
Distribution of Observed Readmission Rates among SNFs with at least 25 index stays, 2011 [N=14,720; Mean (SD) 20.3 (7.0)]



SOURCE: RTI analyses of 2011 MedPAR files (N=14,720 facilities with at least 25 SNF stays). (output: readmit110_HLMFinal_RiskEstDescript02_Histograms_2011.xls)

Figure 4
Distribution of RSRRs among SNFs with at least 25 index stays, 2011 [N=14,720; Mean (SD) 21.3 (2.7)]



SOURCE: RTI analyses of 2011 MedPAR files (N=14,720 facilities with at least 25 SNF stays). (output: readmit110_HLMFinal_RiskEstDescript02_Histograms_2011.xls)

3.2 Ability to Identify Differences among Providers

For several publicly reported readmission measures of hospital outcomes developed with similar methodology, CMS currently generates an interval estimate for each risk-standardized rate. By calculating this interval, the amount of uncertainty associated with the rate can be characterized and comparisons to the national crude rate for the outcome can be made. CMS categorizes hospitals as "better than," "worse than," or "no different than" the US national rate. However, the decision to publicly report this measure and the approach to discriminating performance has not been determined.

To identify meaningful differences in performance between providers, we estimated 95 percent confidence intervals around the providers' scores allowing for comparison with the national average. These results are summarized in ***Table 10*** below.

Table 10
Percent of SNFs statistically significantly different from national mean, overall and by deciles of facility denominator count

Volume Deciles (min-max)	Number of facilities	Number significantly different	Percent significantly different	Percent significantly higher (worse)	Percent significantly lower (better)	Mean Risk Standardized Rate (RSRR)
Decile 1 (1-21)	1,632	1,500	91.9%	31.5%	60.4%	20.9
Decile 2 (22-37)	1,683	1,588	94.4%	35.5%	58.9%	20.8
Decile 3 (38-53)	1,689	1,622	96.0%	39.1%	57.0%	20.8
Decile 4 (54-72)	1,701	1,631	95.9%	40.5%	55.4%	20.8
Decile 5 (73-94)	1,637	1,582	96.6%	43.2%	53.5%	21.0
Decile 6 (95-119)	1,663	1,585	95.3%	46.2%	49.1%	21.3
Decile 7 (120-153)	1,659	1,601	96.5%	47.6%	48.9%	21.2
Decile 8 (154-201)	1,658	1,609	97.0%	49.6%	47.4%	21.3
Decile 9 (202-294)	1,671	1,626	97.3%	51.5%	45.8%	21.4
Decile 10 (205-1912)	1,663	1,619	97.4%	61.2%	36.1%	22.2
Overall	16,656	15,963	95.8%	44.6%	51.2%	21.2

SOURCE: RTI analysis of 2011 MedPAR data (readmit134_BSWalt_ConfInt_2011_fin_by_rank.xls).

We found that 95.8 percent of nursing facilities overall were statistically significantly different than the national average RSRR. The percent of nursing facilities that were

significantly different increased as facility size increased; for example, 91.9 percent of nursing facilities in the smallest decile based on volume was significantly different compared to 97.4 percent significantly different in decile 10, the largest facilities. Larger facility patient volumes tend to lead to greater precision, tighter confidence intervals, for the estimates.

The last two columns present the percent that were significantly higher (worse) and significantly lower (better) than average. Across all deciles, the proportion of nursing facilities with scores significantly better than the national average decreased as the volume of SNF stays decreased, with 60.4 percent of the smallest facilities having higher than average RSRRs, as compared to just 36.1 percent of the highest volume SNFs.

Though the policy decision has not yet been determined by CMS in terms of how SNF readmission rates may be reported with respect to SNFs nationally, results of the bootstrapping analyses suggest the ability to discriminate between providers' performance for this readmission measure. The lower precision of RSRRs for SNFs with fewer stays suggests that public reporting might incorporate a minimum reporting threshold; however, this policy decision has not been determined.

3.3 Model Validation

Using logistic regression results, we computed five summary statistics to assess model performance:

(1) calibration (a measure of over-fitting);
(2) discrimination in terms of predictive ability;
(3) discrimination in terms of the C-statistic (equivalent to area under the receiver operating characteristic [ROC] curve);
(4) distribution of residuals; and
(5) model chi-square.

Further justification for our risk adjustment model can be seen from ***Table 8***, which provides calibration results for the three model years of data we analyzed: 2009, 2010, and 2011.

Over-fitting refers to the phenomenon in which a model fails to generalize to new data because it has been too closely "tuned" to chance variation in the development dataset. We looked at two indices of over-fitting, γ_0 and γ_1. The former should be close to zero and the latter close to one in a model that is not over-fit. Our statistics matched these expectations suggesting there is no evidence of over-fitting. Discrimination in predictive ability assesses the ability to distinguish high-risk from low-risk subjects.

As shown in ***Table 7***, each year's model demonstrates good discrimination, as in each case there is a wide range between the mean predictive probability in the lowest decile versus the highest decile. The C-statistic is a measure of how accurately a statistical model is able to distinguish between a patient with and without an outcome. For binary outcomes the C-statistic is identical to the area under an ROC curve for the model. A C-statistic of 0.50 indicates random prediction, implying the model predicts no better than random chance. A C-statistic of 1.0 indicates perfect prediction, implying the model is perfectly predictive. In these models, each C-

statistic is 0.67, which is in line with observed results for other 30-day readmission measures. The distribution of residuals shows results very similar to the HWR models that Yale developed.

Finally, the Likelihood Ratio model chi-squares show the overall model fit from year to year, but with these large sample sizes, this statistic is less informative. These summary statistics provide further justification for the fit and predictive ability of our risk adjustment model in profiling SNFs by the measure of risk standardized 30-day readmission rate.

Table 8
Model calibration results for 2009, 2010, and 2011 analytic files created from the MedPAR data files

Indices	2009	2010	2011
Calibration (γ_0, γ_1) from regression readmission = $\gamma_0 + \gamma_1 *$ predicted	(0,1)	(0,1)	(0,1)
Discrimination - C-statistic	0.666	0.667	0.667
Distribution of residuals (% Pearson Residual Falling in range)			
<-2	0	0	0
-2 to <0	78	79	79
0 to <2	15	14	14
>2	7	7	7
Model x^2 (DF)*	130666 (309)	131205 (309)	131044 (309)

SOURCE: RTI analysis of 2009, 2010, 2011 MedPAR data (programs: readmit104_idxSNF02_LogRegFinal_02.sas, readmit104_idxSNF02_LogRegFit_03.sas)

A test that explores calibration over ranges of predicted probabilities is a comparison of the observed and predicted readmissions by decile. Results from this test for the 2011 model are reported in ***Table 9***. These results indicate that the difference between the predicted number of readmissions and the observed number of readmissions in percentage points is minimal, less than one percentage point across deciles of expected rates of readmission.

Table 9
SNF Readmission model diagnostics: comparison of observed and predicted readmissions by expected readmission deciles – 2011

Decile based on Expected (Low to high)	Number of SNF Stays	Number of Observed Readmissions	Number of Predicted Readmissions	Difference: Predicted – Observed (% points)
1	221,539	16,219	16,886.64	0.30%
2	221,540	24,341	24,748.81	0.18%
3	221,540	29,794	29,986.13	0.09%
4	221,540	35,047	34,997.32	-0.02%
5	221,540	40,637	40,129.95	-0.23%
6	221,540	45,953	45,744.10	-0.09%
7	221,540	52,357	52,116.72	-0.11%
8	221,540	60,714	59,803.96	-0.41%
9	221,540	70,866	70,186.95	-0.31%
10	221,539	91,179	92,506.41	0.60%

SOURCE: RTI analysis of MedPAR data, 2011. (output: readmit143_idxSNF02_DecileExp.xls).

3.4 Reliability Testing

This section reports results of the reliability analyses conducted including the methods, sample, results, and discussion. Reliability testing was conducted at the data element and the performance measure levels, as described below.

3.4.1 Methods for Data Element Reliability

To enhance the reliability of the model, RTI chose the data elements considered most robust and reliable from prior research using the source data to build the sample and include in the model. Wherever possible, we approached variable selection for development of the SNFRM to harmonize with the construction of the HWR (NQF #1789). In employing this

approach, we cite the same justification used for the HWR with regard to reliability of data elements used. Similar to NQF #1789, we selected data elements focusing on variables that are likely to be coded more consistently across hospitals and SNFs because they are used for payment or are audited. For example, consistent with the HWR, we used admission and discharge dates on SNF and hospital claims to identify transfers and readmissions, rather than relying on the claim "discharge disposition" items. We also note that CMS has an audit process in place for hospitals that includes review of diagnosis and procedure codes (NQF #1789).

Additionally, we examined the consistency of covariate prevalence and odds ratio estimates and confidence limits over the three years of files constructed (2009 – 2011). We also compared the consistency of odds ratio estimates for the two split sample files.

3.4.2 Statistical Results from Data Element Reliability Testing

We found no notable differences in the prevalence of covariates. After making pairwise comparisons of odds ratios between each of the three file years, there were only three instances where odds ratios were found to be significantly different between pairs of years, based on comparisons of the 95 percent confidence intervals (CCS3 Bacterial infection, when comparing 2009 to 2011; CCS130 Pleurisy, pneumothorax, when comparing 2009 to 2010; HCC8 Metastatic Cancer and Acute Leukemia, when comparing 2009 to 2011). See ***Table C1***, in ***Appendix C***, for the full models and results for all three file years analyzed.

For the split sample files, we only found two conditions where the odds ratios were significantly different between files (CCS1 Tuberculosis and CCS28 Cancer of other female genital organs).[21] Tuberculosis was a fairly low prevalence condition (0.1% of each of the 2009 and 2010 samples), and was associated with rates of readmission of 24 percent in 2009 and 27 percent in 2010. Cancer of other female genital organs were also low prevalence (0.1% of each of the 2009 and 2010 samples), and were associated with rates of readmission of 27 percent in 2009 and 22 percent in 2010.

3.4.3 Methods for Performance Measure Reliability

To evaluate the reliability of the quality measure, we followed the test-retest approach used in the evaluation of the HWR. This approach involved examining the level of agreement between facilities' scores when calculated based on two mutually exclusive random samples of patients within each facility. We combined the 2009 and 2010 files and took a random sample at the patient level, splitting the combined years into two halves. We recalculated the SRR for each facility for each data set. The level of agreement between the two measures calculated on the two different samples gave us a test of the repeatability of the measure. Agreement was evaluated using intraclass-correlation (ICC) with the SNF as the cluster, calculated assuming a random subset of all possible raters.[22]

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[21] Source: RTI analysis of 2009 and 2010 MedPAR data (output: readmit108_HLMFinal_split_01_OddsRatioCompare.xlsx)

[22] Shrout PE, and Fleiss JL Intraclass correlations: uses in assessing rater reliability. Psychological Bulletin. 1979, 86, 420-428.

3.4.4 Data Sample for Reliability Testing

Consistent with the reliability testing done for the HWR measure (NQF #1789), we pooled the data sets for 2009 and 2010, splitting the file randomly within facility at the patient level into two data sets. The two data sets derived from the two years of pooled data were used for test-retest reliability testing, and the third year (2011) was used to assess stability over time. The final analytic files included 16,890 SNFs reporting over 2009 and 2010, and had the following counts of patients:

Split Sample 1: 2,196,165 index SNF stays in 16,821 facilities

Split Sample 2: 2,196,066 index SNF stays in 16,890 facilities[23]

3.4.5 Results for Performance Measure Reliability

Examining the level of agreement between SRR scores calculated on each of the split files, we found an ICC of 0.56,[24] indicating a moderate level of agreement between facilities' SRRs. When stratified by quartile of SNF count of stays in Sample 1, the observed ICCs on the split sample comparison was as follows:

SNFs with 1-44 stays (n = 4130 SNFs), ICC=0.30

SNFs with 45-91 stays (n = 4227 SNFs), ICC=0.45

SNFs with 92-171 stays (n = 4244 SNFs), ICC=0.53

SNFs with 172-1510 stays (n = 4220 SNFs), ICC=0.70[25]

Agreement across file years was similar (ICC = 0.59 comparing 2009 to 2010; ICC = 0.56 comparing 2010 to 2011).[26]

In summary, the results of these analyses suggest moderate agreement for test-retest reliability and increasing levels of agreement among larger facilities.

3.5 Validity Testing

We conducted validity testing to assess the relationship between the SNFRM to individual outcome and process measures and to the Five-Star Nursing Home Compare rating. In this section we reports results of these validity analyses, including a description of the methods, sample, results as well as the interpretation of these results and summary of the validity testing.

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[23] Source: RTI analysis of 2009 and 2010 MedPAR data (output: readmit108_HLMFinal_split_01_OddsRatioCompare.xlsx). The larger sample in sample 2 is 69 singular SNFs with small sample sizes (1-2 stays each).

[24] Source: RTI analysis of 2009 and 2010 MedPAR data (output: readmit111_HLMFinal_ICC_split_01_SRR.xls)

[25] Source: RTI analysis of 2009 and 2010 MedPAR data (output:readmit111_HLMFinal_ICC_split_05.lst)

[26] Source: RTI analysis of 2009 - 2011 MedPAR data (output: readmit109_HLMFinal_ICC04_SRR_2009-2010.xls; readmit109_HLMFinal_ICC05_SRR_2010-2011.xls)

3.5.1 Methods for Validity Testing

At the performance measure level, we evaluated the relationship between the SNFRM and other current nursing home outcome and process performance measures. We derived the SNFRM values for each facility using the 2011 MedPAR SNF and acute care hospital claims data, described above. There were 2,215,398 SNF index stays identified, from 16,656 SNFs.

We selected the four NQF-endorsed MDS-based quality measures (QMs) designed for measuring quality of care provided for short stay residents and made publicly available on Nursing Home Compare. These measures, listed below, are constructed using MDS 3.0 assessments, which are submitted by nursing homes nationwide.[27] For these measures, individuals are identified as short stay if they have cumulative stays of 100 days or fewer at a nursing home or SNF.

For this analysis, we calculated facilities' mean QM scores for the four quarters of Nursing Home Compare data from 2011 and merged this data with facilities' SNFRM RSRRs. We performed pairwise correlations examining the relationship between the SNFRM and each of these MDS-based QMs.

Facilities included in the analysis were restricted to those with a valid corresponding value in the MDS-based QM file, based on a denominator size that meets the minimum sample size requirement for public reporting on Nursing Home Compare (n = 20). These quality measures and the corresponding count of facilities included in the final merged sample for each correlation are as follows:

- NQF #0676 Percent of residents who self-report moderate to severe pain (short stay):n = 14,989
- NQF #0678 Percent of residents with pressure ulcers that are new or worsened (short stay): n = 14,977
- NQF #0680 Percent of nursing home residents who were assessed and appropriately given the seasonal influenza vaccine (short stay): n = 14,992
- NQF #0682 Percent of residents assessed and appropriately given the pneumococcal vaccine (short stay): n = 14,993

At the measure level, RTI examined whether a facility's score on the SNFRM was correlated with its score on the currently endorsed quality measures using Spearman's rank-order correlation. We used the selected MDS-based NQF endorsed short stay measures, listed above, which are designed for measuring quality of care provided for short stay residents.[28] We used

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[27] MDS 3.0 QM User's Manual is available in the Downloads at the following url: http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/NursingHomeQualityInits/NHQIQualityMeasures.html

[28] Additional information on the construction of the short stay QM measures is available here: http://www.cms.gov/Medicare/Quality-Initiatives-Patient-Assessment-Instruments/NursingHomeQualityInits/NHQIQualityMeasures.html

facilities' average QM scores in 2011 for the four NQF-endorsed MDS QMs. These QMs are calculated using MDS 3.0 assessments submitted by nursing homes nationwide.

As QM scores are calculated quarterly, we averaged the four quarters of 2011 to create a file covering the comparable period.

Correlations with the SNFRM were not expected to be uniform across these measures because the strength of the relationships between these measured outcomes and processes and readmissions varies from measure to measure. We expected that the relationship between the vaccination measures (influenza and pneumococcal) and the SNFRM would be stronger than the relationship between the pain and pressure ulcers measures and the SNFRM. This is because respiratory infection is a major preventable reason for readmission among nursing home residents and its prevalence can be influenced by influenza and pneumococcal vaccine administration (MedPAC, 2011). Additionally, we expected the correlations of the SNFRM with the vaccine measures to be negative, as higher scores for the two process measures indicate better quality, whereas lower scores for the SNFRM indicate better quality. Lower scores for the two MDS 3.0 outcomes measures, NQF #0676 and NQF #0678, also indicate better quality, so we expected that any correlation with the SNFRM would be positive. However, we expected that correlations among all of these quality measures would be low, given that prior work assessing the validity of the MDS-based QMs showed low correlation.

Additionally, we examined the relationship between the SNFRM and the summary Five-Star ratings available on Nursing Home Compare (2011 data).[29] These quality components and the corresponding count of facilities included in the final merged sample in each correlation are as follows:

- Overall quality rating: n = 14,880
- Health inspection rating: n = 14,880
- Total Staffing rating: n = 14,733
- Registered Nurse (RN) Staffing rating: n = 14,733

For each SNF, we calculated the mean rating across the twelve months of 2011 for each of the Five-Star scores, excluding months where it was indicated that the SNF was too new to rate, or the data was not available. We then ran a Spearman's rank-order correlation with the SNFRM for each mean rating. We hypothesized, as with the individual outcome and process measures, that the Five-Star ratings would have a low correlation with the SNFRM. Of the Five-Star focus areas, we anticipated that the RN staffing rating would have the highest correlation of the set, given that the availability of skilled services supplied by an RN would likely the most impact on post-acute patients and their risk for readmission. We anticipated that the relationship would be negative, as higher Five-Star ratings indicate higher quality, whereas higher SNFRM scores indicate poorer quality.

[29] http://www.medicare.gov/NursingHomeCompare/About/HowWeCalculate.html

3.5.2 Statistical Results from Validity Testing

Relationship to individual outcome and process measures: We found the following correlations among facility rankings on the four NQF endorsed nursing home short stay quality measures and the SNFRM RSRR.[30]

- NQF #0676 Percent of residents who self-report moderate to severe pain (short stay): -0.028
- NQF #0678 Percent of residents with pressure ulcers that are new or worsened (short stay): 0.016
- NQF #0680 Percent of nursing home residents who were assessed and appropriately given the seasonal influenza vaccine (short stay): -0.081
- NQF #0682 Percent of residents assessed and appropriately given the pneumococcal vaccine (short stay): -0.075
- (p value for all correlations <0.05, except for NQF #0678, where the p value is 0.06)

Relationship to Five-Star Nursing Home Compare ratings: We found the following correlations of the Five-Star Nursing Home Compare ratings with the SNFRM RSRR[31]

- Overall quality rating: -0.096
- Health inspection rating: -0.064
- Total Staffing rating: -0.099
- RN Staffing rating: -0.131
- (p value for all correlations <0.05)

3.5.3 Interpretation of the Results in Terms of Demonstrating Validity

With regard to our analyses of the relationship between the SNFRM and existing NQF endorsed outcome and process measures, as expected the correlations of the SNFRM with all four of the MDS 3.0 measures are low. Correlations with the vaccine measures were negative and relatively higher than with the two outcomes measures as anticipated, though differences in observed correlations may be too small to be considered clinically significant. Although the correlation with self-reported pain (NQF #0678) was unexpectedly negative, the correlations for both the outcome measures with the SNFRM were extremely low. It is possible that because the

[30] Source: RTI Analysis of 2011 MedPAR and MDS 3.0 data (output: readmit116_SNFRMLS08_Validity01_QM-Corrs.xls)

[31] Source: RTI Analysis of 2011 MedPAR and MDS 3.0 data (output: readmit116_SNFRMLS08_Validity02_Rate-Corrs.xls)

pain measure reflects prevalent pain it may actually be capturing a mixture of quality of pain management, and quality of pain monitoring. If the pain measure is picking up quality of monitoring, one might expect better quality nursing homes to have higher rates of reported pain (as reflected in the MDS QM) because of better pain monitoring. These same better quality nursing homes also would have lower rates of readmissions reflected in the SNFRM, resulting in this negative correlation.

With regard to our analyses of the relationship between the SNFRM and the Five-Star Nursing Home Compare ratings, correlations also were low and negative as expected. The correlation with RN staffing was the strongest, as predicted.

The results from these correlations corroborate evidence from SNF studies discussed earlier that show a relationship between improved staffing and other processes and readmission rates.

With regard to the validity of critical data elements, multiple studies have been conducted to examine the validity of using Medicare hospital claims for many of the NQF-endorsed quality measures used in public reporting. Additional studies have been conducted to validate claims for detection of several conditions and procedures. The following NQF endorsed measures make use of Medicare hospital claims in their construction: 30-day all-cause risk-standardized readmission following acute myocardial infarction hospitalization (NQF #0505) (Krumholz et al., 2006), 30-day all-cause risk-standardized readmission following heart failure hospitalization (#0330) (Keenan et al., 2008), pneumonia mortality (NQF #0468) (Bratzler et al., 2011), HWR (NQF #1789), complication following cardioverter-defibrillator implantation (NQF#0694), and complication following total hip or knee arthroplasty (NQF #1551).[32] The models for these measures were validated by comparing claims and abstracted medical chart data.

Additionally, several studies have validated the use of Medicare claims, using a variety of sources to calculate the sensitivity and specificity of claims for identifying a range of diagnoses and procedures. Whittle et al. (1991) evaluated the use of claims compared to Surveillance, Epidemiology, and End Results (SEER) data to estimate incidence rates of breast, colon, and lung cancer (n = 745,283 female beneficiaries for the breast cancer sample, 1,213,533 for the colon and for the lung cancer samples). Whittle et al. found that incidence rates estimated using claims were within six percent of those based on SEER data. Resection rates were lower by 12 to 27 percent. Setoguchi et al. (2007) validated the identification of hematological malignancies and solid tumors in Medicare hospital clams, using cancer registry data for a sample of 157,310 Medicare patients. Results from these analyses suggest Medicare Part A claims are valid for identifying cancer diagnoses (77.4% to 98% sensitivity). Ko et al. (2011) linked Medicare colonoscopy claims (n = 15,168) with Clinical Outcomes National Endoscopic Database records and identified findings and procedures performed during a sample of 15,168 colonoscopies. Upper gastrointestinal events appear to be well-detected by ICD-9 codes and Medicare claims.

[32] Full names: NQF #0505 Hospital 30-Day all-cause RSRR following acute myocardial infarction (AMI) hospitalization; NQF #0330 Hospital 30-day, all-cause RSRR following heart failure hospitalization; NQF #0468 Hospital 30-day, all-cause, risk-standardized mortality rate following pneumonia hospitalization; NQF #1789 Hospital-Wide All-Cause Unplanned Readmission Measure (HWR); NQF #694 Hospital risk-standardized complication rate following implantation of implantable cardioverter-defibrillator; NQF #1551: Hospital-level 30-day, all-cause RSRR following elective primary total hip arthroplasty and/or total knee arthroplasty

In 2007, Noyes et al. compared the specificity of claims linked to the Medicare Current Beneficiary Survey data versus only claims to identify Parkinsonism. Using 72,922 observations from 30,469 individuals, researchers found a 0.99 specificity when identifying Parkinsonism with claims linked to the 1992-2000 Medicare Current Beneficiary database, versus a 0.66 specificity when only claims were used. Noyes et al. (2011) validated Medicare claims for identification of depression among older adults against the Mini-International Neuropsychiatric Interview – Major Depressive Episode Module and the Geriatric Depression Scale for 1,551 patients, and found that Medicare claims underestimate depression prevalence (sensitivity <0.50; specificity >0.70). Losina et al. (2003) compared the ability to identify rheumatologic diagnoses among total hip replacement patients using Medicare claims versus using medical records in a sample of 922 hip replacement patients. The sensitivity was low (54%-65%) but the positive predictive value was high for identifying rheumatoid arthritis. Finally, Taylor et al. (2009) linked Medicare claims to the Aging Demographics and Memory Study to identify patients with dementia using a cohort of 758 individuals and estimated Medicare claims have a sensitivity of 0.85 and a specificity of 0.89.

With regard to the face validity of the SNFRM as an indicator of quality, readmissions have consistently been considered to have value applied to other settings and patient groups. Our technical expert panels, including industry representatives and researchers, are in agreement with the approach. Validity was partially tested by statistical tests of the model on multiple years of data to predict readmissions and through the assistance of a Technical Expert Panel. The risk adjusters are of the type used to predict other measures of utilization (e.g., hospitalizations), Medicare, Medicaid and private payer spending for medical services, and mortality. The spending models are used by the Federal and State governments to determine payments. The model structure and many of the variables are similar to those in the Hospital Wide All-Cause Readmission measure approved by NQF (#1789).

SECTION 4
SUMMARY

Given evidence that nearly one out of every four Medicare beneficiaries discharged from acute care hospitals who subsequently received care in a SNF were readmitted to the hospital within 30 days (Mor et al., 2010), monitoring hospital readmissions of beneficiaries utilizing SNFs is an important policy area for CMS. As part of the Nursing Home Quality Initiative, CMS directed RTI International to develop the SNFRM. The goal of the SNFRM is to measure facility-level readmission rates among beneficiaries utilizing SNF.

The SNFRM is calculated using fee-for-service (FFS) Medicare claims. This measure was designed to harmonize with CMS's current HWR measure (NQF #1789) which estimates the hospital-level, risk-standardized rate of unplanned, all-cause readmissions within 30 days of a hospital discharge. The SNFRM uses the same 30-day risk window as the HWR. The SNFRM is also harmonized with readmission measures being developed for other PAC settings, such as IRFs and LTCHs.

The SNFRM was endorsed by the NQF in December 2014 (NQF #2510). However, like several other readmission and hospitalization measures that received endorsement by NQF at that time, the SNFRM was entered into a trial period in order to undergo additional testing for unintended consequences and risk-adjustment for sociodemographic status factors. Despite initial NQF endorsement of this measure, development and testing for the SNFRM continues. RTI, as measure developers, will continue testing and maintaining this measure as needed.

Hospital readmissions among the sizeable proportion of SNF beneficiaries that use SNFs continues to be a key policy area for CMS. Recent legislation mandates additional work by CMS in this area. For example, the Protecting Access to Medicare Act of 2014 and the Improving Post-Acute Care Transformation Act both require hospital readmission measures for SNFs. The former requires SNF value-based purchasing to use an all-cause hospital readmission measure as an initial performance measure, and the latter requires development of a potentially preventable readmission measure for SNFs. Continued refinement and development of readmission measures for SNFs is underway, and the SNFRM will be one of CMS's portfolio of readmission measures for PAC.

This report detailed the development and technical specifications for the SNFRM. This measure estimates the risk-standardized rate of all-cause, unplanned, hospital readmissions for patients who have been admitted to a SNF within 30 days of discharge from their prior proximal hospitalization. The measure is based on FFS claims data for 12 months of SNF admissions. Unplanned readmissions are identified using a modification of the Planned Readmission algorithm from CMS' HWR measure (NQF #1789) with additional procedures added as appropriate for the PAC population.

The numerator of the SNFRM is mathematically related to SNF stays where there was a hospital readmission, but the measure does not have a simple form for the numerator and denominator—that is, the risk adjustment method used does not make the observed stays with readmissions the numerator and a predicted number the denominator. The numerator, as defined, includes risk adjustment for patient characteristics and a statistical estimate of the facility effect

beyond patient mix. The denominator includes all patients who have been admitted to a SNF within 1 day of discharge from a prior proximal hospitalization, taking denominator exclusions into account.

In addition to documenting the outcome definition, the planned readmission approach, inclusion and exclusion criteria, and data sources, we summarized the methods used for model development including the risk-adjustment and statistical approach to calculate facilities RSRR scores. In order to assess comparative performance, we estimated interval estimates using bootstrapping techniques.

Section 3 summarizes the results of the risk-adjustment model, validation, and final model results. We reported the distribution of facilities' RSRRs in comparison with SNFs' unadjusted readmission rates. The mean RSRR was 21.3 percent (SD=2.7%) with a range of 11.9 percent to 41.7 percent, a median of 21.0 percent, and an interquartile range of 3.5 percent. The distribution of the RSRR was much narrower compared to the unadjusted readmission rate. The mean unadjusted readmission rate was 20.3% (SD=7.0%)

This section also summarized results of the reliability and validity testing. Specifically, we assessed five measures for model validation, including: calibration (a measure of over-fitting); discrimination in terms of predictive ability; discrimination in terms of the C-statistic; distribution of residuals; and model chi-square. We assessed some of these validation measures by deciles of SNF size. Each year's model demonstrates good discrimination, as in each case there is a wide range between the mean predicted probability in the lowest decile versus the highest decile based on SNF size. In these models, for each of 3 years, the C-statistic is 0.67, which is in line with observed results for other 30-day readmission measures. The distribution of residuals shows results very similar to the HWR models that Yale developed for CMS. Finally, the Likelihood Ratio model chi-squares show the overall model fit from year to year, but with these large sample sizes, this statistic is less informative. These summary statistics provide further justification for the fit and predictive ability of our risk adjustment model in profiling SNFs by the measure of risk standardized 30-day readmission rate.

We used bootstrapping techniques to estimate confidence intervals around SNFs' RSRRs. We found that 96 percent of nursing facilities overall were significantly different than the national average RSRR. The percent of nursing facilities that were significantly different increased as facility size increased; for example, 92 percent of nursing facilities in the smallest decile based on volume was significantly different compared to 97 percent significantly different in decile 10, the largest facilities.

Results of test-retest reliability were moderate and showed increasing levels of agreement among larger facilities. With regard to our validity analyses of the relationship between the SNFRM and existing NQF endorsed outcome and process measures, as expected the correlations of the SNFRM with all four of the MDS 3.0 measures are low. As expected, correlations were also low and negative in analyses of the relationship between the SNFRM and the Five-Star Nursing Home Compare ratings. The correlation with RN staffing was the strongest. Results from these correlations corroborate evidence from SNF studies discussed earlier that show a relationship between improved staffing and other processes and readmission rates.

With regard to the validity of critical data elements, multiple studies have been conducted to examine the validity of using Medicare hospital claims for many of the NQF-endorsed quality measures used in public reporting. Finally, in terms of face validity of the SNFRM as an indicator of quality, readmissions have consistently been considered to have value applied to other settings and patient groups. Our technical expert panels, including industry representatives and researchers, supported this approach.

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APPENDIX A
OBSERVATION STAYS

This measure does not include observation stays as a readmission because there were few observation stays in comparison to the number of inpatient admissions and very few readmissions after an observation stay. In a recently published analysis, researchers at Brown University evaluated how frequently SNF patients had observation stays with and without formal admission to the hospital (Feng et al., 2012). In 2009, of the approximately 2.5 million SNF stays among FFS Medicare beneficiaries aged 65+ nationwide, there were roughly 18,000 observation stays (0.7%) and few readmissions within 30 days after the observation stay (Feng, 2012). The results indicated that the vast majority of hospital observation stays in 2009 (over 1 million in total) originated from the community (83% from community without home health care and 8% from community with home health care). Only a small number and proportion of observation stays originated from a SNF (i.e., were preceded immediately by a SNF stay): N=17,731 or 1.7 percent of all observation stays, nationally. Consistent with the pattern of their origins, the vast majority of hospital observation stays were discharged to the community (80% without home health and 11% with home health care). Again, only a small number and proportion of observation stays were discharged to a SNF (regardless of their origin): N=25,884, or 2.6 percent of all observations stays (Feng, 2012). These results suggest that excluding hospital observation stays from the SNF hospital readmission measure will not make a meaningful difference in the SNF facility-level rate of hospital readmissions or in the relative ranking of SNF providers according to this measure.

Second, although the overall prevalence of hospital observation stays has been on the rise, raising legitimate concerns about their causes and consequences, the number of observation stays that originated from and were subsequently discharged to SNF settings is very small relative to other settings (mostly community). A recent report by the Office of Inspector General shows that this trend has indeed continued in more recent years. According to this report, Medicare beneficiaries had 1.5 million observations stays in 2012 and an additional 1.4 million long outpatient stays that lasted at least one night but were not coded as observation stays (Wright, 2013). However, this study did not break down the data by setting, that is, the setting from which observation patients came. Based on our preliminary analysis results above, we emphasize that despite an increasing number of Medicare beneficiaries held for observation in hospitals at the national level, the vast majority of them are from community settings, and relatively few come from or are discharged to SNFs. CMS and the measure developers (RTI International) agree that the rising trend of hospital observation stays is an important issue that warrants continuous monitoring and policy attention.

Third, and perhaps most importantly, mingling outpatient observation stays with inpatient admissions raises serious questions as to whether other types of hospital outpatient stays, such as emergency department (ED) visits or prolonged outpatient stays other than observation care in the hospital, should also be counted as admissions. RTI argues that this could not only introduce bias into the measure from a technical and conceptual perspective but also send a mixed signal to SNF providers and hospitals, with the potential to compromise patient care. For SNFs, their 30-day readmission rate would increase more or less depending on how many of their patients were sent back to the hospital via the ED and held for observation within the 30-day tracking window.

Counting observation stays in the SNFRM could potentially increase perverse incentives already identified as a general concern with public reporting of any quality measure. Namely, SNFs may have an incentive *not* to send patients to the ED even though the patients truly require hospital care, or may deliberately postpone doing so until after the 30-day measurement period ends to lower their publically reported readmission rate. Including observation stays in the measure could potentially add to these incentives.

The increased use of hospital observation stays as outpatient care is an important issue that may have a significant adverse impact on Medicare beneficiaries. Observation stays may reduce eligibility for SNF services because of lack of a qualifying prior acute admission and therefore increase out-of-pocket spending. However, when looking at SNF readmissions, the absolute number and percentage share of observation stays involving Medicare beneficiaries in the SNF setting are small relative to other settings. Most importantly, there remain significant conceptual and practical challenges in the consideration of counting observation stays in the SNFRM. A decision to do so would require a better understanding of possible negative consequences, including postponing transfer of SNF patients to the ED.

APPENDIX B
PLANNED READMISSION ALGORITHM (TABLES B1-B5)

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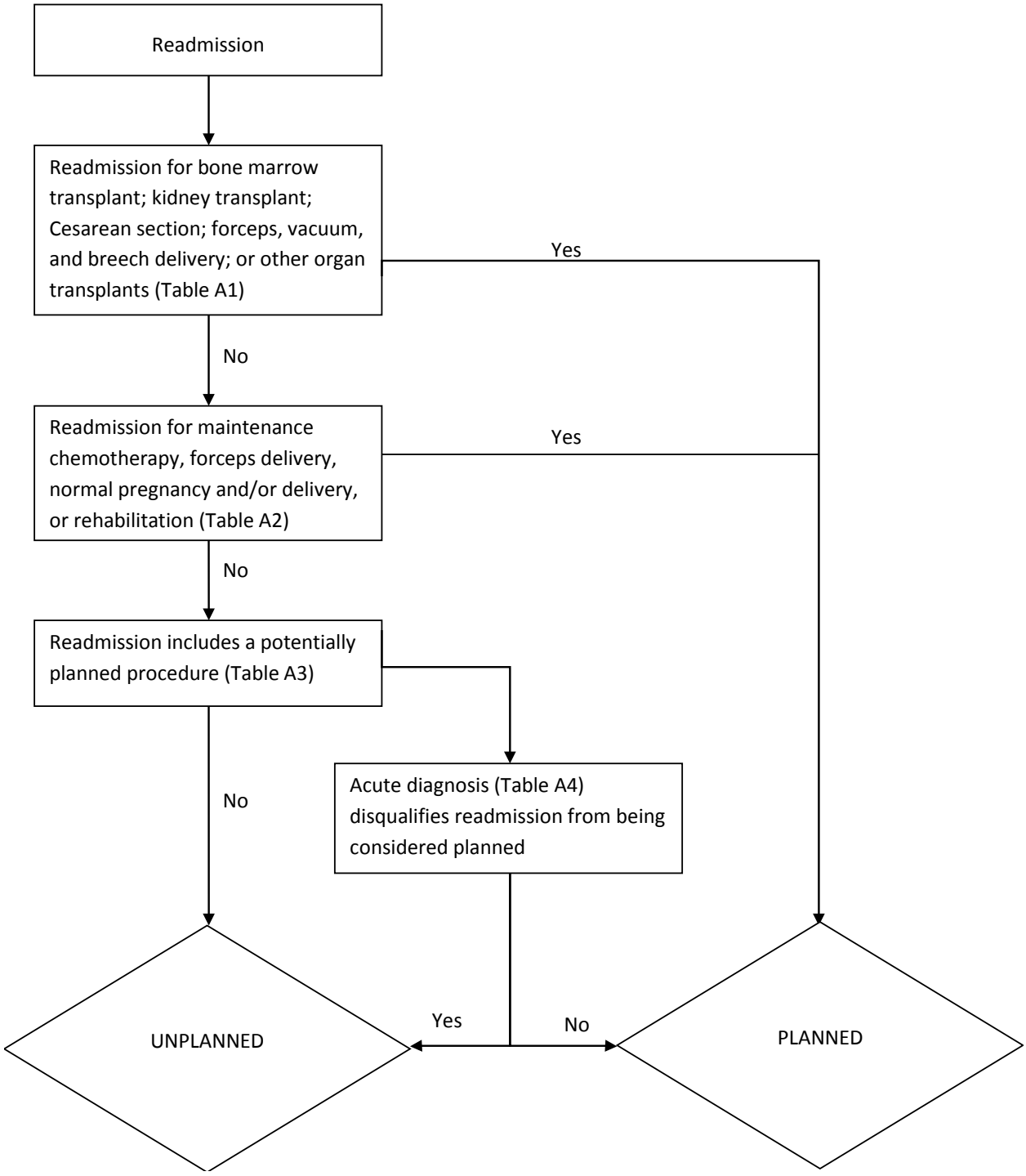
Planned Readmission Algorithm[33]



[33] Adapted from Yale, 2012

Table B1
Procedure categories that are always planned regardless of diagnosis procedure

AHRQ CCS Procedures	Name
64	Bone marrow transplant
105	Kidney transplant
134	Cesarean section
135	Forceps; vacuum; and breech delivery
176	Other organ transplantation

Table B2
Diagnosis categories that are always planned regardless of procedure

AHRQ CCS Diagnoses	Name
45	Maintenance chemotherapy
194	Forceps delivery
196	Normal pregnancy and/or delivery
254	Rehabilitation

Table B3
HWR planned procedures

AHRQ CCS Procedures	Name
3	Laminectomy; excision intervertebral disc
5	Insertion of catheter or spinal stimulator and injection into spinal
9	Other OR therapeutic nervous system procedures
10	Thyroidectomy; partial or complete
12	Other therapeutic endocrine procedures
33	Other OR therapeutic procedures on nose; mouth and pharynx
36	Lobectomy or pneumonectomy
38	Other diagnostic procedures on lung and bronchus
40	Other diagnostic procedures of respiratory tract and mediastinum
43	Heart valve procedures
44	Coronary artery bypass graft (CABG)
45	Percutaneous transluminal coronary angioplasty (PTCA)
47	Diagnostic cardiac catheterization; coronary arteriography
48	Insertion; revision; replacement; removal of cardiac pacemaker or cardioverter/defibrillator
49	Other OR heart procedures
51	Endarterectomy; vessel of head and neck
52	Aortic resection; replacement or anastomosis
53	Varicose vein stripping; lower limb
55	Peripheral vascular bypass
56	Other vascular bypass and shunt; not heart
59	Other OR procedures on vessels of head and neck
62	Other diagnostic cardiovascular procedures
66	Procedures on spleen
67	Other therapeutic procedures; hemic and lymphatic system
74	Gastrectomy; partial and total
78	Colorectal resection
79	Local excision of large intestine lesion (not endoscopic)
84	Cholecystectomy and common duct exploration
85	Inguinal and femoral hernia repair

(continued)

Table B3 (continued)
HWR planned procedures

AHRQ CCS Procedures	Name
86	Other hernia repair
99	Other OR gastrointestinal therapeutic procedures
104	Nephrectomy; partial or complete
106	Genitourinary incontinence procedures
107	Extracorporeal lithotripsy; urinary
109	Procedures on the urethra
112	Other OR therapeutic procedures of urinary tract
113	Transurethral resection of prostate (TURP)
114	Open prostatectomy
119	Oophorectomy; unilateral and bilateral
120	Other operations on ovary
124	Hysterectomy; abdominal and vaginal
129	Repair of cystocele and rectocele; obliteration of vaginal vault
132	Other OR therapeutic procedures; female organs
142	Partial excision bone
152	Arthroplasty knee
153	Hip replacement; total and partial
154	Arthroplasty other than hip or knee
157	Amputation of lower extremity
158	Spinal fusion
159	Other diagnostic procedures on musculoskeletal system
166	Lumpectomy; quadrantectomy of breast
167	Mastectomy
169	Debridement of wound; infection or burn
170	Excision of skin lesion
172	Skin graft
211	Therapeutic radiology for cancer treatment
224	Cancer chemotherapy

(continued)

Table B3 (continued)
HWR planned procedures

AHRQ CCS Procedures	Name
ICD-9 Codes	Description
30.1, 30.29, 30.3, 30.4, 31.74, 34.6	Laryngectomy, revision of tracheostomy, scarification of pleura (from Proc CCS 42- Other OR Rx procedures on respiratory system and mediastinum)
38.18	Endarterectomy leg vessel (from Proc CCS 60- Embolectomy and endarterectomy of lower limbs)
55.03, 55.04	Percutaneous nephrostomy with and without fragmentation (from Proc CCS 103- Nephrotomy and nephrostomy)
94.26, 94.27	Electroshock therapy (from Proc CCS 218- Psychological and psychiatric evaluation and therapy)

NOTE: From the February 2013 Version of the HWR Planned Readmission Algorithm

Table B4
HWR discharge condition categories that disqualify a readmission from being considered planned

Diagnosis CCS	Description
1	Tuberculosis
2	Septicemia (except in labor)
3	Bacterial infection; unspecified site
4	Mycoses
5	HIV infection
7	Viral infection
8	Other infections; including parasitic
9	Sexually transmitted infections (not HIV or hepatitis)
54	Gout and other crystal arthropathies
55	Fluid and electrolyte disorders
60	Acute posthemorrhagic anemia
61	Sickle cell anemia
63	Diseases of white blood cells
76	Meningitis (except that caused by tuberculosis or sexually transmitted disease)
77	Encephalitis (except that caused by tuberculosis or sexually transmitted disease)
78	Other CNS infection and poliomyelitis
82	Paralysis
83	Epilepsy; convulsions
84	Headache; including migraine
85	Coma; stupor; and brain damage
87	Retinal detachments; defects; vascular occlusion; and retinopathy
89	Blindness and vision defects
90	Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease)
91	Other eye disorders
92	Otitis media and related conditions
93	Conditions associated with dizziness or vertigo
100	Acute myocardial infarction (with the exception of ICD-9 codes 410.x2)
102	Nonspecific chest pain
104	Other and ill-defined heart disease

(continued)

Table B4 (continued)
HWR discharge condition categories that disqualify a readmission from being considered planned

Diagnosis CCS	Description
107	Cardiac arrest and ventricular fibrillation
109	Acute cerebrovascular disease
112	Transient cerebral ischemia
116	Aortic and peripheral arterial embolism or thrombosis
118	Phlebitis; thrombophlebitis and thromboembolism
120	Hemorrhoids
122	Pneumonia (except that caused by TB or sexually transmitted disease)
123	Influenza
124	Acute and chronic tonsillitis
125	Acute bronchitis
126	Other upper respiratory infections
127	Chronic obstructive pulmonary disease and bronchiectasis
128	Asthma
129	Aspiration pneumonitis; food/vomitus
130	Pleurisy; pneumothorax; pulmonary collapse
131	Respiratory failure; insufficiency; arrest (adult)
135	Intestinal infection
137	Diseases of mouth; excluding dental
139	Gastroduodenal ulcer (except hemorrhage)
140	Gastritis and duodenitis
142	Appendicitis and other appendiceal conditions
145	Intestinal obstruction without hernia
146	Diverticulosis and diverticulitis
148	Peritonitis and intestinal abscess
153	Gastrointestinal hemorrhage
154	Noninfectious gastroenteritis
157	Acute and unspecified renal failure
159	Urinary tract infections
165	Inflammatory conditions of male genital organs

(continued)

Table B4 (continued)
HWR discharge condition categories that disqualify a readmission from being considered planned

Diagnosis CCS	Description
168	Inflammatory diseases of female pelvic organs
169	Debridement of wound; infection or burn
172	Ovarian cyst
197	Skin and subcutaneous tissue infections
198	Other inflammatory condition of skin
225	Joint disorders and dislocations; trauma-related
226	Fracture of neck of femur (hip)
227	Spinal cord injury
228	Skull and face fractures
229	Fracture of upper limb
230	Fracture of lower limb
232	Sprains and strains
233	Intracranial injury
234	Crushing injury or internal injury
235	Open wounds of head; neck; and trunk
237	Complication of device; implant or graft
238	Complications of surgical procedures or medical care
239	Superficial injury; contusion
240	Burns
241	Poisoning by psychotropic agents
242	Poisoning by other medications and drugs
243	Poisoning by nonmedicinal substances
244	Other injuries and conditions due to external causes
245	Syncope
246	Fever of unknown origin
247	Lymphadenitis
249	Shock
250	Nausea and vomiting
251	Abdominal pain

(continued)

Table B4 (continued)
HWR discharge condition categories that disqualify a readmission from being considered planned

Diagnosis CCS	Description
252	Malaise and fatigue
253	Allergic reactions
259	Residual codes; unclassified
650	Adjustment disorders
651	Anxiety disorders
652	Attention-deficit, conduct, and disruptive behavior disorders
653	Delirium, dementia, and amnestic and other cognitive disorders
656	Impulse control disorders, NEC
658	Personality disorders
660	Alcohol-related disorders
661	Substance-related disorders
662	Suicide and intentional self-inflicted injury
663	Screening and history of mental health and substance abuse codes
670	Miscellaneous disorders
ICD-9 Codes	**Description**
Acute ICD-9 codes within Dx CCS 97: Peri-; endo-; and myocarditis; cardiomyopathy	
03282	Diphtheritic myocarditis
03640	Meningococcal carditis nos
03641	Meningococcal pericarditis
03642	Meningococcal endocarditis
03643	Meningococcal myocarditis
07420	Coxsackie carditis nos
07421	Coxsackie pericarditis
07422	Coxsackie endocarditis
07423	Coxsackie myocarditis
11281	Candidal endocarditis
11503	Histoplasma capsulatum pericarditis
11504	Histoplasma capsulatum endocarditis

(continued)

Table B4 (continued)
HWR discharge condition categories that disqualify a readmission from being considered planned

Diagnosis CCS	Description
11513	Histoplasma duboisii pericarditis
11514	Histoplasma duboisii endocarditis
11593	Histoplasmosis pericarditis
11594	Histoplasmosis endocarditis
1303	Toxoplasma myocarditis
3910	Acute rheumatic pericarditis
3911	Acute rheumatic endocarditis
3912	Acute rheumatic myocarditis
3918	Acute rheumatic heart disease nec
3919	Acute rheumatic heart disease nos
3920	Rheumatic chorea w heart involvement
3980	Rheumatic myocarditis
39890	Rheumatic heart disease nos
39899	Rheumatic heart disease nec
4200	Acute pericarditis in other disease
42090	Acute pericarditis nos
42091	Acute idiopath pericarditis
42099	Acute pericarditis nec
4210	Acute/subacute bacterial endocarditis
4211	Acute endocarditis in other diseases
4219	Acute/subacute endocarditis nos
4220	Acute myocarditis in other diseases
42290	Acute myocarditis nos
42291	Idiopathic myocarditis
42292	Septic myocarditis
42293	Toxic myocarditis
42299	Acute myocarditis nec
4230	Hemopericardium
4231	Adhesive pericarditis

(continued)

Table B4 (continued)
HWR discharge condition categories that disqualify a readmission from being considered planned

Diagnosis CCS	Description
4232	Constrictive pericarditis
4233	Cardiac tamponade
4290	Myocarditis nos
Acute ICD-9 codes within Dx CCS 105: Conduction disorders	
4260	Atrioventricular block complete
42610	Atrioventricular block nos
42611	Atrioventricular block-1st degree
42612	Atrioventricular block-mobitz ii
42613	Atrioventricular block-2nd degree nec
4262	Left bundle branch hemiblock
4263	Left bundle branch block nec
4264	Right bundle branch block
42650	Bundle branch block nos
42651	Right bundle branch block/left posterior fascicular block
42652	Right bundle branch block/left ant fascicular block
42653	Bilateral bundle branch block nec
42654	Trifascicular block
4266	Other heart block
4267	Anomalous atrioventricular excitation
42681	Lown-ganong-levine syndrome
42682	Long qt syndrome
4269	Conduction disorder nos
Acute ICD-9 codes within Dx CCS 106: Dysrhythmia	
4272	Paroxysmal tachycardia nos
7850	Tachycardia nos
42789	Cardiac dysrhythmias nec
4279	Cardiac dysrhythmia nos
42769	Premature beats nec

(continued)

Table B4 (continued)
HWR discharge condition categories that disqualify a readmission from being considered planned

Diagnosis CCS	Description
Acute ICD-9 codes within Dx CCS 108: Congestive heart failure; nonhypertensive	
39891	Rheumatic heart failure
4280	Congestive heart failure
4281	Left heart failure
42820	Unspecified systolic heart failure
42821	Acute systolic heart failure
42823	Acute on chronic systolic heart failure
42830	Unspecified diastolic heart failure
42831	Acute diastolic heart failure
42833	Acute on chronic diastolic heart failure
42840	Unpec combined syst & dias heart failure
42841	Acute combined systolic & diastolic heart failure
42843	Acute on chronic combined systolic & diastolic heart failure
4289	Heart failure nos

NOTE: From the February 2013 Version of the HWR Planned Readmission Algorithm

Table B5
RTI added AHRQ CCS single level procedure codes and ICD-9 procedure codes to Yale's planned readmission algorithm, March 13, for the post-acute care setting

AHRQ CCS Single Level Procedures Codes	Description	Comment
37	Diagnostic Bronchoscopy and Biopsy of Bronchus	
71	Gastrostomy: temporary and permanent	
82	Endoscopic retrograde cannulation of pancreases (ERCP)	
87	Laparoscopy (GI only)	
89	Exploratory Laparotomy	
160	Other therapeutic procedure on muscles and tendons	
164	Other OR therapeutic procedures on musculoskeletal system	
171	Suture of skin and subcutaneous tissue	
ICD-9 Procedure Codes	**Description**	**Comment**
	Topic: Amputation of Lower Extremity	
83.82	Graft of muscle or fascia	
86.87	Fat graft of skin and subcutaneous tissue	Required, Diagnosis V58.41, encounter for planned postoperative wound closure
	Topic: Amputation of Upper Extremity	
84.00	Upper limb amputation, not otherwise specified	
84.01	Amputation and disarticulation of finger	
84.02	Amputation and disarticulation of thumb	
84.03	Amputation through hand	
84.04	Disarticulation of wrist	
84.05	Amputation through forearm	
84.06	Disarticulation of elbow	
84.07	Amputation through humerus	
84.08	Disarticulation of shoulder	
84.09	Interthoracoscapular amputation	

(continued)

Table B5 (continued)
RTI added AHRQ CCS single level procedure codes and ICD-9 procedure codes to Yale's planned readmission algorithm, March 13, for the post-acute care setting

ICD-9 Procedure Codes	Description	Comment
Topic: Removal of Vascular Obstruction, Non-Coronary		
38.18	Endarterectomy, lower limb vessels	
38.08	Embolectomy, lower limb arteries	
39.50	Angioplasty or atherectomy of other non-coronary vessels	
00.55	Insertion of drug-eluting stent(s) of other peripheral vessel(s)	
00.60	Insertion of drug-eluting stent(s) of superficial femoral artery	
39.90	Insertion of non-drug-eluting peripheral (non-coronary) vessel stent(s)	
	Topic: Colon and Rectal Procedures, Selected	
46.85	Dilation of intestine (includes endosopic approach)	
96.08	Insertion of naso-intestinal tube (includes for decompression)	
96.09	Insertion of rectal tube	
46.50	Closure of intestinal stoma, not otherwise specified	Required, Diagnosis code V55.2, attention to ileostomy, and V55.3, attention to colostomy
46.51	Closure of stoma of small intestine	Required, Diagnosis code V55.2, attention to ileostomy, and V55.3, attention to colostomy
46.52	Closure of stoma of large intestine	Required, Diagnosis code V55.2, attention to ileostomy, and V55.3, attention to colostomy
46.86	Endoscopic insertion of colonic stent(s)	
46.87	Other insertion of colonic stent (s)	
	Topic: Insertion of Feeding Tubes	
44.39	Other gastroenterostomy (GJ-tube)	
46.39	Other enterostomy (J-tube)	

(continued)

Table B5 (continued)
RTI added AHRQ CCS single level procedure codes and ICD-9 procedure codes to Yale's planned readmission algorithm, March 13, for the post-acute care setting

ICD-9 Procedure Codes	Description	Comment
Topic: Routine Device Replacement		
86.06	Insertion of totally implanted infusion pump	
Topic: Routine Removal of Devices		
84.57	Removal of (cement) spacer (includes antibiotic impregnated spacer)	
97.41	Removal of thoracotomy tube or pleural cavity drain (non-incisional)	
02.43	Removal of ventricular shunt	
97.37	Removal of tracheostomy tube (non-incisional)	
01.27	removal of catheter(s) from cranial cavity or tissue	
86.05	Incision with removal of foreign body or device from skin and subcutaneous tissue	
02.95	Removal of skull tongs or halo traction device	
78.60-78.69	Removal of implanted devices from bone(includes internal and external fixation)	
80.00-80.09	Orthopedic implants arthrotomy for removal of prosthesis without replacement	This code became available in CY 2010
	Topic: Pleurosclerosis	
34.6	Scarification of pleura	
34.92	Injection into thoracic cavity	
	Topic: Colon and Rectal Procedures, Selected	
51.14	Other close (endoscopic) biopsy of biliary duct or sphincter of Oddi	
51.64	Endoscopic excision or destruction of lesion of biliary ducts or sphincter of Oddi	
51.84	Endoscopic dilation of ampulla and biliary duct	

(continued)

Table B5 (continued)
RTI added AHRQ CCS single level procedure codes and ICD-9 procedure codes to Yale's planned readmission algorithm, March 13, for the post-acute care setting

ICD-9 Procedure Codes	Description	Comment
51.85	Endoscopic sphincterotomy and papillotomy	
51.86	Endoscopic insertion of nasobiliary drainage tube	
51.87	Endoscopic insertion of stent (tube) into bile duct	
51.88	Endoscopic removal of stone(s)from biliary tract	
	Topic: Fistula	
42.84	Repair of esophageal fistula, not elsewhere classified	
44.63	Closure of other gastric fistula (include gastrocolic, gastrojejunocolic fistula)	
46.72	Closure of fistula of duodenum	
46.74	Closure of fistula of small intestine, except duodenum (includes enterocutaneous)	
46.76	Closure of fistula of large intestine	
47.92	Closure of appendiceal fistula	
48.73	Closure of other rectal fistula	
48.93	Repair of perirectal fistula	
49.11	Anal fistulotomy	
49.12	Anal fistulectomy	
49.73	Closure of anal fistula	
19.9	Other repair of middle ear (includes closure of mastoid fistula	
20.93	Repair of oval and round windows (includes closure of fistula)	
21.82	Closure of nasal fistula	
31.62	Closure of fistula of larynx (includes laryngotracheal)	
31.73	Closure of other fistula of trachea (includes tracheoesophageal)	

(continued)

Table B5 (continued)
RTI added AHRQ CCS single level procedure codes and ICD-9 procedure codes to Yale's planned readmission algorithm, March 13, for the post-acute care setting

ICD-9 Procedure Codes	Description	Comment
33.42	Closure of bronchial fistula (includes bronchocutaneous, bronchoesophageal, bronchovisceral)	
34.73	Closure of other fistula of thorax (includes bronchopleural, bronchopleurocutaneous, bronchopleuromediastinal)	
34.83	Closure of fistula of diaphragm (includes thoracicoabdominal, thoracicogastric, thoracicointestinal)	
34.93	Repair of pleura (includes closure of unspecified pleural fistula)	
61.42	repair of scrotal fistula	
	Topic: Tendon Repair (eye)	
15.7	Repair of injury of extraocular muscle (includes repair of tendon)	
	Topic: Aneurysm	
39.51	Clipping of aneurysm	

NOTE: December, 2012 Yale added several additional AHRQ CCS Single-Level Procedure Codes. Two of these codes 169 (Debridement of wound; infection or burn) and 172 (Skin graft) had been on the prior RTI developed list.

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APPENDIX C
MODELING RESULTS (TABLE C-1)

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Table C1
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
Male age 18-64	4.01	26.17	1.005	0.983	1.028	4.13	25.43	0.989	0.967	1.011	4.27	25.42	0.999	0.978	1.021
Male age 65-69	3.95	27.73	1.010	0.989	1.031	4.00	26.90	0.997	0.976	1.018	4.14	26.81	1.004	0.983	1.025
Male age 70-74	4.04	24.10	1.088	1.064	1.113	4.13	23.81	1.089	1.065	1.113	4.23	23.24	1.079	1.056	1.103
Male age 75-79	5.44	24.27	1.129	1.105	1.152	5.42	23.84	1.130	1.107	1.153	5.43	23.47	1.128	1.105	1.151
Male age 80-84	7.03	23.96	1.138	1.116	1.161	6.97	23.63	1.146	1.123	1.169	6.89	23.14	1.134	1.112	1.157
Male age 85-89	6.55	23.82	1.153	1.130	1.177	6.53	23.32	1.148	1.124	1.171	6.51	22.88	1.142	1.119	1.166
Male age 90-94	3.28	22.44	1.109	1.083	1.137	3.39	22.39	1.132	1.105	1.159	3.54	21.85	1.120	1.094	1.147
Male age GT 95	0.92	21.44	1.070	1.030	1.111	0.94	21.04	1.073	1.033	1.114	0.95	20.32	1.054	1.015	1.095
Female age 18-64	3.99	25.09	1.026	1.003	1.049	4.11	24.60	1.011	0.989	1.034	4.29	24.33	1.012	0.990	1.034
Female age 65-69*	5.17	25.44	—	—	—	5.27	24.86	—	—	—	5.46	24.62	—	—	—
Female age 70-74	6.16	20.64	1.024	1.003	1.045	6.26	20.32	1.029	1.009	1.050	6.33	20.19	1.035	1.014	1.056
Female age 75-79	9.27	20.24	1.016	0.997	1.036	9.05	19.83	1.018	0.999	1.038	8.90	19.70	1.024	1.005	1.044
Female age 80-84	13.32	19.70	1.000	0.981	1.018	12.95	19.60	1.015	0.997	1.034	12.52	19.28	1.018	1.000	1.037
Female age 85-89	14.50	19.26	0.990	0.971	1.008	14.35	18.94	0.992	0.974	1.011	13.94	18.54	0.988	0.970	1.007
Female age 90-94	8.87	18.16	0.949	0.930	0.968	9.00	17.83	0.952	0.933	0.971	9.15	17.52	0.955	0.937	0.975
Female age GT 95	3.50	17.15	0.907	0.885	0.931	3.50	16.76	0.907	0.885	0.931	3.43	16.21	0.897	0.875	0.920
LOS btwn 1 & 3 days*	24.07	16.56	—	—	—	24.92	16.12	—	—	—	25.27	15.79	—	—	—
LOS btwn 4 & 7 days	45.40	20.14	1.122	1.112	1.133	45.35	19.97	1.126	1.116	1.137	45.30	19.84	1.136	1.126	1.147
LOS btwn 8 & 14 days	21.99	26.51	1.346	1.332	1.361	21.52	26.46	1.360	1.345	1.374	21.35	26.08	1.353	1.338	1.367
LOS GT 14 days	8.54	32.17	1.596	1.573	1.619	8.22	31.61	1.583	1.560	1.606	8.09	31.40	1.601	1.577	1.624
Originally disabled: based on denominator file	20.17	24.65	1.030	1.019	1.041	20.79	24.33	1.043	1.032	1.054	21.46	24.09	1.039	1.028	1.049

(continued)

Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
End Stage Renal Disease Indicator	4.40	38.73	1.370	1.346	1.394	4.39	38.13	1.381	1.357	1.405	4.52	38.22	1.400	1.376	1.424
Ophthalmology Surgery	0.01	17.16	0.738	0.541	1.006	0.01	17.98	0.809	0.586	1.117	0.01	18.77	0.904	0.661	1.238
Vascular Surgery	2.93	28.88	1.061	1.039	1.082	2.95	28.50	1.064	1.043	1.086	2.96	28.25	1.063	1.042	1.085
Orthopedics Surgery	17.45	13.59	0.922	0.905	0.939	17.75	13.29	0.923	0.905	0.940	17.72	13.09	0.924	0.907	0.941
General surgery	4.80	25.59	0.993	0.974	1.013	4.80	25.16	0.988	0.969	1.007	4.81	25.01	0.975	0.956	0.994
Cardio Thoracic Surgery	1.63	28.19	0.932	0.903	0.962	1.62	27.26	0.908	0.880	0.938	1.61	26.83	0.913	0.884	0.943
Urologic surgery	0.87	26.37	1.032	0.991	1.075	0.86	26.31	1.011	0.970	1.053	0.85	26.76	1.061	1.019	1.105
Neurosurgery	0.61	24.69	1.143	1.095	1.194	0.64	24.65	1.153	1.105	1.204	0.66	24.33	1.189	1.140	1.240
Plastic Surgery	1.28	21.68	0.945	0.916	0.975	1.35	21.42	0.955	0.927	0.985	1.42	21.24	0.963	0.934	0.992
Otolaryngology Surgery	0.17	22.48	0.903	0.830	0.983	0.17	23.85	1.008	0.927	1.097	0.17	22.60	0.940	0.863	1.024
Obstetrics/Gynecology Surgery	0.26	20.70	0.919	0.845	1.000	0.26	21.16	0.955	0.878	1.039	0.25	21.55	0.992	0.912	1.080
0* hospitalizations	44.78	15.92	—	—	—	45.50	15.63	—	—	—	45.83	15.48	—	—	—
1-3 hospitalizations	45.49	24.02	1.057	1.048	1.067	45.04	23.85	1.064	1.054	1.074	44.78	23.51	1.062	1.052	1.072
4-6 hospitalizations	7.80	35.28	1.264	1.245	1.284	7.59	34.89	1.265	1.246	1.285	7.52	34.63	1.274	1.254	1.294
7-9 hospitalizations	1.48	44.57	1.599	1.557	1.642	1.45	43.96	1.587	1.545	1.631	1.43	43.74	1.604	1.561	1.647
10+ hospitalizations	0.45	54.22	2.183	2.088	2.281	0.43	53.00	2.139	2.046	2.237	0.44	53.34	2.197	2.102	2.297
At least one day in ICU (y/n)	25.75	27.39	1.108	1.099	1.117	26.91	26.94	1.110	1.101	1.120	27.73	26.52	1.106	1.097	1.115
1 Tuberculosis	0.01	23.76	1.339	0.960	1.867	0.01	27.37	1.614	1.163	2.241	0.01	30.06	1.740	1.247	2.428
2 Septicemia (except in labor)	5.65	28.18	1.817	1.759	1.877	6.12	27.66	1.771	1.715	1.829	6.65	27.28	1.796	1.739	1.855
3 Bacterial infection; unspecified site	0.03	28.30	2.221	1.835	2.688	0.02	26.25	1.877	1.519	2.320	0.02	19.92	1.363	1.082	1.717
4 Mycoses	0.16	32.01	2.284	2.111	2.472	0.16	30.44	2.141	1.977	2.319	0.15	31.03	2.225	2.053	2.412
5 HIV infection	0.05	38.39	2.240	1.952	2.571	0.05	35.29	2.070	1.789	2.395	0.04	31.49	1.759	1.508	2.051

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
6 Hepatitis	0.06	40.67	2.720	2.406	3.074	0.06	41.70	2.712	2.413	3.048	0.07	42.73	2.793	2.494	3.128
7 Viral infection	0.12	21.19	1.880	1.699	2.080	0.11	21.36	1.869	1.683	2.075	0.11	20.88	1.887	1.701	2.092
8 Other infections; including parasitic	0.02	20.74	1.540	1.229	1.931	0.02	21.70	1.587	1.250	2.014	0.02	17.88	1.355	1.074	1.710
11 Cancer of head and neck	0.04	25.86	2.091	1.753	2.494	0.04	24.27	1.754	1.466	2.099	0.04	25.61	2.058	1.729	2.449
12 Cancer of esophagus	0.01	34.76	2.533	1.893	3.390	0.01	27.44	1.788	1.318	2.427	0.01	28.45	1.938	1.448	2.593
13 Cancer of stomach	0.04	30.63	2.009	1.716	2.351	0.03	28.48	1.874	1.592	2.205	0.03	29.19	2.022	1.714	2.385
14 Cancer of colon	0.35	21.89	1.586	1.486	1.692	0.34	21.97	1.585	1.484	1.692	0.33	21.66	1.599	1.496	1.708
15 Cancer of rectum and anus	0.10	27.59	2.221	2.010	2.454	0.10	25.75	2.007	1.806	2.229	0.09	26.00	2.091	1.879	2.327
16 Cancer of liver and intrahepatic bile duct	0.01	36.18	3.042	2.165	4.274	0.01	27.22	1.865	1.299	2.677	0.01	27.88	1.852	1.306	2.625
17 Cancer of pancreas	0.03	31.53	2.266	1.921	2.674	0.03	29.34	2.053	1.731	2.435	0.03	32.70	2.478	2.098	2.928
18 Cancer of other GI organs; peritoneum	0.03	26.97	1.945	1.633	2.317	0.03	27.65	1.956	1.647	2.324	0.03	29.05	2.126	1.798	2.512
19 Cancer of bronchus; lung	0.11	22.63	1.747	1.573	1.940	0.11	22.16	1.723	1.548	1.918	0.11	22.10	1.751	1.574	1.948
21 Cancer of bone and connective tissue	0.02	24.22	2.286	1.829	2.857	0.02	22.56	2.141	1.710	2.682	0.02	23.14	2.282	1.829	2.846
23 Other non-epithelial cancer of skin	0.02	14.10	1.226	0.915	1.641	0.02	17.13	1.456	1.098	1.932	0.02	17.28	1.502	1.129	1.998
24 Cancer of breast	0.05	15.18	1.609	1.365	1.897	0.05	14.42	1.541	1.293	1.838	0.04	14.72	1.601	1.332	1.925
25 Cancer of uterus	0.05	19.56	2.002	1.682	2.382	0.05	20.36	2.061	1.723	2.465	0.04	19.94	1.970	1.641	2.365
27 Cancer of ovary	0.03	23.40	2.003	1.630	2.462	0.03	23.08	1.942	1.590	2.370	0.03	24.67	1.982	1.612	2.436
28 Cancer of other female genital organs	0.01	26.75	3.035	2.321	3.969	0.01	21.88	2.416	1.828	3.193	0.01	22.19	2.374	1.778	3.170
29 Cancer of prostate	0.02	24.27	1.865	1.502	2.316	0.02	22.60	1.629	1.294	2.052	0.02	23.43	1.577	1.251	1.988

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
32 Cancer of bladder	0.10	26.98	1.976	1.776	2.198	0.10	29.07	2.205	1.983	2.453	0.10	29.60	2.216	1.991	2.465
33 Cancer of kidney and renal pelvis	0.05	20.03	1.456	1.251	1.695	0.05	22.14	1.638	1.411	1.901	0.05	21.07	1.477	1.272	1.716
34 Cancer of other urinary organs	0.01	21.36	1.554	1.117	2.161	0.01	23.92	1.779	1.283	2.467	0.01	27.54	2.144	1.596	2.881
35 Cancer of brain and nervous system	0.02	29.15	2.425	1.988	2.957	0.02	29.64	2.442	2.009	2.968	0.02	23.95	1.863	1.518	2.286
37 Hodgkin`s disease	0.00	26.00	1.916	1.011	3.632	0.00	36.74	2.968	1.644	5.359	0.00	31.58	2.731	1.350	5.524
38 Non-Hodgkin`s lymphoma	0.03	27.01	2.018	1.707	2.385	0.03	32.24	2.587	2.207	3.032	0.03	30.66	2.443	2.071	2.881
39 Leukemias	0.00	26.47	1.387	0.800	2.404	0.00	33.33	2.172	1.270	3.716	0.00	25.81	1.586	0.888	2.833
40 Multiple myeloma	0.01	34.57	3.079	2.205	4.298	0.01	25.00	1.902	1.340	2.698	0.01	25.90	1.962	1.372	2.805
41 Cancer; other and unspecified primary	0.00	28.79	2.659	1.534	4.607	0.00	21.69	1.660	0.975	2.826	0.00	23.26	1.688	1.015	2.808
42 Secondary malignancies	0.13	27.33	2.040	1.863	2.233	0.13	26.62	1.956	1.786	2.141	0.12	25.17	1.800	1.639	1.978
43 Malignant neoplasm without specification of site	0.00	30.51	2.484	1.409	4.381	0.00	24.10	1.666	1.001	2.775	0.00	26.42	2.079	1.340	3.223
44 Neoplasms of unspecified nature or uncertain behavior	0.02	25.42	2.169	1.773	2.653	0.02	26.08	2.140	1.753	2.612	0.02	22.04	1.865	1.515	2.295
47 Other and unspecified benign neoplasm	0.17	21.54	1.839	1.687	2.005	0.16	23.74	2.049	1.884	2.229	0.16	24.47	2.161	1.985	2.352
48 Thyroid disorders	0.06	22.17	1.927	1.674	2.218	0.06	20.19	1.693	1.467	1.955	0.06	19.45	1.623	1.404	1.875
49 Diabetes mellitus without complication	0.02	18.67	1.708	1.351	2.159	0.02	20.44	1.899	1.506	2.394	0.02	19.36	1.731	1.343	2.230
50 Diabetes mellitus with complications	1.51	23.98	1.665	1.601	1.731	1.50	23.15	1.594	1.533	1.657	1.50	23.05	1.612	1.550	1.677
51 Other endocrine disorders	0.25	21.65	1.781	1.659	1.913	0.26	21.12	1.740	1.621	1.868	0.27	21.55	1.841	1.718	1.974

(continued)

Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
52 Nutritional deficiencies	0.10	26.33	2.230	2.017	2.466	0.09	26.37	2.237	2.016	2.482	0.08	26.23	2.256	2.019	2.521
54 Gout and other crystal arthropathies	0.09	20.92	1.712	1.524	1.924	0.10	20.82	1.708	1.529	1.907	0.10	19.94	1.700	1.524	1.897
55 Fluid and electrolyte disorders	2.21	21.31	1.870	1.804	1.938	2.09	21.27	1.838	1.773	1.907	1.93	20.96	1.852	1.784	1.922
57 Immunity disorders	0.00	30.30	2.242	1.041	4.829	0.00	36.67	3.492	1.625	7.505	0.00	34.38	2.913	1.376	6.164
58 Other nutritional; endocrine; and metabolic disorders	0.34	21.24	1.832	1.720	1.953	0.33	21.41	1.817	1.705	1.937	0.33	21.28	1.793	1.681	1.912
59 Deficiency and other anemia	0.84	26.79	2.072	1.983	2.166	0.82	26.76	2.046	1.958	2.139	0.81	26.91	2.070	1.980	2.164
60 Acute posthemorrhagic anemia	0.13	24.58	1.913	1.747	2.094	0.15	24.21	1.890	1.735	2.058	0.18	24.23	1.882	1.738	2.038
61 Sickle cell anemia	0.01	35.86	2.211	1.637	2.986	0.01	37.50	2.398	1.801	3.194	0.01	37.64	2.428	1.772	3.326
62 Coagulation and hemorrhagic disorders	0.08	29.35	2.250	2.017	2.510	0.07	31.29	2.458	2.197	2.750	0.07	31.71	2.474	2.206	2.775
63 Diseases of white blood cells	0.09	27.28	1.942	1.748	2.157	0.09	27.89	1.998	1.800	2.219	0.09	26.49	1.886	1.693	2.100
64 Other hematologic conditions	0.01	28.93	2.081	1.519	2.851	0.01	31.84	2.427	1.758	3.351	0.01	31.29	2.315	1.650	3.247
76 Meningitis (except that caused by tuberculosis or sexually transmitted disease)	0.03	24.52	1.958	1.634	2.347	0.03	25.52	2.032	1.698	2.430	0.03	25.24	2.095	1.760	2.493
77 Encephalitis (except that caused by tuberculosis or sexually transmitted disease)	0.03	27.38	2.107	1.743	2.547	0.03	26.77	2.064	1.717	2.482	0.03	22.97	1.692	1.400	2.046
78 Other CNS infection and poliomyelitis	0.03	28.78	2.119	1.784	2.516	0.03	30.26	2.307	1.947	2.733	0.03	27.48	2.104	1.773	2.498

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
79 Parkinson`s disease	0.15	13.40	1.346	1.211	1.497	0.13	13.53	1.383	1.237	1.546	0.12	13.03	1.360	1.213	1.526
80 Multiple sclerosis	0.05	14.44	1.475	1.237	1.758	0.05	13.93	1.416	1.190	1.687	0.05	14.54	1.477	1.247	1.751
81 Other hereditary and degenerative nervous system conditions	0.24	18.62	1.723	1.597	1.859	0.24	17.94	1.660	1.537	1.794	0.23	17.21	1.592	1.471	1.723
82 Paralysis	0.02	15.40	1.343	1.034	1.744	0.02	16.87	1.497	1.147	1.953	0.02	18.63	1.781	1.386	2.287
83 Epilepsy; convulsions	0.65	20.22	1.639	1.558	1.724	0.64	20.63	1.672	1.590	1.759	0.65	20.58	1.712	1.628	1.800
84 Headache; including migraine	0.02	18.22	1.552	1.225	1.966	0.02	21.70	1.895	1.532	2.345	0.03	19.86	1.760	1.424	2.175
85 Coma; stupor; and brain damage	0.12	19.29	1.635	1.473	1.815	0.11	19.52	1.646	1.483	1.828	0.12	18.04	1.522	1.372	1.689
89 Blindness and vision defects	0.01	17.50	1.586	1.094	2.300	0.01	15.64	1.328	0.910	1.937	0.01	16.19	1.438	0.991	2.087
90 Inflammation; infection of eye (except that caused by tuberculosis or sexually transmitted disease)	0.02	18.90	1.762	1.409	2.203	0.03	22.97	2.221	1.818	2.713	0.02	22.55	2.245	1.827	2.759
91 Other eye disorders	0.01	16.32	1.466	0.991	2.170	0.01	20.69	1.909	1.378	2.646	0.01	18.27	1.746	1.220	2.500
93 Conditions associated with dizziness or vertigo	0.16	10.86	1.095	0.980	1.224	0.16	12.38	1.271	1.144	1.413	0.15	11.42	1.166	1.043	1.303
94 Other ear and sense organ disorders	0.01	18.23	1.660	1.154	2.389	0.01	20.46	1.894	1.355	2.648	0.01	16.96	1.437	1.010	2.043
95 Other nervous system disorders	1.07	20.18	1.696	1.624	1.771	1.15	20.45	1.709	1.639	1.783	1.19	19.70	1.652	1.584	1.723
96 Heart valve disorders	0.47	28.09	2.138	2.016	2.266	0.48	27.96	2.139	2.018	2.267	0.51	26.40	2.030	1.915	2.151

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
97 Periendo & myocarditis cardiomyopathy (except caused by tuberculosis or sexually transmitted disease)	0.14	31.39	2.099	1.930	2.283	0.13	31.85	2.161	1.984	2.353	0.13	31.95	2.207	2.026	2.405
98 Essential hypertension	0.09	16.98	1.678	1.486	1.894	0.09	16.80	1.664	1.470	1.883	0.09	14.54	1.436	1.260	1.637
99 Hypertension with complications and secondary hypertension	0.68	30.31	1.950	1.862	2.042	0.68	29.11	1.843	1.759	1.930	0.69	28.72	1.859	1.775	1.948
100 Acute myocardial infarction	1.83	28.19	2.169	2.091	2.251	1.77	27.68	2.113	2.037	2.193	1.69	27.79	2.175	2.095	2.258
101 Coronary atherosclerosis and other heart disease	0.87	26.38	1.993	1.901	2.088	0.80	25.06	1.883	1.795	1.976	0.74	24.88	1.915	1.823	2.012
102 Nonspecific chest pain	0.48	22.43	1.722	1.630	1.819	0.46	22.66	1.744	1.650	1.843	0.41	21.48	1.656	1.561	1.756
103 Pulmonary heart disease	0.61	23.84	1.810	1.722	1.903	0.64	23.24	1.762	1.677	1.850	0.63	21.94	1.696	1.613	1.783
104 Other and ill-defined heart disease	0.01	24.57	1.842	1.403	2.418	0.02	20.49	1.569	1.213	2.029	0.02	21.01	1.689	1.312	2.175
105 Conduction disorders	0.21	17.46	1.433	1.320	1.555	0.21	18.91	1.561	1.440	1.693	0.21	18.70	1.579	1.458	1.711
106 Cardiac dysrhythmias	2.06	23.34	1.908	1.840	1.978	2.07	22.96	1.868	1.801	1.936	2.06	23.31	1.955	1.885	2.027
107 Cardiac arrest and ventricular fibrillation	0.02	31.59	1.867	1.496	2.331	0.02	30.74	1.785	1.456	2.188	0.02	29.23	1.708	1.411	2.067
108 Congestive heart failure; nonhypertensive	5.15	29.68	2.103	2.037	2.171	5.00	29.37	2.036	1.972	2.102	4.78	28.51	2.011	1.947	2.077
109 Acute cerebrovascular disease	3.00	20.86	1.952	1.885	2.020	3.02	20.48	1.922	1.856	1.989	3.03	19.95	1.891	1.827	1.959
110 Occlusion or stenosis of precerebral arteries	0.14	18.69	1.444	1.310	1.592	0.13	17.78	1.362	1.231	1.508	0.13	17.86	1.431	1.292	1.584

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
111 Other and ill-defined cerebrovascular disease	0.08	16.49	1.493	1.309	1.703	0.07	16.55	1.489	1.296	1.712	0.07	17.07	1.561	1.356	1.799
112 Transient cerebral ischemia	0.55	16.98	1.633	1.545	1.727	0.54	15.58	1.462	1.380	1.549	0.53	15.50	1.506	1.420	1.596
113 Late effects of cerebrovascular disease	0.15	19.36	1.642	1.496	1.802	0.14	18.99	1.588	1.442	1.748	0.14	17.99	1.523	1.380	1.680
114 Peripheral and visceral atherosclerosis	0.62	25.91	1.934	1.840	2.032	0.60	25.48	1.869	1.778	1.965	0.60	25.91	1.967	1.871	2.068
115 Aortic; peripheral; and visceral artery aneurysms	0.19	25.69	1.800	1.666	1.945	0.19	25.05	1.713	1.584	1.852	0.20	25.34	1.831	1.695	1.978
116 Aortic and peripheral arterial embolism or thrombosis	0.15	27.27	2.095	1.923	2.283	0.14	28.07	2.174	1.994	2.370	0.14	27.90	2.231	2.044	2.435
117 Other circulatory disease	0.61	20.94	1.614	1.534	1.699	0.59	21.01	1.625	1.543	1.711	0.57	20.61	1.631	1.547	1.719
118 Phlebitis; thrombophlebitis and thromboembolism	0.74	21.26	1.734	1.652	1.819	0.73	20.44	1.657	1.579	1.740	0.71	20.42	1.674	1.593	1.758
119 Varicose veins of lower extremity	0.02	16.25	1.405	1.059	1.866	0.01	17.93	1.588	1.185	2.127	0.01	16.26	1.449	1.054	1.991
120 Hemorrhoids	0.08	24.11	1.854	1.652	2.081	0.08	25.85	2.036	1.819	2.278	0.08	25.01	2.000	1.790	2.234
121 Other diseases of veins and lymphatics	0.13	19.39	1.569	1.420	1.733	0.12	19.05	1.495	1.349	1.657	0.12	19.39	1.574	1.419	1.746
122 Pneumonia (except that caused by tuberculosis or sexually transmitted disease)	5.30	23.17	1.802	1.745	1.861	5.23	23.00	1.769	1.713	1.826	5.25	22.60	1.777	1.720	1.835
123 Influenza	0.05	17.01	1.346	1.150	1.577	0.04	18.42	1.418	1.182	1.700	0.10	15.09	1.276	1.132	1.438
125 Acute bronchitis	0.20	17.75	1.648	1.517	1.790	0.19	15.64	1.427	1.306	1.558	0.20	15.28	1.432	1.312	1.562

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
126 Other upper respiratory infections	0.05	19.84	1.916	1.633	2.248	0.05	20.22	1.902	1.623	2.229	0.05	18.10	1.683	1.433	1.976
127 Chronic obstructive pulmonary disease and bronchiectasis	2.57	27.71	2.173	2.099	2.250	2.45	27.33	2.107	2.035	2.182	2.49	26.83	2.119	2.046	2.194
128 Asthma	0.40	25.26	2.037	1.923	2.157	0.37	24.54	1.926	1.815	2.044	0.37	24.93	2.055	1.937	2.179
129 Aspiration pneumonitis; food/vomitus	1.93	26.48	1.959	1.889	2.032	1.87	26.08	1.917	1.848	1.989	1.78	25.16	1.876	1.807	1.948
130 Pleurisy; pneumothorax; pulmonary collapse	0.35	29.69	2.057	1.941	2.180	0.34	27.54	1.822	1.716	1.934	0.33	27.81	1.913	1.801	2.031
131 Respiratory failure; insufficiency; arrest (adult)	1.52	32.57	2.069	1.993	2.149	1.48	32.41	2.030	1.954	2.108	1.52	31.80	2.043	1.967	2.122
132 Lung disease due to external agents	0.02	29.74	2.316	1.847	2.904	0.02	27.75	1.971	1.546	2.512	0.02	26.20	2.006	1.594	2.524
133 Other lower respiratory disease	0.26	25.94	2.006	1.877	2.145	0.25	25.51	1.942	1.814	2.079	0.24	26.32	2.044	1.909	2.188
134 Other upper respiratory disease	0.08	25.70	1.847	1.647	2.071	0.08	24.39	1.705	1.518	1.914	0.08	25.03	1.782	1.587	2.001
135 Intestinal infection	1.09	30.00	2.196	2.109	2.287	1.06	29.71	2.168	2.081	2.258	1.10	28.28	2.091	2.008	2.178
136 Disorders of teeth and jaw	0.02	18.81	1.700	1.285	2.250	0.02	13.81	1.161	0.867	1.555	0.02	18.23	1.677	1.273	2.211
137 Diseases of mouth; excluding dental	0.06	21.51	1.669	1.458	1.911	0.06	22.21	1.743	1.524	1.994	0.06	19.89	1.549	1.347	1.782
138 Esophageal disorders	0.29	22.02	1.707	1.596	1.826	0.29	21.47	1.633	1.527	1.746	0.28	22.61	1.796	1.679	1.921
139 Gastroduodenal ulcer (except hemorrhage)	0.10	22.75	1.773	1.596	1.971	0.11	23.45	1.858	1.678	2.057	0.10	22.55	1.779	1.603	1.975
140 Gastritis and duodenitis	0.24	22.98	1.760	1.638	1.890	0.23	22.75	1.746	1.624	1.878	0.22	22.77	1.766	1.640	1.902

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
141 Other disorders of stomach and duodenum	0.16	28.34	2.023	1.865	2.194	0.16	26.51	1.801	1.659	1.955	0.17	27.64	1.944	1.795	2.105
142 Appendicitis and other appendiceal conditions	0.06	21.94	1.859	1.627	2.123	0.07	19.23	1.569	1.371	1.795	0.06	20.74	1.805	1.578	2.065
143 Abdominal hernia	0.38	20.10	1.580	1.483	1.684	0.39	20.53	1.624	1.526	1.728	0.42	20.66	1.691	1.591	1.797
144 Regional enteritis and ulcerative colitis	0.08	30.14	2.395	2.149	2.668	0.08	30.10	2.440	2.185	2.725	0.07	29.34	2.409	2.150	2.699
145 Intestinal obstruction without hernia	1.13	23.26	1.765	1.693	1.841	1.10	23.17	1.765	1.691	1.841	1.04	23.61	1.841	1.763	1.921
146 Diverticulosis and diverticulitis	0.68	22.58	1.805	1.719	1.896	0.67	22.93	1.844	1.756	1.936	0.65	23.04	1.893	1.802	1.989
147 Anal and rectal conditions	0.13	23.81	1.971	1.794	2.167	0.13	23.38	1.915	1.743	2.104	0.13	21.53	1.825	1.657	2.011
148 Peritonitis and intestinal abscess	0.06	34.60	2.368	2.089	2.684	0.05	32.41	2.083	1.832	2.368	0.05	31.69	2.070	1.820	2.354
149 Biliary tract disease	0.72	20.69	1.633	1.553	1.717	0.70	20.26	1.603	1.523	1.686	0.68	19.90	1.608	1.527	1.693
151 Other liver diseases	0.28	39.26	2.562	2.404	2.729	0.29	39.13	2.537	2.384	2.701	0.30	38.35	2.496	2.347	2.655
152 Pancreatic disorders (not diabetes)	0.30	22.07	1.635	1.530	1.747	0.30	22.37	1.673	1.567	1.786	0.28	21.98	1.671	1.561	1.789
153 Gastrointestinal hemorrhage	1.49	23.99	1.808	1.740	1.880	1.46	24.05	1.800	1.731	1.871	1.46	24.08	1.819	1.749	1.891
154 Noninfectious gastroenteritis	0.23	21.58	1.852	1.720	1.993	0.23	20.12	1.684	1.563	1.815	0.23	20.59	1.761	1.633	1.899
155 Other gastrointestinal disorders	0.59	26.24	2.019	1.922	2.122	0.61	25.34	1.943	1.850	2.041	0.60	24.97	1.937	1.843	2.035
156 Nephritis; nephrosis; renal sclerosis	0.01	27.89	1.864	1.289	2.695	0.01	35.29	2.610	1.920	3.548	0.01	32.42	2.263	1.695	3.020

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
157 Acute and unspecified renal failure	2.58	27.09	2.017	1.948	2.087	2.68	26.37	1.956	1.890	2.024	3.19	25.45	1.971	1.906	2.039
158 Chronic renal failure	0.05	30.48	1.690	1.480	1.931	0.05	30.51	1.651	1.445	1.886	0.05	35.08	2.036	1.790	2.316
159 Urinary tract infections	4.62	20.05	1.778	1.721	1.837	4.68	19.44	1.722	1.667	1.779	4.58	19.18	1.738	1.682	1.796
160 Calculus of urinary tract	0.10	22.34	1.769	1.586	1.972	0.11	22.88	1.845	1.661	2.049	0.10	22.97	1.831	1.648	2.034
161 Other diseases of kidney and ureters	0.08	26.06	2.140	1.907	2.402	0.07	24.06	1.886	1.673	2.125	0.08	22.43	1.760	1.562	1.984
162 Other diseases of bladder and urethra	0.08	24.46	1.905	1.692	2.146	0.08	22.85	1.718	1.522	1.939	0.07	24.15	1.876	1.662	2.116
163 Genitourinary symptoms and ill-defined conditions	0.14	23.78	1.870	1.708	2.047	0.14	24.44	1.895	1.734	2.072	0.13	24.76	1.953	1.785	2.136
164 Hyperplasia of prostate	0.11	21.30	1.628	1.465	1.808	0.11	20.83	1.597	1.437	1.774	0.10	21.11	1.615	1.449	1.801
165 Inflammatory conditions of male genital organs	0.04	18.36	1.364	1.153	1.613	0.05	22.87	1.704	1.465	1.983	0.05	20.19	1.536	1.316	1.793
166 Other male genital disorders	0.02	25.13	1.811	1.429	2.295	0.02	24.56	1.710	1.325	2.206	0.02	18.38	1.274	0.975	1.666
167 Nonmalignant breast conditions	0.01	17.38	1.334	0.960	1.854	0.01	22.22	1.704	1.274	2.281	0.01	22.15	1.858	1.395	2.476
168 Inflammatory diseases of female pelvic organs	0.02	17.46	1.415	1.092	1.834	0.02	22.11	1.907	1.498	2.429	0.02	24.94	2.138	1.682	2.718
170 Prolapse of female genital organs	0.02	14.16	1.702	1.288	2.250	0.02	13.16	1.485	1.107	1.990	0.02	12.56	1.386	1.022	1.879
173 Menopausal disorders	0.01	18.27	1.544	1.145	2.081	0.01	18.21	1.465	1.075	1.997	0.01	22.26	1.805	1.352	2.411
175 Other female genital disorders	0.03	22.65	1.882	1.576	2.248	0.04	22.37	1.817	1.530	2.158	0.04	22.73	1.871	1.575	2.222

(continued)

Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
197 Skin and subcutaneous tissue infections	1.73	19.20	1.627	1.565	1.691	1.77	18.80	1.579	1.519	1.641	1.77	18.86	1.629	1.567	1.693
198 Other inflammatory condition of skin	0.03	23.41	1.953	1.639	2.328	0.03	26.43	2.384	1.994	2.849	0.03	27.85	2.592	2.182	3.079
199 Chronic ulcer of skin	0.52	21.77	1.610	1.524	1.701	0.48	20.94	1.526	1.442	1.615	0.45	20.14	1.485	1.400	1.575
200 Other skin disorders	0.01	20.14	1.488	1.110	1.994	0.01	22.64	1.856	1.402	2.456	0.02	20.41	1.576	1.202	2.067
201 Infective arthritis and osteomyelitis (except that caused by tuberculosis or sexually transmitted disease)	0.42	21.47	1.610	1.520	1.705	0.40	20.14	1.495	1.409	1.586	0.39	20.03	1.560	1.470	1.656
202 Rheumatoid arthritis and related disease	0.07	13.25	1.317	1.134	1.528	0.07	12.07	1.225	1.048	1.432	0.07	13.31	1.334	1.141	1.559
203 Osteoarthritis*	5.61	7.40	—	—	—	5.84	7.28	—	—	—	5.69	7.11	—	—	—
204 Other non-traumatic joint disorders	0.27	14.14	1.512	1.397	1.636	0.26	13.74	1.483	1.368	1.607	0.25	13.10	1.428	1.314	1.552
205 Spondylosis; intervertebral disc disorders; other back problems	1.42	16.09	1.741	1.675	1.810	1.43	15.51	1.656	1.593	1.722	1.42	15.19	1.646	1.583	1.712
207 Pathological fracture	0.85	17.93	1.809	1.729	1.892	0.79	17.41	1.736	1.657	1.818	0.76	16.91	1.709	1.629	1.792
209 Other acquired deformities	0.17	14.21	1.497	1.362	1.646	0.18	14.36	1.517	1.384	1.664	0.19	14.03	1.512	1.380	1.656
210 Systemic lupus erythematosus and connective tissue disorders	0.02	31.39	2.420	1.981	2.956	0.02	28.90	2.155	1.739	2.672	0.02	29.16	2.184	1.755	2.718
211 Other connective tissue disease	0.69	15.79	1.490	1.414	1.570	0.71	15.80	1.487	1.412	1.566	0.73	14.84	1.425	1.353	1.502

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
212 Other bone disease and musculoskeletal deformities	0.29	14.60	1.526	1.416	1.643	0.29	13.67	1.418	1.315	1.530	0.29	13.77	1.471	1.364	1.587
213 Cardiac and circulatory congenital anomalies	0.01	28.05	2.191	1.647	2.914	0.01	24.79	2.024	1.498	2.733	0.01	20.35	1.540	1.147	2.067
214 Digestive congenital anomalies	0.00	24.49	1.995	1.248	3.190	0.00	25.74	2.141	1.361	3.368	0.00	26.53	2.224	1.409	3.512
215 Genitourinary congenital anomalies	0.00	24.14	1.982	1.076	3.650	0.00	29.23	2.121	1.222	3.684	0.00	25.86	1.754	0.958	3.212
217 Other congenital anomalies	0.04	14.66	1.848	1.516	2.251	0.04	14.93	1.835	1.518	2.219	0.04	13.10	1.652	1.339	2.038
225 Joint disorders and dislocations; trauma-related	0.09	14.69	1.671	1.474	1.895	0.10	14.32	1.709	1.513	1.930	0.10	14.93	1.740	1.545	1.960
226 Fracture of neck of femur (hip)	5.93	15.76	1.750	1.703	1.798	5.93	15.64	1.733	1.687	1.780	5.92	15.18	1.708	1.662	1.756
227 Spinal cord injury	0.03	24.27	2.262	1.880	2.722	0.03	23.17	2.210	1.850	2.639	0.03	24.83	2.391	2.014	2.840
228 Skull and face fractures	0.10	13.77	1.359	1.195	1.545	0.10	15.30	1.516	1.342	1.712	0.09	14.81	1.508	1.329	1.710
229 Fracture of upper limb	1.00	15.19	1.722	1.648	1.799	0.99	15.04	1.703	1.630	1.780	0.99	14.74	1.700	1.627	1.778
230 Fracture of lower limb	1.72	15.59	1.722	1.661	1.785	1.76	15.65	1.726	1.666	1.789	1.77	15.54	1.738	1.677	1.802
231 Other fractures	2.21	14.57	1.527	1.472	1.585	2.22	14.46	1.519	1.464	1.576	2.25	14.30	1.537	1.481	1.595
232 Sprains and strains	0.17	13.67	1.451	1.316	1.600	0.17	12.84	1.331	1.203	1.473	0.15	12.94	1.379	1.241	1.532
233 Intracranial injury	0.72	22.99	2.112	2.013	2.216	0.76	22.08	2.013	1.920	2.111	0.79	21.37	1.993	1.901	2.090
234 Crushing injury or internal injury	0.16	21.81	1.780	1.634	1.939	0.17	23.02	1.908	1.758	2.071	0.17	21.83	1.844	1.695	2.006
235 Open wounds of head; neck; and trunk	0.07	15.78	1.525	1.318	1.765	0.07	15.33	1.435	1.238	1.664	0.07	14.46	1.401	1.205	1.629

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
236 Open wounds of extremities	0.05	19.45	1.886	1.625	2.188	0.06	18.32	1.706	1.467	1.983	0.06	18.57	1.776	1.533	2.057
237 Complication of device; implant or graft	2.89	25.10	1.891	1.832	1.952	2.94	24.55	1.850	1.792	1.909	3.02	24.07	1.851	1.793	1.911
238 Complications of surgical procedures or medical care	1.44	27.27	1.946	1.873	2.022	1.44	26.84	1.893	1.822	1.966	1.44	26.79	1.910	1.838	1.984
239 Superficial injury; contusion	0.35	17.13	1.698	1.589	1.815	0.33	16.90	1.631	1.523	1.745	0.32	16.11	1.578	1.471	1.693
240 Burns	0.03	22.31	1.913	1.602	2.283	0.03	22.19	1.802	1.503	2.161	0.03	22.97	1.990	1.664	2.381
241 Poisoning by psychotropic agents	0.03	18.32	1.369	1.129	1.658	0.04	18.75	1.406	1.171	1.689	0.04	19.21	1.497	1.260	1.778
242 Poisoning by other medications and drugs	0.14	19.81	1.442	1.309	1.587	0.14	19.37	1.395	1.267	1.535	0.14	18.95	1.382	1.254	1.522
243 Poisoning by nonmedicinal substances	0.01	22.54	1.827	1.314	2.538	0.01	23.26	1.915	1.387	2.645	0.01	19.39	1.423	0.993	2.041
244 Other injuries and conditions due to external causes	0.27	20.01	1.724	1.607	1.850	0.28	19.51	1.647	1.534	1.767	0.27	18.46	1.554	1.445	1.671
245 Syncope	0.80	16.09	1.494	1.422	1.571	0.79	15.79	1.477	1.405	1.553	0.72	15.37	1.451	1.377	1.529
246 Fever of unknown origin	0.13	23.37	1.910	1.739	2.097	0.13	23.37	1.904	1.734	2.091	0.12	22.40	1.820	1.653	2.003
248 Gangrene	0.38	27.49	1.792	1.690	1.902	0.37	27.28	1.764	1.662	1.873	0.36	27.82	1.863	1.754	1.978
249 Shock	0.01	32.24	2.101	1.482	2.977	0.01	30.00	1.876	1.327	2.651	0.01	26.24	1.593	1.088	2.333
250 Nausea and vomiting	0.08	22.23	1.828	1.630	2.051	0.09	21.85	1.790	1.604	1.998	0.09	23.49	1.990	1.780	2.225
251 Abdominal pain	0.16	22.39	1.856	1.702	2.023	0.15	22.54	1.825	1.673	1.992	0.15	22.98	1.909	1.747	2.086
252 Malaise and fatigue	0.28	16.49	1.581	1.469	1.702	0.28	16.64	1.603	1.489	1.725	0.28	15.70	1.515	1.405	1.633
253 Allergic reactions	0.03	24.97	2.084	1.754	2.476	0.03	26.95	2.263	1.905	2.687	0.03	23.97	1.962	1.640	2.346

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
257 Other aftercare	0.02	22.64	1.855	1.460	2.359	0.01	23.08	1.731	1.327	2.259	0.02	21.32	1.685	1.320	2.150
259 Residual codes; unclassified	0.58	20.08	1.723	1.635	1.816	0.60	20.40	1.744	1.656	1.837	0.57	19.85	1.719	1.630	1.812
651 Anxiety disorders	0.03	17.78	1.560	1.266	1.923	0.03	16.34	1.448	1.172	1.788	0.03	13.98	1.165	0.921	1.474
653 Delirium	2.22	12.67	1.202	1.154	1.251	2.16	12.67	1.204	1.157	1.254	2.08	12.42	1.196	1.148	1.247
654 Developmental disorders	0.02	18.13	1.791	1.354	2.368	0.01	17.70	1.734	1.297	2.318	0.01	16.17	1.537	1.082	2.185
657 Mood disorders	0.68	13.09	1.069	1.010	1.131	0.69	12.68	1.039	0.981	1.099	0.68	12.86	1.061	1.002	1.123
659 Schizophrenia and other psychotic disorders	0.70	13.41	1.147	1.084	1.214	0.69	13.44	1.155	1.092	1.221	0.72	13.62	1.166	1.103	1.233
660 Alcohol-related disorders	0.13	15.16	1.173	1.054	1.306	0.15	14.95	1.201	1.085	1.329	0.15	14.84	1.210	1.095	1.338
661 Substance-related disorders	0.19	19.04	1.525	1.403	1.657	0.19	18.66	1.454	1.337	1.582	0.18	18.76	1.449	1.330	1.578
663 Screening and history of mental health and substance abuse codes	0.07	32.43	2.262	2.017	2.538	0.07	34.09	2.416	2.150	2.716	0.07	31.44	2.196	1.956	2.465
670 Miscellaneous disorders	0.02	17.32	1.524	1.163	1.997	0.02	19.01	1.643	1.256	2.149	0.02	17.29	1.530	1.152	2.030
Non-significant CCS with Protective Effect	0.04	11.36	0.997	0.805	1.236	0.04	10.22	0.877	0.700	1.098	0.04	11.73	1.030	0.837	1.269
Nonsignificant CCS with effect that increases risk	0.12	17.23	1.611	1.445	1.795	0.11	15.73	1.419	1.266	1.589	0.11	14.15	1.306	1.160	1.471
HCC1 HIV/AIDS	0.21	34.43	1.209	1.123	1.302	0.23	32.50	1.144	1.065	1.228	0.23	31.48	1.157	1.078	1.241
HCC2 Septicemia, Sepsis, Systemic Inflammatory Response Syndrome/Shock	13.47	30.71	1.038	1.015	1.063	13.97	30.18	1.052	1.028	1.077	14.79	29.55	1.042	1.018	1.067
HCC6 Opportunistic Infections	0.96	35.30	1.134	1.094	1.176	0.97	34.59	1.145	1.104	1.188	0.97	34.84	1.175	1.133	1.219

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
HCC8 Metastatic Cancer and Acute Leukemia	2.38	28.59	1.207	1.172	1.242	2.35	28.82	1.260	1.224	1.297	2.32	28.84	1.290	1.252	1.329
HCC9 Lung and Other Severe Cancers	1.50	30.56	1.211	1.173	1.251	1.53	30.12	1.222	1.184	1.262	1.56	29.76	1.223	1.185	1.263
HCC10 Lymphoma and Other Cancers	1.45	26.69	1.160	1.122	1.198	1.46	26.01	1.151	1.113	1.189	1.48	26.04	1.176	1.138	1.216
HCC11 Colorectal, Bladder, and Other Cancers	1.11	27.49	1.047	1.010	1.085	1.11	27.37	1.070	1.032	1.110	1.10	27.20	1.080	1.041	1.120
HCC12 Breast, Prostate, and Other Cancers and Tumors	1.58	23.46	1.023	0.990	1.057	1.53	22.83	1.012	0.979	1.047	1.56	22.86	1.049	1.014	1.085
HCC17 Diabetes with Acute Complications	0.61	32.95	1.123	1.075	1.172	0.63	32.66	1.153	1.105	1.203	0.70	32.60	1.155	1.108	1.204
HCC18 Diabetes with Chronic Complications	9.52	29.67	1.100	1.075	1.126	9.64	29.06	1.096	1.071	1.123	10.02	28.81	1.112	1.085	1.139
HCC19 Diabetes without complication	22.31	23.19	1.052	1.029	1.075	22.25	22.71	1.057	1.034	1.081	22.85	22.46	1.076	1.052	1.100
HCC21 Protein-Calorie Malnutrition	12.55	29.66	1.110	1.085	1.135	13.19	29.23	1.124	1.098	1.150	13.70	28.85	1.124	1.098	1.150
HCC23 Other Significant Endocrine and Metabolic Disorders	4.50	31.05	1.071	1.044	1.098	4.69	30.74	1.086	1.059	1.114	4.97	30.69	1.087	1.059	1.115
HCC24 Disorders of Fluid/ Electrolyte/Acid-Base Balance	47.44	25.53	1.061	1.039	1.084	48.23	25.13	1.072	1.049	1.096	50.09	24.80	1.080	1.056	1.105
HCC27 End-Stage Liver Disease	1.00	38.43	1.414	1.361	1.468	1.06	38.23	1.440	1.387	1.494	1.15	37.77	1.453	1.401	1.506
HCC28 Cirrhosis of Liver	0.62	29.26	1.168	1.118	1.221	0.66	28.64	1.169	1.119	1.220	0.72	28.02	1.155	1.107	1.204
HCC29 Chronic Hepatitis	0.33	29.51	1.043	0.985	1.105	0.35	28.51	1.043	0.985	1.103	0.39	28.52	1.054	0.999	1.112

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
HCC31 Other Hepatitis and Liver Disease	0.92	26.62	1.039	1.000	1.080	0.95	25.88	1.039	1.000	1.080	1.04	25.84	1.068	1.029	1.109
HCC32 Gallbladder and Biliary Tract Disorders	2.19	26.84	0.964	0.943	0.985	2.15	26.25	0.948	0.927	0.969	2.15	26.37	0.968	0.947	0.990
HCC33 Intestinal Obstruction/Perforation	6.57	28.50	1.049	1.024	1.075	6.36	28.01	1.047	1.022	1.073	6.06	28.10	1.063	1.037	1.090
HCC36 Peptic Ulcer, Hemorrhage, Other Specified Gastrointestinal Disorders	14.55	29.91	1.086	1.062	1.111	14.01	29.54	1.092	1.068	1.117	14.15	29.34	1.100	1.075	1.126
HCC40 Rheumatoid Arthritis and Inflammatory Connective Tissue Disease	4.26	23.86	1.111	1.083	1.140	4.28	23.44	1.118	1.089	1.148	4.52	23.25	1.135	1.106	1.166
HCC46 Severe Hematological Disorders	2.52	33.26	1.233	1.199	1.269	2.63	32.62	1.225	1.191	1.260	2.51	32.38	1.236	1.201	1.272
HCC48 Coagulation Defects and Other Specified Hematological Disorders	6.15	27.76	1.073	1.047	1.099	6.85	27.18	1.080	1.054	1.107	7.37	26.83	1.087	1.061	1.115
HCC49 Iron Deficiency and Other/Unspecified Anemias and Blood Disease	35.95	23.10	1.033	1.011	1.056	35.74	22.61	1.041	1.018	1.064	37.29	22.40	1.046	1.023	1.069
HCC50 Delirium and Encephalopathy	11.38	27.50	1.055	1.031	1.079	12.91	27.00	1.063	1.039	1.088	14.57	26.56	1.064	1.040	1.089
HCC51 Dementia with complications	4.56	20.54	0.969	0.952	0.986	4.23	20.03	0.954	0.937	0.971	4.26	19.73	0.964	0.947	0.982
HCC52 Dementia Without Complication	23.53	20.04	0.937	0.929	0.945	23.62	19.67	0.929	0.921	0.937	24.28	19.51	0.933	0.925	0.941
HCC61 Depression	11.75	21.09	0.979	0.968	0.989	11.35	20.58	0.976	0.966	0.987	12.25	20.23	0.968	0.958	0.979

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
HCC63 Other Psychiatric Disorders	3.70	21.81	1.026	0.999	1.054	3.74	21.13	1.023	0.995	1.051	4.14	20.81	1.027	1.000	1.056
HCC70 Quadriplegia	0.45	28.95	1.095	1.042	1.152	0.50	27.88	1.074	1.023	1.128	0.55	28.32	1.116	1.065	1.170
HCC82 Respirator Dependence/ Tracheostomy Status	0.66	40.25	1.348	1.293	1.405	0.64	40.35	1.410	1.353	1.471	0.69	39.96	1.405	1.348	1.463
HCC84 Cardio-Respiratory Failure and Shock	13.53	32.79	1.140	1.115	1.166	14.59	32.21	1.156	1.130	1.182	15.79	31.37	1.144	1.118	1.171
HCC85 Congestive Heart Failure	35.57	28.02	1.137	1.113	1.162	35.70	27.77	1.161	1.136	1.186	36.24	27.28	1.154	1.128	1.180
HCC86 Acute Myocardial Infarction	5.78	31.44	1.110	1.083	1.137	5.76	31.11	1.123	1.096	1.151	5.78	30.88	1.136	1.108	1.165
HCC87 Unstable Angina and Other Acute Ischemic Heart Disease	1.81	29.60	1.126	1.092	1.162	1.70	28.81	1.107	1.073	1.143	1.76	27.67	1.071	1.037	1.106
HCC88 Angina Pectoris	1.13	24.96	1.043	1.006	1.082	0.97	25.53	1.103	1.062	1.146	0.87	25.19	1.096	1.053	1.140
HCC89 Coronary Atherosclerosis/Other Chronic Ischemic Heart Diseases	26.43	24.37	1.049	1.027	1.072	25.79	24.04	1.061	1.038	1.084	26.41	23.54	1.054	1.031	1.078
HCC90 Heart Infection/ Inflammation, Except Rheumatic	1.24	33.36	1.082	1.046	1.119	1.23	32.48	1.070	1.034	1.107	1.24	32.77	1.102	1.065	1.141
HCC91 Valvular and Rheumatic Heart Disease	9.76	25.86	1.042	1.018	1.066	9.32	25.48	1.055	1.031	1.080	9.66	24.91	1.052	1.027	1.077
HCC96 Specified Heart Arrhythmias	28.75	26.22	1.099	1.076	1.123	29.07	25.77	1.098	1.075	1.123	30.27	25.34	1.106	1.081	1.131

(continued)

Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
HCC102 Cerebrovascular Atherosclerosis, Aneurysm, and Other Disease	2.16	20.52	0.979	0.956	1.002	2.09	20.42	0.987	0.963	1.011	2.14	20.41	0.987	0.964	1.011
HCC105 Late Effects of Cerebrovascular Disease, Except Paralysis	2.91	22.34	0.985	0.966	1.004	2.87	21.87	0.978	0.958	0.998	3.06	21.64	0.986	0.967	1.005
HCC106 Atherosclerosis of the Extremities with Ulceration or Gangrene	2.39	30.52	1.004	0.975	1.034	2.35	30.03	1.023	0.993	1.054	2.34	29.96	1.031	1.000	1.063
HCC107 Vascular Disease with Complications	3.01	29.28	1.054	1.026	1.083	3.09	28.60	1.056	1.028	1.085	3.11	28.29	1.060	1.031	1.090
HCC108 Vascular Disease	11.06	26.55	1.041	1.018	1.065	11.12	26.35	1.058	1.034	1.082	11.58	25.90	1.053	1.028	1.078
HCC111 Chronic Obstructive Pulmonary Disease	25.66	27.24	1.116	1.092	1.140	25.46	27.01	1.142	1.117	1.167	26.00	26.55	1.142	1.116	1.168
HCC112 Fibrosis of Lung and Other Chronic Lung Disorders	1.30	24.31	1.066	1.030	1.104	1.28	23.52	1.059	1.023	1.097	1.29	23.29	1.077	1.040	1.116
HCC114 Aspiration and Specified Bacterial Pneumonias	6.95	32.58	1.152	1.125	1.180	7.04	31.95	1.138	1.111	1.166	7.22	31.42	1.135	1.107	1.163
HCC116 Viral and Unspecified Pneumonia, Pleurisy	16.65	28.65	1.080	1.056	1.104	16.47	28.40	1.085	1.061	1.109	16.64	27.84	1.080	1.056	1.105
HCC117 Pleural Effusion/Pneumothorax	7.23	31.35	1.077	1.052	1.103	6.97	31.21	1.103	1.077	1.130	6.94	30.82	1.101	1.074	1.128
HCC132 Kidney Transplant Status	0.35	39.50	1.452	1.376	1.531	0.37	38.61	1.473	1.398	1.553	0.40	38.28	1.490	1.416	1.568

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
HCC138 Chronic Kidney Disease, Moderate Stage 3)	1.75	21.57	1.087	1.053	1.123	2.26	20.93	1.107	1.074	1.142	2.85	20.25	1.105	1.073	1.138
HCC139 Chronic Kidney Disease, Mild or Unspecified (Stages 1-2 or Unspecified)	6.01	22.59	1.116	1.089	1.144	5.54	21.63	1.121	1.093	1.150	5.44	21.07	1.127	1.099	1.157
HCC141 Nephritis	0.16	22.85	1.088	1.001	1.181	0.14	22.77	1.131	1.034	1.236	0.13	22.16	1.111	1.013	1.219
HCC142 Urinary Obstruction and Retention	7.31	25.54	1.033	1.009	1.058	7.63	25.13	1.049	1.024	1.075	8.32	24.64	1.049	1.024	1.075
HCC144 Urinary Tract Infection	34.83	25.15	1.028	1.006	1.050	34.48	24.79	1.041	1.019	1.064	34.57	24.40	1.039	1.016	1.063
HCC145 Other Urinary Tract Disorders	8.27	26.00	1.036	1.012	1.060	7.59	25.78	1.064	1.039	1.090	7.69	25.25	1.055	1.030	1.081
HCC157 Pressure Ulcer of Skin with Necrosis Through to Muscle, Tendon, or Bone	1.12	32.88	1.223	1.180	1.268	1.21	32.44	1.246	1.203	1.291	1.18	31.86	1.226	1.183	1.270
HCC158 Pressure Ulcer of Skin with Full Thickness Skin Loss	1.58	31.92	1.201	1.164	1.240	1.76	31.05	1.190	1.154	1.227	1.80	31.06	1.207	1.169	1.245
HCC159 Pressure Ulcer of Skin with Partial Thickness Skin Loss	1.45	26.86	1.094	1.059	1.131	1.43	26.19	1.108	1.072	1.146	1.48	26.14	1.129	1.092	1.167
HCC160 Pressure Pre-Ulcer Skin Changes or Unspecified Stage	3.72	28.53	1.075	1.047	1.103	3.02	28.12	1.100	1.070	1.131	3.09	27.72	1.095	1.065	1.126
HCC161 Chronic Ulcer of Skin, Except Pressure	3.16	25.69	1.018	0.991	1.047	3.16	25.81	1.059	1.030	1.088	3.17	25.25	1.039	1.010	1.068

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
HCC169 Vertebral Fractures without Spinal Cord Injury	3.58	23.29	1.037	1.010	1.065	3.47	22.66	1.035	1.007	1.063	3.47	22.08	1.017	0.989	1.046
HCC170 Hip Fracture/ Dislocation	5.65	21.78	0.938	0.925	0.952	5.51	21.47	0.935	0.921	0.949	5.37	21.15	0.943	0.929	0.958
HCC176 Complications of Specified Implanted Device	4.76	30.02	1.046	1.020	1.073	4.66	29.36	1.060	1.033	1.088	4.72	28.94	1.068	1.041	1.097
HCC177 Other Complications of Medical Care	10.74	28.46	1.036	1.013	1.061	9.39	28.46	1.049	1.025	1.074	8.62	27.97	1.050	1.024	1.075
HCC186 Major Organ Transplant or Replacement Status	0.16	39.16	1.243	1.152	1.341	0.18	37.18	1.201	1.117	1.291	0.20	37.32	1.203	1.123	1.289
HCC188 Artificial Openings for Feeding or Elimination	2.22	32.89	1.214	1.179	1.250	2.12	32.26	1.219	1.184	1.256	2.20	32.19	1.240	1.204	1.278
HCC197 Supplemental Oxygen	2.26	32.47	1.229	1.194	1.265	2.56	31.91	1.226	1.192	1.261	3.11	31.23	1.221	1.188	1.256
HCC: Advanced Chronic Kidney Disease and Dialysis (134, 135, 136, 137)	27.67	30.22	1.207	1.181	1.234	29.91	29.46	1.226	1.199	1.253	31.08	29.01	1.235	1.208	1.263
HCC134 Dialysis Status	2.02	39.18	—	—	—	2.13	38.06	—	—	—	2.30	37.84	—	—	—
HCC135 Acute Renal Failure	23.43	29.45	—	—	—	25.56	28.72	—	—	—	26.51	28.24	—	—	—
HCC136 Chronic Kidney Disease, Stage 5	1.39	32.90	—	—	—	1.31	33.17	—	—	—	1.24	32.75	—	—	—
HCC137 Chronic Kidney Disease, Severe (Stage 4)	0.84	25.47	—	—	—	0.92	24.71	—	—	—	1.02	24.49	—	—	—
HCC: Cerebral or Ischemic Hemorrhage/ Stroke (99, 100)	4.95	27.60	1.082	1.055	1.109	4.86	27.36	1.107	1.080	1.136	4.80	26.81	1.102	1.074	1.131
HCC99 Cerebral Hemorrhage	0.97	28.24	—	—	—	0.97	27.94	—	—	—	1.01	28.00	—	—	—

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Table C1 (continued)
Final models, risk variable and odds ratios by year, 2009, 2010 and 2011

Label	2009 % with variable	2009 % with readm	2009 Odds Ratio	2009 LCL	2009 UCL	2010 % with variable	2010 % with readm	2010 Odds Ratio	2010 LCL	2010 UCL	2011 % with variable	2011 % with readm	2011 Odds Ratio	2011 LCL	2011 UCL
HCC100 Ischemic or Unspecified Stroke	3.98	27.44	—	—	—	3.89	27.21	—	—	—	3.78	26.49	—	—	—
Count of HCCs, if 2 or more	—	—	1.068	1.049	1.088	—	—	1.063	1.043	1.083	—	—	1.058	1.038	1.079
Square of count of HCCs, if 2 or more	—	—	0.995	0.995	0.996	—	—	0.995	0.995	0.995	—	—	0.995	0.995	0.996

Abbreviations and symbols: * indicates the referent category. LCL = lower confidence limit for the odds ratio; UCL = upper confidence interval for the odds ratio

NOTE: Sample sizes for each file year: 2009 = 2,191,546 index stays in 16,713 SNFs; 2010 =2,200,685 index stays in 16,671 SNFs; 2011 = 2,215,398 index stays in 16,656 SNFs. Unadjusted readmission rates for each file year: 2009 = 21.71%; 2010 = 21.36%; 2011 = 21.08%.

SOURCE: RTI analysis of Medicare claims (MedPAR files 2009, 2010, 2011). Program: \\wallsas03.waltham.rti.org\vol1\hipaa\0211942.004_PGM\100.008\pgm\stan\programs\ readmit104_idxSNF02_HLMFinal_inclDth.sas, readmit107_idxSNF02_BiVar_Descript_Model_nomiss_ForTable.sas