# 2024 Condition- and Procedure-Specific Readmission Measures Supplemental Methodology Report

**Acute Myocardial Infarction**
**Chronic Obstructive Pulmonary Disease**
**Heart Failure**
**Pneumonia**
**Isolated Coronary Artery Bypass Graft (CABG) Surgery**
**Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty (TKA)**

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# Center for Outcomes Research and Evaluation Project Team

**Medicare Advantage Team**:
Kelly Kyanko, MD, MHS – Project Lead
Wanda Johnson, BS, RN – Team Coordinator
Shu-Xia Li, PhD – Analytic Leadership, Associate Director of Data Management and Analytics
Jacqueline Grady, MS – Division Director
Hiral Dudhwala, RN, MSN/MPH – Division Lead
Jennifer Falcone, BA – Project Manager
Elizabeth Triche, PhD - Associate Director, Quality Measurement Programs
Yongfei Wang*, MS – Lead Analyst
Jing Zhang*, MBA, MPhil, MS – Data Manager
Isabella Epshtein, MA – Research Associate
Lisa G. Suter*, MD – Contract Director

**Risk Model Respecification Team:**
Chenxi Huang*, PhD – Project Lead
Jennifer Falcone, BA – Project Manager
Philippa Chadwick, MPH – Team Coordinator
Zhenqiu Lin, PhD – Analytic Leadership, Senior Director of Data Management and Analytics
Shu-Xia Li, PhD – Analytic Leadership, Associate Director of Data Management and Analytics
Jacqueline Grady, MS – Division Director
Elizabeth Triche, PhD – Associate Director, Quality Measurement Programs
Yongfei Wang*, MS – Lead Analyst
Ji Chen*, PhD – Data Analyst
Peizheng Chen*, MS – Data Analyst
Samantha Mancuso, MPH – Research Associate
Lisa G. Suter*, MD – Contract Director

* Yale School of Medicine

# Acknowledgements

**NOTE: This supplemental methodology report is not meant to replace the original measure methodology reports, but to provide additional information and results based on the addition of Medicare Advantage (MA) admissions to the cohorts and the modification of the risk adjustment models. The original methodology reports for the measures are available on QualityNet <u>here</u>.**

## 1. EXECUTIVE SUMMARY

In this supplemental methodology report, we present the rationale and testing results of two updates to the condition- and procedure-specific readmission measures: 1) integrating Medicare Advantage (MA) beneficiaries into the cohorts and, 2) the reselection of risk adjustment variables. Measure results in this report include: hospital-level 30-day risk-standardized readmission rates (RSRRs) following acute myocardial infarction (AMI), chronic obstructive pulmonary disease (COPD), heart failure (HF), pneumonia, coronary artery bypass graft (CABG) surgery and elective total hip arthroplasty and/or total knee arthroplasty (THA/TKA) admissions.

Changes to the current readmission measures include the addition of MA admissions into the cohorts and the reevaluation of the risk adjustment models; all other specifications remain the same. For testing purposes, the cohorts include hospital admissions with discharge dates from January 1 to December 30, 2022. Inpatient, outpatient, and professional claims for Medicare Fee-For-Service (FFS) and MA beneficiaries were extracted from the Centers for Medicare & Medicaid Services (CMS) Integrated Data Repository (IDR). The MA claims data comprise Medicare Advantage Organization (MAO)-submitted encounter data (Encounter Data Records and Chart Review Records for all settings) and hospital-submitted inpatient MA claims.[1]

The addition of MA admissions into the condition- and procedure-specific readmission measures roughly doubled the number of admissions in the cohorts and led to improved measure reliability (with the exception of THA/TKA) and more hospitals and beneficiaries included for measure calculation. Across measures, unadjusted 30-day readmission rates were generally similar for MA versus FFS admissions for condition-specific measures (AMI, COPD, HF, pneumonia) and higher for MA for the CABG and THA/TKA measures. The prevalence of comorbidities was generally higher in the MA cohort as compared to FFS.

A new approach to variable reselection was implemented to leverage the specificity of individual International Classification of Diseases (ICD)-10 codes in place of Condition Categories (CCs) to improve performance of the risk adjustment models. Previous work found that model performance for the condition- and procedure-specific mortality and complication measures improved with the new approach.[2] With this new variable selection strategy, the discriminative performance of the models for the readmission measures as measured by c-statistics remained similar. However, to align methods across all measures, we adopted the new ICD-10-based risk variable selection approach for the readmission measures included in this report. Overall model performance proved to be satisfactory using the new approach. After the two measure updates, we observed meaningful shifts in hospital performance.

## 2. BACKGROUND AND OBJECTIVES

### 2.1. Importance of Including MA Beneficiaries in Hospital Outcome Measures

Including MA beneficiaries in CMS hospital outcome measures helps ensure that hospital quality is measured across all Medicare beneficiaries and not just the FFS population. MA beneficiary enrollment has been rapidly expanding as a share of Medicare beneficiaries. In 2023, nearly 51% of the eligible Medicare beneficiaries — or 30.8 million people — were covered by MA plans.[3] The Congressional Budget Office projects that by 2030, 62% of beneficiaries will be covered by MA plans.[4] Consequently, using FFS-only beneficiaries may exclude a large segment of the focus population for CMS quality measures, which are intended to measure the quality of care of all Medicare beneficiaries.

Inclusion of MA beneficiaries has several important benefits for the reliability and validity of the hospital outcome measures. The addition of MA beneficiaries to FFS significantly increases the size of the measure's cohort, which enhances the reliability of the measure scores, leads to more hospitals receiving results, and increases the chance of identifying meaningful differences in quality for some low-volume hospitals. Moreover, this update addresses stakeholder concerns about differences in quality for MA and FFS beneficiaries.[5,6] The addition of MA inpatient admissions also allows for inclusion in the measure of beneficiaries who switch between FFS and MA. CMS's current claims-based measures require enrollment in FFS Part A and Part B for the 12 months prior to the date of admission and Part A during the index admission.

### 2.2. Importance of Risk Adjustment Model Changes

The goal of risk-adjustment models is to adjust for case-mix differences across the hospitals. Risk adjustment supports fair and accurate comparison of outcomes across measured entities by including an adjustment for factors such as age, comorbid diseases, and indicators of patient frailty, which are clinically relevant and have relationships with the outcome.

The original process for clinical risk adjustment for the current measures involved reviewing CCs for clinical relevance and evaluating the CCs for statistical association with the outcome. The CCs are part of CMS's Hierarchical Condition Categories (HCC), and the HCC system groups the ICD-10 diagnosis codes into larger clinically relevant diagnostic categories.[7,8] Mappings which show the assignment of ICD-10 codes to the CCs are available on _QualityNet_. In pursuing an approach that best leverages the data and analytical advancements since initial measure development, we developed and evaluated a framework to use individual ICD-10 codes for risk adjustment. The main advantage of leveraging ICD-10 codes in place of CCs is the ability to address the clinical heterogeneity found in the broadly defined CCs. Our previous research indicates that the model performance of the mortality measures is significantly improved by using individual codes instead of CCs.[2] Therefore, this new approach has also been applied to each of the readmission measures in this report.

### 2.3. Objectives

We had two main objectives: 1) To assess the impact of incorporating MA inpatient admissions into the claims-based condition- and procedure-specific readmission measures, and 2) To improve the

performance of risk adjustment models for these measures by leveraging the individual ICD-10 codes rather than CCs.

## 3. METHODS

### 3.1. Data Sources

For testing of these measure updates, we extracted all claims and beneficiary data for FFS and MA beneficiaries as well as Medicare provider data from the CMS IDR. The condition- and procedure-specific readmission measures use inpatient claims and enrollment data for cohort construction and outcome derivation and use inpatient and outpatient facility, professional, and durable medical equipment (DME) claims data for risk adjustment. We downloaded claims data for index admissions with the claim discharge date from January 1 to December 30, 2022 (calendar year [CY] 2022) as well as historical claims up to 12 months prior to the index admission and inpatient claims data up to 30-days post-index admission based on the claim types in Table 1. We also downloaded beneficiary enrollment information needed for cohort inclusion and exclusion criteria. We downloaded provider history data that details the association between the CMS Certification Number (CCN) and National Provider Identifier (NPI).

Most MA beneficiary inpatient admissions had two claim submission sources: MAO-submitted encounter claims and hospital-submitted claims. MAO-submitted encounter claims are information-only (i.e., not billing) claims for items and services provided under the plan that are required to be submitted by MAOs to CMS.[1] Hospitals that receive disproportionate-share hospital or medical education payments from Medicare are also required to submit information-only claims for inpatient stays for MA beneficiaries.

To create the combined FFS+MA cohort, we included both MAO-submitted and hospital-submitted MA admission claims. While most hospitals submit MA inpatient claims, not all hospitals are required to submit claims for MA beneficiaries (i.e., those that do not receive disproportionate-share hospital or medical education payments from Medicare), so MAO-submitted claims capture additional admissions not found in the hospital-submitted claims. However, there are benefits in including the hospital-submitted claims. Hospital-submitted claims are timelier than MAO-submitted claims, which is advantageous for reporting deadlines for CMS hospital outcome measures. In addition, a small proportion of admissions were only found in the hospital-submitted claims. Further, unlike MAO-submitted claims which are associated with NPI, hospital-submitted claims are already associated with a CCN used to identify hospitals in the CMS outcome measures. Therefore, if an admission was found in both datasets, we used the claim found in the hospital-submitted data. For a small portion of admissions with only MAO-submitted claims, we obtained the CCN using the IDR provider history data through NPI, claim discharge date, provider history begin (effective) date, and provider history end (obsolete) date.

Admissions with only MAO-submitted claims not associated with a CCN were excluded from analyses (<5% of all admissions).

Hospital measures used for public reporting are limited to short-term acute care hospitals and critical access hospitals. In a last step, we used the CCN taxonomy to restrict the claims to those filed by acute care hospitals (3rd and 4th digit as '01') and critical access hospitals (3rd and 4th digit as '13').

**Table 1: Claim Type Codes**

| Type of Claim | FFS | Hospital-submitted MA | MAO-submitted (encounter) MA |
|---|---|---|---|
| Inpatient | 60 | 62, 63, 64 | 4011, 4041 |
| Outpatient Facility | 40 | - | 4012 – 4014, 4022, 4023, 4034, 4043, 4071 – 4077, 4079, 4083, 4085, 4089 |
| Professional | 71, 72 | - | 4700 |
| DME | 81, 82 | - | 4800 |

### 3.2. Cohort and Outcomes

The cohorts included hospital admissions with discharge dates from January 1 to December 30, 2022 (CY 2022). The risk adjustment data were derived from both FFS and MA inpatient and outpatient claims one year prior to and during the index claims. We followed the methodology for the current FFS-only readmission measures for cohort inclusion/exclusion criteria, risk factor derivations from inpatient, outpatient, DME, and professional claims diagnoses/procedures during the 12 months prior to admission or present on admission (POA) at the index hospitalization, outcome definitions, and measure score calculation. After adding the MA beneficiaries, the enrollment requirement was updated to include patients with 12 months FFS or MA enrollment prior to the index admission and at least one-month post-index admission. Information on the FFS-only measures, including measure specifications and calculation methodology, is available on *QualityNet* at:

- 2023 Condition-Specific Readmission Measure Updates and Specifications Report: https://qualitynet.cms.gov/inpatient/measures > Readmission Measures > Methodology
- 2023 Procedure-Specific Readmission Measure Updates and Specifications Report: https://qualitynet.cms.gov/inpatient/measures > Readmission Measures > Methodology

### 3.3. Risk Model Reselection

For candidate risk variables, we included all secondary ICD-10 codes documented as POA during the index admission (with the exception of the palliative care code Z51.5 which, effective October 1, 2021, was considered POA-exempt) and both principal and secondary ICD-10 codes in the 12 months prior to admission from any inpatient, outpatient, and professional provider claims. For procedure-specific measures, we additionally considered the principal discharge diagnosis code for the index admission. We also considered age, frailty, sex, an indicator for whether the admission was MA vs. FFS, and other non-individual-ICD variables in the existing publicly reported CMS readmission measures. The variable selection of individual ICD codes mainly relied on data-driven methodologies involving three key steps:

1) pre-processing, 2) evaluating association with outcome, and 3) consideration of associations between other non-individual-code variables, including frailty, with the outcome.

In pre-processing, we screened and included index and history (pre-index) codes if their prevalence exceeded 0.5% and 2.5%, respectively. Further, pairs of index and pre-index codes that had a correlation larger than 0.8 were combined into one risk variable. Specific ICD-10 codes for social risk factors were removed from the candidate list to be consistent with how the measures currently address social risk. Finally, pairs of index and pre-index ICD-10 codes where the difference in association with the outcome, measured by Odds Ratio (OR), was less than 0.2 were merged.

In the second step, we included the remaining candidate variables with age in a multivariable logistic regression model and underwent variable selection through 1,000 iterations of bootstrapping. We selected variables which were statistically significantly associated with outcome (p<0.05) greater than a certain cutoff value of frequency over the bootstrapped samples. The cutoff value was chosen for each measure based on empirical evaluation of the model performance. We forced age into the model if it was not selected into the model through the bootstrapping process.

Lastly, based on literature evidence, specific suggestions and guidance from the consensus-based entity for measure endorsement, the Assistant Secretary for Planning and Evaluation, other stakeholders as well as prior testing results, we included a claims-based indicator of frailty that was developed for CMS's Multiple Chronic Conditions (MCC) measure[9] in the final model for all measures. We generally did not include sex as a variable since sex can be considered a socio-demographic variable. However, there remains some evidence that females are at higher risk of readmission after CABG due to them having smaller coronary vessels and requiring more challenging CABG procedures.[10] Therefore, sex was included for the CABG readmission measure only. There were other non-individual-ICD variables currently included in the publicly reported CMS readmission measures that may contain additional predictive information. For example, for the CABG readmission measure, the current risk model includes a variable that accounts for the history of prior CABG and/or valve surgery, which is defined by a combination of diagnosis and procedure codes. Such variables were included in the final models if their regression coefficients were statistically significant when added to the models. We also added into the model for all measures the history of coronavirus disease 2019 (COVID-19) variable to be consistent with current CMS policy.

For the combined MA and FFS cohort, the risk adjustment model was updated to include an MA indicator (versus FFS) as a main effect. This was to adjust for the generally higher prevalence of comorbidities in the MA cohort, especially among the pre-index variables that were derived from services in the outpatient setting (e.g. physician visits).

### 3.4. Statistical Analyses

We first compared between MA and FFS admissions the number of admissions and observed (unadjusted) readmission rates for each condition (AMI, COPD, HF, and pneumonia) and procedure (CABG, THA/TKA). We then examined risk variable prevalence in MA and FFS admissions for both the CC-based (original) and ICD-10-based (reselected) risk variables. For MA+FFS admissions with reselected

ICD-10-based variables, we calculated the adjusted OR and 95% confidence intervals (CIs) for the hierarchical logistic regression model.

To evaluate the impact of adding MA admissions and risk variable reselection on model performance metrics, we compared c-statistics and predictive ability for three different combinations of cohorts and risk models: 1) FFS-only admissions with the original CC-based risk model, 2) FFS+MA admissions with the original CC-based risk model, and 3) FFS+MA admissions with reselected ICD-10-based variables. Calibration performance was also assessed by calibration slope and intercept and visually by calibration plots, both in the overall cohort and in subgroups stratified by sex, MA indicator, and hospital volume.

We used hierarchical logistic models with a random effect for hospitals to calculate hospital risk-standardized readmission ratios and rates (SRRs and RSRRs) for each condition and procedure and compared these and the number of hospitals using the three different combinations of cohort and risk model variables listed above. We show the distribution of measure scores among all hospitals and among reporting hospitals with at least 25 admissions. We also calculated and compared signal-to-noise reliability (STNR) for hospitals with at least 25 admissions based on between-hospital variance and hospital volume. The volume threshold of 25 admissions used here was to align with the public reporting volume cutoff.

To assess the overall impact of adding MA data to hospital measure scores, using original CC-based risk variables we examined shifts in hospital RSRR quintiles in the FFS-only cohort versus the combined FFS+MA cohort among hospitals with at least 25 FFS admissions. To examine the associations between hospital characteristics and the addition of MA admissions, we examined quintile shifts in hospital RSRR by quintiles of the proportion of hospital MA admissions and by quintiles of overall hospital volume. We then repeated these analyses to assess the impact of adding both MA and updated risk model variables, examining hospital performance shifts in the FFS-only cohort with the original CC-based variables and the FFS+MA cohort with the reselected ICD-10-based variables.

## 4. RESULTS

### 4.1. Acute Myocardial Infarction (AMI) Readmission Results

*AMI Admission Volume and Observed Readmission Rate*

As presented in Table 4.1.1, the FFS+MA cohort included 226,980 unique admissions from January 1 – December 30, 2022 (111,616 FFS and 115,364 MA). The observed (unadjusted) 30-day readmission rate for the FFS+MA cohort for AMI was 13.1%. The observed readmission rate was 13.2% among FFS beneficiaries compared to 13.0% among MA beneficiaries (difference 0.2%).

**Table 4.1.1: Number of Admissions and Observed 30-Day Readmission Rate for AMI, FFS versus MA Admissions, CY 2022**

| AMI | MA + FFS | FFS | MA | Difference FFS − MA |
|---|---|---|---|---|
| N | 226,980 | 111,616 | 115,364 | NA |
| Readmission Rate (%) | 13.1 | 13.2 | 13.0 | 0.2 |

*Frequency of AMI Risk Variables*

We examined the frequencies of variables used for risk adjustment in FFS and MA admissions. The variables from the original CC-based risk model are presented in Table 4.1.2, and the reselected ICD-10-based variables in Table 4.1.3. Frequencies of model variables were generally higher in MA than FFS admissions for both the CC- and ICD-10-based variables. The median difference in risk variable prevalence between FFS and MA (%FFS – %MA) was -1.7% for CC-based variables with a range from -10.9% to 1.6%. The risk variable prevalence differences between FFS and MA for ICD-10-based variables ranged from -5.4% to 1.8% with no difference at the median, however for ICD-10 codes in the 12 months prior to admission (pre-index codes), the differences were more pronounced. Table 4.1.3 also presents adjusted OR and 95% CIs for the hierarchical logistic regression model using FFS+MA admissions.

**Table 4.1.2: Frequency of CC-Based Risk Variables in the AMI Cohort, FFS versus MA Admissions, CY 2022**

| Variable (% unless otherwise indicated) | MA + FFS (N=226,980) | FFS (N=111,616) | MA (N=115,364) | FFS - MA |
|---|---|---|---|---|
| Age, mean (SD) | 76.9 (7.7) | 77.4 (7.9) | 76.4 (7.5) | 1.0 |
| Male | 55.5 | 56.3 | 54.8 | 1.6 |
| History of coronary artery bypass graft (CABG) surgery | 15.5 | 15.1 | 15.8 | -0.7 |
| History of percutaneous transluminal coronary angioplasty (PTCA) | 27.4 | 26.7 | 27.9 | -1.2 |
| Angina pectoris/old myocardial infarction (CC 88) | 26.1 | 23.2 | 29.0 | -5.7 |
| Congestive heart failure (CC 85) | 54.2 | 52.0 | 56.3 | -4.3 |
| Coronary atherosclerosis/other chronic ischemic heart disease (CC 89) | 83.2 | 82.0 | 84.4 | -2.4 |
| Acute coronary syndrome (CC 86,87) | 86.4 | 84.8 | 88.1 | -3.3 |
| Arrhythmias (CC 96, 97) | 56.1 | 56.5 | 55.7 | 0.8 |
| Valvular or rheumatic heart disease (CC 91) | 36.8 | 36.0 | 37.6 | -1.5 |
| Cerebrovascular disease (CC 101,102, 105) | 22.5 | 21.5 | 23.5 | -2.0 |
| Stroke (CC 99 – 100) | 7.4 | 6.8 | 8.1 | -1.3 |
| Vascular or circulatory disease (CC 106 – 109) | 48.3 | 42.7 | 53.6 | -10.9 |
| Hemiplegia, paralysis, functional disability (CC 70 – 74, 103,104, 189,190) | 7.2 | 6.2 | 8.1 | -1.9 |
| Diabetes and DM complications (CC 17 – 19, 122, 123) | 51 | 47.3 | 54.6 | -7.3 |
| Renal failure (CC 135 – 140) | 47.8 | 45.2 | 50.3 | -5.1 |
| End-stage renal disease or dialysis (CC 134) | 3.9 | 3.9 | 3.9 | -0.1 |
| Other urinary tract disorders (CC 145) | 17.4 | 15.9 | 18.8 | -2.9 |
| Chronic obstructive pulmonary disease (CC 111) | 26.2 | 23.3 | 29 | -5.7 |
| Pneumonia (CC 114 – 116) | 19.4 | 18.1 | 20.7 | -2.6 |
| Asthma (CC 113) | 9.4 | 8.2 | 10.5 | -2.3 |

| Variable (% unless otherwise indicated) | MA + FFS (N=226,980) | FFS (N=111,616) | MA (N=115,364) | FFS - MA |
|---|---|---|---|---|
| Disorders of fluid/electrolyte/acid-base (CC23, 24) | 41.1 | 39.7 | 42.4 | -2.7 |
| History of infection (CC1, 3 – 7) | 24.2 | 23.9 | 24.6 | -0.7 |
| Metastatic cancer and acute leukemia (CC 8) | 2.4 | 2.5 | 2.3 | 0.2 |
| Cancer (CC9 – 14) | 19.7 | 20.4 | 19.2 | 1.2 |
| Iron deficiency and other/unspecified anemias and blood disease (CC 49) | 42.4 | 41.3 | 43.5 | -2.2 |
| Decubitus ulcer or chronic skin ulcer (CC 157 – 161) | 6.9 | 6.9 | 6.9 | 0.0 |
| Dementia or other specified brain disorders (CC 51 – 53) | 16.6 | 15.6 | 17.6 | -2.1 |
| Protein-calorie malnutrition (CC 21) | 6.6 | 6.4 | 6.9 | -0.5 |
| Anterior myocardial infarction | 7.5 | 7.7 | 7.4 | 0.3 |
| Other location of myocardial infarction | 14.3 | 14.4 | 14.2 | 0.1 |
| History of COVID-19 | 15.2 | 15.1 | 15.3 | -0.2 |

**Table 4.1.3: Frequency of ICD-10-Based Risk Variables in the AMI Cohort, FFS versus MA Admissions, and Adjusted OR and 95% Confidence Intervals for the AMI Hierarchical Logistic Regression Model Using FFS+MA Admissions, CY 2022**

| Variable | Description | MA + FFS (%) (N= 226,980) | FFS (%) (N= 111,616) | MA (%) (N= 115,364) | FFS – MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| AGE | Age, mean (SD) | 76.9 (7.7) | 77.4 (7.9) | 76.4 (7.5) | 1.0 | 1.01 (1.01,1.01) |
| ICD-10 codes during the index admission | | | | | | |
| D631 | Anemia in chronic kidney disease | 6.3 | 6.4 | 6.1 | 0.3 | 1.27 (1.21,1.33) |
| D638 | Anemia in other chronic diseases classified elsewhere | 1.8 | 1.8 | 1.8 | 0.0 | 1.30 (1.20,1.41) |
| D649 | Anemia, unspecified | 7.8 | 7.6 | 8.0 | -0.5 | 1.22 (1.17, 1.28) |
| D72829 | Elevated white blood cell count, unspecified | 4.3 | 4.2 | 4.3 | -0.1 | 1.11 (1.05,1.18) |
| E43 | Unspecified severe protein-calorie malnutrition | 1.5 | 1.5 | 1.4 | 0.1 | 1.10 (1.01,1.21) |
| E782 | Mixed hyperlipidemia | 8.7 | 8.8 | 8.7 | 0.0 | 0.91 (0.87,0.95) |
| E785 | Hyperlipidemia, unspecified | 60.8 | 60.5 | 61.1 | -0.6 | 0.92 (0.89,0.94) |
| E871 | Hypo-osmolality and hyponatremia | 6.8 | 7.0 | 6.6 | 0.4 | 1.27 (1.22,1.33) |
| G250 | Essential tremor | 0.5 | 0.5 | 0.5 | 0.0 | 0.75 (0.62,0.91) |
| G40909 | Epilepsy, unspecified, not intractable, without status epilepticus | 1.3 | 1.4 | 1.3 | 0.0 | 1.29 (1.17,1.42) |
| I10 | Essential (primary) hypertension | 36.1 | 36.5 | 35.8 | 0.7 | 0.79 (0.77,0.82) |
| I120 | Hypertensive chronic kidney disease with stage 5 chronic kidney disease or end stage renal disease | 1.1 | 1.1 | 1.0 | 0.0 | 1.33 (1.20,1.47) |
| I313 | Pericardial effusion (noninflammatory) | 0.7 | 0.7 | 0.7 | 0.0 | 1.43 (1.26,1.61) |
| I429 | Cardiomyopathy, unspecified | 3.7 | 3.6 | 3.7 | 0.0 | 1.09 (1.03,1.16) |
| I4891 | Unspecified atrial fibrillation | 6.4 | 6.6 | 6.1 | 0.5 | 1.13 (1.07,1.18) |
| I5021 | Acute systolic (congestive) heart failure | 5.4 | 5.5 | 5.3 | 0.3 | 1.25 (1.18,1.31) |
| I5023 | Acute on chronic systolic (congestive) heart failure | 6.3 | 6.1 | 6.4 | -0.3 | 1.28 (1.22,1.34) |
| I5033 | Acute on chronic diastolic (congestive) heart failure | 4.0 | 4.1 | 4.0 | 0.1 | 1.24 (1.17,1.31) |
| I5043 | Acute on chronic combined systolic (congestive) and diastolic (congestive) heart failure | 3.6 | 3.6 | 3.6 | -0.1 | 1.26 (1.19,1.34) |
| I513 | Intracardiac thrombosis, not elsewhere classified | 0.5 | 0.5 | 0.5 | 0.0 | 1.35 (1.16,1.58) |
| I5181 | Takotsubo syndrome | 1.5 | 1.6 | 1.4 | 0.2 | 0.78 (0.69, 0.87) |
| I739 | Peripheral vascular disease, unspecified | 4.6 | 4.7 | 4.5 | 0.2 | 1.15 (1.08,1.21) |

| Variable | Description | MA + FFS (%) (N= 226,980) | FFS (%) (N= 111,616) | MA (%) (N= 115,364) | FFS − MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| N170 | Acute kidney failure with tubular necrosis | 1.4 | 1.4 | 1.5 | -0.1 | 1.32 (1.21,1.44) |
| N179 | Acute kidney failure, unspecified | 17.0 | 16.5 | 17.4 | -1.0 | 1.15 (1.11,1.19) |
| R338 | Other retention of urine | 0.8 | 0.8 | 0.8 | 0.0 | 1.28 (1.13,1.45) |
| R54 | Age-related physical debility | 0.7 | 0.8 | 0.6 | 0.1 | 1.26 (1.10,1.44) |
| R7303 | Prediabetes | 2.9 | 2.7 | 3.0 | -0.3 | 0.77 (0.70,0.84) |
| Z515 | Encounter for palliative care | 3.0 | 3.2 | 2.7 | 0.5 | 0.50 (0.46,0.54) |
| Z66 | Do not resuscitate | 9.0 | 9.9 | 8.1 | 1.8 | 0.91 (0.87,0.95) |
| ICD-10 codes in the 12 months prior to admission | | | | | | |
| D509 | Iron deficiency anemia, unspecified | 9.0 | 9.0 | 9.0 | 0.0 | 1.24 (1.19,1.30) |
| D649 | Anemia, unspecified | 18.1 | 16.6 | 19.5 | -2.9 | 1.22 (1.18,1.26) |
| F17210 | Nicotine dependence, cigarettes, uncomplicated | 9.0 | 7.3 | 10.6 | -3.2 | 1.26 (1.21,1.32) |
| I10 | Essential (primary) hypertension | 77.4 | 71.5 | 83.1 | -11.6 | 1.17 (1.13,1.21) |
| I160 | Hypertensive urgency | 4.5 | 3.5 | 5.4 | -1.9 | 1.29 (1.23,1.36) |
| I2111 | ST elevation (STEMI) myocardial infarction involving right coronary artery | 4.7 | 4.6 | 4.8 | -0.2 | 0.86 (0.79,0.92) |
| I213 | ST elevation (STEMI) myocardial infarction of unspecified site | 17.8 | 17.3 | 18.3 | -1.0 | 1.05 (1.00,1.10) |
| J90 | Pleural effusion, not elsewhere classified | 11.8 | 10.4 | 13.1 | -2.7 | 1.25 (1.21, 1.30) |
| Z888 | Allergy status to other drugs, medicaments and biological substances | 7.2 | 7.7 | 6.6 | 1.1 | 1.21 (1.16,1.27) |
| ICD-10 codes either during the index admission or 12 months prior to admission | | | | | | |
| E1122 | Type 2 diabetes mellitus with diabetic chronic kidney disease | 23.6 | 20.8 | 26.2 | -5.4 | 1.22 (1.18,1.26) |
| I130 | Hypertensive heart and chronic kidney disease with heart failure and stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease | 20.1 | 18.7 | 21.4 | -2.7 | 1.11 (1.07,1.15) |
| I350 | Nonrheumatic aortic (valve) stenosis | 9.3 | 9.4 | 9.2 | 0.2 | 1.10 (1.06,1.15) |
| I480 | Paroxysmal atrial fibrillation | 18.2 | 18.7 | 17.6 | 1.1 | 1.21 (1.17,1.25) |
| J441 | Chronic obstructive pulmonary disease with (acute) exacerbation | 7.2 | 6.2 | 8.2 | -2.1 | 1.33 (1.28, 1.39) |

| Variable | Description | MA + FFS (%) (N= 226,980) | FFS (%) (N= 111,616) | MA (%) (N= 115,364) | FFS – MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| Other risk variables | | | | | | |
| MCCFI | Multiple Chronic Conditions Frailty Index | 22.5 | 21.7 | 23.3 | -1.6 | 1.27 (1.23,1.31) |
| AMI_ANT | Anterior myocardial infarction | 7.5 | 7.7 | 7.4 | 0.3 | 1.21 (1.14,1.28) |
| AMI_OTH | Other location of myocardial infarction | 14.3 | 14.4 | 14.2 | 0.1 | 1.05 (1.00,1.11) |
| HXPTCA | History of PTCA | 27.4 | 26.7 | 27.9 | -1.2 | 1.05 (1.02,1.08) |
| HXCABG | History of CABG | 15.5 | 15.1 | 15.8 | -0.7 | 1.04 (1.01,1.08) |
| HX_COVID | History of COVID-19 | 15.2 | 15.1 | 15.3 | -0.2 | 1.02 (0.99,1.06) |
| MA | MA (versus FFS) | 50.8 | NA | NA | NA | 0.92 (0.89,0.94) |

*AMI Model Performance*

Table 4.1.4 presents model performance for the AMI measure across three scenarios: the FFS-only cohort with CC-based risk variables, the FFS+MA cohort with CC-based risk variables, and the FFS+MA cohort with ICD-10-based risk variables. Predictive ability and c-statistics were similar between the FFS-only and FFS+MA cohorts using the original CC-based variables. For the MA+FFS cohort, the model using reselected ICD-10-based risk variables also had a similar c-statistic and predictive ability compared to the original CC-based model. Calibration performance was generally acceptable across all modeling approaches in the overall cohort and in subgroups, including male versus female, MA versus FFS, and quartiles of hospital volume (figures not shown).

**Table 4.1.4: AMI Readmission: Predictive Ability and C-Statistics Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Predictive Ability, % (lowest decile – highest decile) | 4.8 – 27.0 | 4.4 – 26.7 | 5.3 – 27.6 |
| c-statistic | 0.66 | 0.66 | 0.67 |

Note: These statistics were calculated using the patient-level logistic model.

*Risk-Standardized Readmission Rates for AMI*

Tables 4.1.5 and 4.1.6 present distribution of hospital volume, SRR, and RSRR for all hospitals (Table 4.1.5) and for hospitals with 25 or more eligible admissions (Table 4.1.6). Numbers of hospitals and admissions were higher in the combined FFS+MA data compared to the FFS-only data. With the addition of MA data, 204 additional hospitals were included in the measure (3,333 versus 3,129) and 384 additional hospitals met the 25 or more admissions cutoff for public reporting (1,728 versus 1,344). For all hospitals, the mean RSRR was 13.2% for the FFS-only cohort with CC-based risk variables, 13.1% for the FFS+MA cohort with CC-based risk variables, and 13.1% for the FFS+MA cohort with reselected ICD-10-based risk variables. Among hospitals with 25 or more admissions, mean RSRRs were 13.2%, 13.1%, and 13.1%, respectively.

**Table 4.1.5: AMI Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for All Hospitals**

| Value | FFS-Only cohort with CC-based risk variables (N= 3,129 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 3,333 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 3,333 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| Hospital Volume | 35.7 (47.7) | 16 (2, 52) | 68.1 (91.6) | 29 (3, 102) | 68.1 (91.6) | 29 (3, 102) |
| SRR | 1.00 (0.03) | 1.00 (0.99, 1.01) | 1.00 (0.04) | 1.00 (0.99, 1.02) | 1.00 (0.05) | 1.00 (0.98,1.02) |
| RSRR (%) | 13.2 (0.5) | 13.1 (13.0, 13.4) | 13.1 (0.6) | 13.0 (12.9, 13.3) | 13.1 (0.6) | 13.0 (12.9, 13.3) |

**Table 4.1.6: AMI Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-Only cohort with CC-based risk variables (N= 1,344 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 1,728 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 1,728 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| Hospital Volume | 75.0 (50.3) | 59 (40, 95) | 126.2 (95.6) | 98 (59, 164) | 126.2 (95.6) | 98 (59, 164) |
| SRR | 1.00 (0.05) | 1.00 (0.97, 1.03) | 1.00 (0.06) | 1.00 (0.97, 1.03) | 1.00 (0.06) | 1.00 (0.96, 1.04) |
| RSRR (%) | 13.2 (0.6) | 13.1 (12.8, 13.6) | 13.1 (0.8) | 13.1 (12.6, 13.5) | 13.1 (0.8) | 13.1 (12.6, 13.6) |

*Measure Reliability for AMI*

Between hospital variance and STNR for the measure score comparing the addition of MA admissions to the FFS-only cohort and reselected ICD-10-based variables to the CC-based variables in the FFS+MA cohort are noted in Table 4.1.7. Median STNR, calculated based on between hospital variance and hospital volume, was 0.290 for the FFS-only cohort with CC-based risk variables, 0.403 for the FFS+MA cohort with CC-based risk variables, and 0.416 for the FFS+MA cohort with reselected ICD-10-based risk variables.

**Table 4.1.7: AMI Readmission: Between Hospital Variance and Signal-to-Noise Reliability (STNR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Number of Hospitals | 1,344 | 1,728 | 1,728 |
| Between Hospital Variance | 0.023 | 0.023 | 0.024 |
| STNR: Median (Q1, Q3) | 0.290 (0.217, 0.397) | 0.403 (0.289, 0.531) | 0.416 (0.300, 0.544) |

*Change in Hospital Performance for AMI*

Tables 4.1.8 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the AMI measure in the combined FFS+MA cohort as compared to the FFS-only cohort in hospitals for the model with the original CC-based variables. After adding MA admissions to the FFS-only cohort, about half (47.5%) of hospitals remained in the same performance quintile, and 84.4% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.78. As hospitals' proportion of MA admissions increased, fewer hospitals remained in the same performance quintile (56.7% among hospitals in the lowest quintile of percent MA admissions; 41.9% of hospitals in the highest quintile of percent of MA admissions). As hospital volume increased, there was not a notable trend in RSRR shifts.

Table 4.1.9 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the AMI measure after both measure updates, comparing the combined FFS+MA cohort using the reselected ICD-10-based risk variables to the FFS-only cohort using the CC-based variables. With the addition of the MA admissions and the ICD-10-based risk variables, 46.4% of hospitals remained in the same performance quintile and 84.2% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.78. Stratified by proportion of MA admissions in a hospital, 57.5% of hospitals in the lowest quintile of percent MA admissions remained in the same performance quintile versus 38.9% in the highest quintile.

**Table 4.1.8: Shifts in RSRR Hospital Performance Quintile Rankings for AMI, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-Only Cohort to the FFS+MA Cohort, CC-Based Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| Overall | 47.5 | 84.4 | 0.78 |
| By Percent of MA Admissions | | | |
| Q1: 0.0% – 34.4% | 56.7 | 92.5 | 0.90 |
| Q2: 34.4% – 44.0% | 53.5 | 92.6 | 0.84 |
| Q3: 44.0% – 51.7% | 45.7 | 84.0 | 0.82 |
| Q4: 51.8% – 59.9% | 39.6 | 76.5 | 0.66 |
| Q5: 60.0% – 95.2% | 41.9 | 76.7 | 0.69 |
| By MA+FFS Admission Volume | | | |
| Q1: 28 – 72 admissions | 48.9 | 93.8 | 0.79 |
| Q2: 73 – 102 admissions | 48.5 | 88.5 | 0.79 |
| Q3: 103 – 141 admissions | 44.4 | 81.6 | 0.75 |
| Q4: 142 – 207 admissions | 44.4 | 80.2 | 0.74 |
| Q5: 208 – 818 admissions | 51.1 | 78.0 | 0.80 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions.
Total N=1,344, representing hospitals with 25 or more FFS admissions

**Table 4.1.9: Shifts in RSRR Hospital Performance Quintile Rankings for AMI, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-only Cohort with CC-Based Variables to the FFS+MA Cohort with Reselected ICD-10-Based Risk Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| Overall | 46.4 | 84.2 | 0.78 |
| By Percent of MA Admissions | | | |
| Q1: 0.0% – 34.4% | 57.5 | 92.9 | 0.89 |
| Q2: 34.4% – 44.0% | 51.7 | 90.7 | 0.84 |
| Q3: 44.0% – 51.7% | 46.1 | 84.8 | 0.82 |
| Q4: 51.8% – 59.9% | 38.1 | 75.7 | 0.65 |
| Q5: 60.0% – 95.2% | 38.9 | 77.0 | 0.69 |
| By MA+FFS Admission Volume | | | |
| Q1: 28 – 72 admissions | 47.4 | 92.6 | 0.78 |
| Q2: 73 – 102 admissions | 47.8 | 88.9 | 0.79 |
| Q3: 103 – 141 admissions | 43.2 | 80.8 | 0.74 |
| Q4: 142 – 207 admissions | 43.7 | 78.7 | 0.74 |
| Q5: 208 – 818 admissions | 50.0 | 79.9 | 0.81 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions and with reselected ICD-10-based risk variables.
Total N=1,344, representing hospitals with 25 or more FFS admissions

### 4.2. Chronic Obstructive Pulmonary Disease (COPD) Readmission Results

*COPD Admission Volume and Observed Readmission Rate*

As presented in <u>Table 4.2.1</u>, the FFS+MA cohort included 214,005 unique admissions from January 1 – December 30, 2022 (103,485 FFS and 110,520 MA). The observed (unadjusted) 30-day readmission rate for the FFS+MA cohort for COPD was 18.1%. The observed readmission rate was 18.1% among FFS beneficiaries compared to 18.0% among MA beneficiaries (difference 0.1%).

**Table 4.2.1: Number of Admissions and Observed 30-Day Readmission Rate for COPD, FFS versus MA Admissions, CY 2022**

| COPD | MA + FFS | FFS | MA | Difference FFS - MA |
|---|---|---|---|---|
| **N** | 214,005 | 103,485 | 110,520 | NA |
| **Readmission Rate (%)** | 18.1 | 18.1 | 18.0 | 0.1 |

*Frequency of COPD Risk Variables*

We examined the frequencies of variables used for risk adjustment in FFS and MA admissions. The variables from the original CC-based risk model are presented in <u>Table 4.2.2</u>, and the reselected ICD-10-based variables in <u>Table 4.2.3</u>. Frequencies of model variables were generally higher in MA than FFS admissions for both the CC- and ICD-10-based variables. The median difference in risk variable prevalence between FFS and MA (%FFS – %MA) was -1.5% for CC-based variables with a range from -10.3% to 1.6%. There was less of a difference overall in risk variable prevalence between FFS and MA for ICD-10-based variables with a median difference of -1.4% (range from -12.8% to 3.6%), however, for ICD-10 codes in the 12 months prior to admission (pre-index codes), the differences were more pronounced. <u>Table 4.2.3</u> also presents adjusted OR and 95% confidence intervals for the hierarchical logistic regression model using FFS+MA admissions.

**Table 4.2.2: Frequency of CC-Based Risk Variables in the COPD Cohort, FFS versus MA Admissions, CY 2022**

| Variable (% unless otherwise indicated) | MA + FFS (N= 214,005) | FFS (N= 103,485) | MA (N= 110,520) | FFS - MA |
|---|---|---|---|---|
| Age, mean (SD) | 75.5 (7.2) | 76.3 (7.3) | 74.7 (6.9) | 1.6 |
| Sleep apnea | 27.2 | 26.5 | 27.8 | -1.3 |
| History of mechanical ventilation | 15.5 | 14.9 | 16.1 | -1.2 |
| Respirator dependence/respiratory arrest (CC 82 – 83) | 2.6 | 1.9 | 3.2 | -1.3 |
| Cardio-respiratory failure and shock (CC 84) | 85.2 | 83.4 | 86.9 | -3.5 |
| Congestive heart failure (CC 85) | 58.3 | 56.5 | 59.9 | -3.4 |
| Acute coronary syndrome (CC 86 – 87) | 18.8 | 17.7 | 19.9 | -2.2 |
| Chronic atherosclerosis (CC 88-89) | 51.4 | 49.8 | 53.0 | -3.2 |
| Arrhythmias (CC 96 – 97) | 49.8 | 50.4 | 49.3 | 1.1 |
| Other and unspecified heart disease (CC 98) | 26.6 | 22.7 | 30.3 | -7.6 |
| Vascular or circulatory disease (CC 106 – 109) | 55.3 | 50.0 | 60.3 | -10.3 |
| Fibrosis of lung and other chronic lung disorder (CC 112) | 16.6 | 15.0 | 18.1 | -3.0 |
| Pneumonia (CC 114 – 116) | 51.1 | 49.7 | 52.4 | -2.7 |

| Variable (% unless otherwise indicated) | MA + FFS (N= 214,005) | FFS (N= 103,485) | MA (N= 110,520) | FFS - MA |
|---|---|---|---|---|
| History of infection (CC 1, 3 – 7) | 36.8 | 36.7 | 36.9 | -0.2 |
| Metastatic cancer and acute leukemia (CC 8) | 3.8 | 3.8 | 3.9 | -0.1 |
| Lung, upper digestive tract, and other severe cancers (CC 9) | 9.1 | 9.4 | 8.9 | 0.5 |
| Lymphatic, head and neck, brain, and other major cancers; breast, colorectal and other cancers and tumors; other respiratory and heart neoplasms (CC 10 – 13) | 13.6 | 13.6 | 13.5 | 0.0 |
| Other digestive and urinary neoplasms (CC 14) | 6.9 | 6.5 | 7.2 | -0.7 |
| Diabetes and DM complications (CC 17 – 19, 122 – 123) | 42.8 | 39.8 | 45.5 | -5.7 |
| Protein-calorie malnutrition (CC 21) | 16.9 | 16.2 | 17.6 | -1.4 |
| Disorders of fluid/electrolyte/acid-base (CC 23 – 24) | 59.7 | 58.3 | 60.9 | -2.6 |
| Obesity/disorders of thyroid, cholesterol, lipids (CC 22,25 – 26) | 88.2 | 86.7 | 89.5 | -2.9 |
| Pancreatic disease (CC 34) | 0.7 | 0.6 | 0.8 | -0.2 |
| Peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 36) | 14.9 | 14.1 | 15.6 | -1.5 |
| Other gastrointestinal disorders (CC 38) | 68.8 | 66.7 | 70.8 | -4.1 |
| Severe hematological disorders (CC 46) | 0.8 | 0.8 | 0.9 | 0.0 |
| Iron deficiency and other/unspecified anemia and blood disease (CC 49) | 54.4 | 53.4 | 55.3 | -1.8 |
| Dementia or senility (CC 51 – 53) | 19.5 | 19.1 | 19.9 | -0.8 |
| Drug/alcohol induced dependence/psychosis (CC 54 – 55) | 10.8 | 7.9 | 13.6 | -5.6 |
| Major psychiatric disorders (CC 57 – 59) | 23.4 | 18.3 | 28.1 | -9.8 |
| Depression (CC 61) | 31.7 | 29.9 | 33.4 | -3.5 |
| Anxiety disorders (CC 62) | 16.2 | 14.1 | 18.2 | -4.1 |
| Other psychiatric disorders (CC 63) | 39.9 | 38.9 | 40.8 | -1.9 |
| Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74,103 – 104,189 – 190) | 7.2 | 6.6 | 7.8 | -1.2 |
| Polyneuropathy (CC 75,81) | 28.1 | 26.0 | 30.0 | -4.1 |
| Stroke (CC 99 – 100) | 6.7 | 6.1 | 7.2 | -1.0 |
| Renal failure (CC 135 – 140) | 43.1 | 41.1 | 44.9 | -3.9 |
| Decubitus ulcer or chronic skin ulcer (CC 157 – 161) | 9.6 | 10.2 | 9.1 | 1.2 |
| Cellulitis, local skin infection (CC 164) | 12.4 | 12.5 | 12.4 | 0.1 |
| Vertebral fractures (CC 169) | 5.6 | 5.8 | 5.4 | 0.4 |
| History of COVID-19 | 23.5 | 23.4 | 23.6 | -0.2 |

**Table 4.2.3: Frequency of ICD-10-Based Risk Variables in the COPD Cohort, FFS versus MA Admissions, and Adjusted OR and 95% Confidence Intervals for the COPD Hierarchical Logistic Regression Model Using FFS+MA Admissions, CY 2022**

| Variable | Description | MA + FFS (%) (N=21,4005) | FFS (%) (N=103,485) | MA (%) (N=110,520) | FFS - MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| AGE | Age, mean (SD) | 75.5 (7.2) | 76.3 (7.3) | 74.7 (6.9) | 1.6 | 1.00 (1.00, 1.00) |
| ICD-10 codes during the index admission | | | | | | |
| B9789 | Other viral agents as the cause of diseases classified elsewhere | 0.9 | 0.9 | 0.9 | 0.0 | 0.79 (0.69, 0.90) |
| C3411 | Malignant neoplasm of upper lobe, right bronchus or lung | 0.5 | 0.5 | 0.5 | 0.0 | 1.29 (1.12, 1.49) |
| D649 | Anemia, unspecified | 8.9 | 9.2 | 8.7 | 0.4 | 1.12 (1.08, 1.17) |
| D751 | Secondary polycythemia | 0.7 | 0.7 | 0.8 | -0.1 | 0.82 (0.70, 0.95) |
| E875 | Hyperkalemia | 5.1 | 5.1 | 5.2 | -0.2 | 1.23 (1.18, 1.29) |
| F17210 | Nicotine dependence, cigarettes, uncomplicated | 23.8 | 21.4 | 26.1 | -4.7 | 0.93 (0.89, 0.96) |
| G629 | Polyneuropathy, unspecified | 2.8 | 3.0 | 2.7 | 0.3 | 1.12 (1.05, 1.20) |
| G928 | Other toxic encephalopathy | 1.1 | 1.1 | 1.1 | 0.0 | 0.89 (0.80, 0.98) |
| I480 | Paroxysmal atrial fibrillation | 11.2 | 12.0 | 10.5 | 1.5 | 1.20 (1.16, 1.24) |
| I4891 | Unspecified atrial fibrillation | 8.0 | 8.6 | 7.4 | 1.2 | 1.14 (1.09, 1.19) |
| I5031 | Acute diastolic (congestive) heart failure | 0.9 | 0.9 | 0.9 | 0.0 | 1.22 (1.09, 1.36) |
| J101 | Influenza due to other identified influenza virus with other respiratory manifestations | 1.6 | 1.6 | 1.6 | 0.0 | 0.82 (0.74, 0.91) |
| J209 | Acute bronchitis, unspecified | 5.6 | 5.6 | 5.5 | 0.1 | 0.87 (0.83, 0.92) |
| J90 | Pleural effusion, not elsewhere classified | 2.4 | 2.5 | 2.3 | 0.2 | 1.14 (1.06, 1.22) |
| Z515 | Encounter for palliative care | 4.0 | 4.2 | 3.9 | 0.4 | 0.55 (0.52, 0.59) |
| Z66 | Do not resuscitate | 14.0 | 15.6 | 12.6 | 3.0 | 0.90 (0.87, 0.93) |
| Z720 | Tobacco use | 1.0 | 0.9 | 1.0 | -0.1 | 0.85 (0.75, 0.96) |
| Z7984 | Long term (current) use of oral hypoglycemic drugs | 10.3 | 9.5 | 11.0 | -1.5 | 0.91 (0.87, 0.95) |
| Z87891 | Personal history of nicotine dependence | 42.9 | 44.8 | 41.2 | 3.6 | 0.94 (0.91, 0.96) |
| ICD-10 codes in the 12 months prior to admission | | | | | | |
| D649 | Anemia, unspecified | 26.9 | 4.8 | 27.8 | -1.8 | 1.15 (1.12, 1.18) |

| Variable | Description | MA + FFS (%) (N=21,4005) | FFS (%) (N=103,485) | MA (%) (N=110,520) | FFS - MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| E440 | Moderate protein-calorie malnutrition | 3.7 | 2.6 | 4.1 | -0.8 | 1.15 (1.09, 1.22) |
| E871 | Hypo-osmolality and hyponatremia | 14.6 | 4.8 | 15.1 | -1.0 | 1.12 (1.09, 1.16) |
| F17210 | Nicotine dependence, cigarettes, uncomplicated | 29.5 | 2.6 | 33.4 | -8.0 | 1.10 (1.07, 1.13) |
| F32A | Depression, unspecified | 16.8 | 4.8 | 18.4 | -3.4 | 1.10 (1.07, 1.14) |
| F410 | Panic disorder [episodic paroxysmal anxiety] | 2.6 | 2.1 | 3.0 | -0.9 | 1.15 (1.08, 1.23) |
| F419 | Anxiety disorder, unspecified | 28.1 | 26.4 | 29.6 | -3.2 | 1.05 (1.03, 1.08) |
| H9190 | Unspecified hearing loss, unspecified ear | 3.2 | 3.3 | 3.0 | 0.2 | 1.09 (1.03, 1.16) |
| I160 | Hypertensive urgency | 3.9 | 3.2 | 4.6 | -1.3 | 1.13 (1.08, 1.20) |
| I509 | Heart failure, unspecified | 32.5 | 28.9 | 35.9 | -7.0 | 1.18 (1.15, 1.21) |
| J440 | Chronic obstructive pulmonary disease with (acute) lower respiratory infection | 25.6 | 24.5 | 26.6 | -2.2 | 1.08 (1.05, 1.11) |
| J449 | Chronic obstructive pulmonary disease, unspecified | 82.8 | 78.8 | 86.5 | -7.7 | 1.10 (1.06, 1.14) |
| J8410 | Pulmonary fibrosis, unspecified | 6.5 | 5.4 | 7.5 | -2.1 | 1.13 (1.08, 1.18) |
| J90 | Pleural effusion, not elsewhere classified | 19.2 | 17.6 | 20.7 | -3.1 | 1.19 (1.15, 1.22) |
| J9600 | Acute respiratory failure, unspecified whether with hypoxia or hypercapnia | 9.3 | 7.3 | 11.1 | -3.7 | 1.07 (1.03, 1.11) |
| J9602 | Acute respiratory failure with hypercapnia | 12.4 | 9.2 | 15.4 | -6.2 | 1.10 (1.06, 1.14) |
| J9620 | Acute and chronic respiratory failure, unspecified whether with hypoxia or hypercapnia | 7.8 | 6.6 | 8.9 | -2.3 | 1.09 (1.04, 1.13) |
| J9621 | Acute and chronic respiratory failure with hypoxia | 31.7 | 29.6 | 33.7 | -4.1 | 1.09 (1.06, 1.13) |
| J9622 | Acute and chronic respiratory failure with hypercapnia | 16.2 | 14.3 | 18.0 | -3.7 | 1.11 (1.07, 1.16) |
| M542 | Cervicalgia | 9.4 | 8.5 | 10.4 | -1.9 | 1.00 (0.97, 1.04) |
| M7989 | Other specified soft tissue disorders | 11.2 | 10.0 | 12.3 | -2.3 | 1.12 (1.08, 1.16) |
| R0689 | Other abnormalities of breathing | 5.6 | 4.3 | 6.9 | -2.6 | 1.10 (1.05, 1.15) |
| R079 | Chest pain, unspecified | 38.2 | 35.0 | 41.2 | -6.2 | 1.11 (1.08, 1.14) |
| R0902 | Hypoxemia | 32.1 | 25.5 | 38.3 | -12.8 | 0.97 (0.95, 0.99) |
| R1084 | Generalized abdominal pain | 5.1 | 4.3 | 5.9 | -1.6 | 1.15 (1.10, 1.20) |

| Variable | Description | MA + FFS (%) (N=21,4005) | FFS (%) (N=103,485) | MA (%) (N=110,520) | FFS - MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| R627 | Adult failure to thrive | 2.7 | 2.6 | 2.8 | -0.2 | 1.15 (1.08, 1.23) |
| R918 | Other nonspecific abnormal finding of lung field | 46.1 | 42.6 | 49.4 | -6.8 | 1.10 (1.07, 1.12) |
| T380X5A | Adverse effect of glucocorticoids and synthetic analogues, initial encounter | 6.1 | 5.7 | 6.4 | -0.7 | 1.14 (1.09, 1.19) |
| Z0000 | Encounter for general adult medical examination without abnormal findings | 19.8 | 14.7 | 24.6 | -10.0 | 0.94 (0.91, 0.97) |
| Z1231 | Encounter for screening mammogram for malignant neoplasm of breast | 12.4 | 11.4 | 13.5 | -2.1 | 0.85 (0.82, 0.88) |
| Z515 | Encounter for palliative care | 5.3 | 4.5 | 5.9 | -1.4 | 1.16 (1.10, 1.21) |
| Z716 | Tobacco abuse counseling | 3.3 | 2.3 | 4.3 | -2.0 | 1.07 (1.01, 1.14) |
| Z7951 | Long term (current) use of inhaled steroids | 24.6 | 22.9 | 26.2 | -3.3 | 1.08 (1.05, 1.11) |
| Z7952 | Long term (current) use of systemic steroids | 11.9 | 11.6 | 12.1 | -0.6 | 1.18 (1.14, 1.22) |
| Z9114 | Patient's other noncompliance with medication regimen | 4.2 | 3.5 | 4.9 | -1.4 | 1.21 (1.15, 1.27) |
| Z9119 | Patient's noncompliance with other medical treatment and regimen | 5.5 | 4.7 | 6.3 | -1.6 | 1.19 (1.13, 1.24) |
| Z9981 | Dependence on supplemental oxygen | 34.4 | 33.0 | 35.8 | -2.7 | 1.09 (1.06, 1.12) |
| ICD-10 codes either during the index admission or 12 months prior to admission | | | | | | |
| C3490 | Malignant neoplasm of unspecified part of unspecified bronchus or lung | 5.8 | 5.8 | 5.8 | 0.0 | 1.23 (1.17, 1.28) |
| E1122 | Type 2 diabetes mellitus with diabetic chronic kidney disease | 16.1 | 14.4 | 17.7 | -3.3 | 1.17 (1.13, 1.21) |
| N184 | Chronic kidney disease, stage 4 (severe) | 5.1 | 4.8 | 5.3 | -0.6 | 1.19 (1.14, 1.26) |
| N2581 | Secondary hyperparathyroidism of renal origin | 3.0 | 2.6 | 3.3 | -0.7 | 1.28 (1.21, 1.36) |
| Other risk variables | | | | | | |
| MCCFI | Multiple Chronic Conditions Frailty Index | 61.6 | 60.9 | 62.3 | -1.4 | 1.19 (1.16, 1.23) |
| HX_SA | Sleep-disordered breathing | 27.2 | 26.5 | 27.8 | -1.3 | 0.96 (0.93, 0.98) |
| HX_MV | History of mechanical ventilation | 15.5 | 14.9 | 16.1 | -1.2 | 1.11 (1.08, 1.15) |
| HX_COVID | History of COVID-19 | 23.5 | 23.4 | 23.6 | -0.2 | 1.03 (1.00, 1.06) |
| MA | MA (versus FFS) | 51.6 | NA | NA | NA | 0.89 (0.87, 0.91) |

*COPD Model Performance*

Table 4.2.4 presents model performance for the COPD measure across three scenarios: the FFS-only cohort with CC-based risk variables, the FFS+MA cohort with CC-based risk variables, and the FFS+MA cohort with ICD-10-based risk variables. Predictive ability and c-statistics were similar between the FFS-only and FFS+MA cohorts using the original CC-based variables. For the MA+FFS cohort, the model using reselected ICD-10-based risk variables had a slightly higher c-statistic compared to the original CC-based model and wider predictive ability. Calibration performance was generally acceptable across all modeling approaches in the overall cohort and in subgroups, including male versus female, MA versus FFS, and quartiles of hospital volume (figures not shown).

**Table 4.2.4: COPD Readmission: Predictive Ability and C-Statistics Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Predictive Ability, % (lowest decile – highest decile) | 8.4 – 35.6 | 8.2 – 35.6 | 7.3 – 38.4 |
| c-statistic | 0.65 | 0.65 | 0.67 |

Note: These statistics were calculated using the patient-level logistic model.

*Risk-Standardized Readmission Rates for COPD*

Tables 4.2.5 and 4.2.6 present distribution of hospital volume, SRR, and RSRR for all hospitals (Table 4.2.5) and for hospitals with 25 or more eligible admissions (Table 4.2.6). Numbers of hospitals and admissions were higher in the combined FFS+MA data compared to the FFS-only data. With the addition of MA data, 132 additional hospitals were included in the measure (4,269 versus 4,137) and 827 additional hospitals met the 25 or more admissions cutoff for public reporting (2,269 versus 1,442). For all hospitals, the mean RSRR was 18.1% for the FFS-only cohort with CC-based risk variables, 18.1% for the FFS+MA cohort with CC-based risk variables, and 18.1% for the FFS+MA cohort with reselected ICD-10-based risk variables. Among hospitals with 25 or more admissions, mean RSRRs were 18.2%, 18.1%, and 18.1%, respectively.

**Table 4.2.5: COPD Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for All Hospitals**

| Value | FFS-Only cohort with CC-based risk variables (N= 4,137 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 4,269 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 4,269 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| Hospital Volume | 25.0 (28.9) | 15 (5, 35) | 50.1 (57.9) | 28 (9, 74) | 50.1 (57.9) | 28 (9,74) |
| SRR | 1.00 (0.03) | 1.00 (0.99, 1.01) | 1.00 (0.04) | 1.00 (0.98, 1.02) | 1.00 (0.04) | 1.00 (0.98, 1.02) |
| RSRR (%) | 18.1 (0.5) | 18.1 (17.9, 18.4) | 18.1 (0.7) | 18.0 (17.7, 18.4) | 18.1 (0.7) | 18.0 (17.7, 18.4) |

**Table 4.2.6: COPD Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-Only cohort with CC-based risk variables (N= 1,442 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 2,269 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 2,269 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| Hospital Volume | 54.6 (31.2) | 45 (33, 65) | 85.9 (59.6) | 70 (44, 108) | 85.9 (59.6) | 70 (44, 108) |
| SRR | 1.00 (0.04) | 1.00 (0.97, 1.03) | 1.00 (0.05) | 1.00 (0.97, 1.03) | 1.00 (0.05) | 1.00 (0.97, 1.03) |
| RSRR (%) | 18.2 (0.8) | 18.1 (17.6, 18.6) | 18.1 (1.0) | 18.0 (17.5, 18.7) | 18.1 (0.9) | 18.0 (17.5, 18.6) |

*Measure Reliability for COPD*

Between hospital variance and STNR for the measure score comparing the addition of MA admissions to the FFS-only cohort and reselected ICD-10-based variables to the CC-based variables in the FFS+MA cohort are noted in Table 4.2.7. Median STNR, calculated based on between hospital variance and hospital volume, was 0.222 for the FFS-only cohort with CC-based risk variables, 0.322 for the FFS+MA cohort with CC-based risk variables, and 0.309 for the FFS+MA cohort with reselected ICD-10-based risk variables.

**Table 4.2.7: COPD Readmission: Between Hospital Variance and Signal-to-Noise Reliability (STNR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Number of Hospitals | 1,442 | 2,269 | 2,269 |
| Between Hospital Variance | 0.021 | 0.022 | 0.021 |
| STNR: Median (Q1, Q3) | 0.222 (0.173, 0.292) | 0.322 (0.230, 0.423) | 0.309 (0.219, 0.408) |

*Change in Hospital Performance for COPD*

Table 4.2.8 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the COPD measure in the combined FFS+MA cohort as compared to the FFS-only cohort in hospitals for the model with the original CC-based variables. After adding MA admissions to the FFS-only cohort, about half (44.0%) of hospitals remained in the same performance quintile, and 83.4% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.73. As hospitals' proportion of MA admissions increased, fewer hospitals remained in the same performance quintile (53.1% among hospitals in the lowest quintile of percent MA admissions; 31.9% of hospitals in the highest quintile of percent of MA admissions). As hospital volume increased, the trend in RSRR shifts was less pronounced.

Table 4.2.9 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the COPD measure after both measure updates, comparing the combined FFS+MA cohort using the reselected ICD-10-based risk variables to the FFS-only cohort using the CC-based variables. With the addition of the MA admissions and the ICD-10-based risk variables, 41.3% of hospitals remained in the same performance quintile and 81.3% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.71. Stratified by proportion of MA admissions in a hospital, 49.0% of hospitals in the lowest quintile of percent MA admissions remained in the same performance quintile versus 32.3% in the highest quintile.

**Table 4.2.8: Shifts in RSRR Hospital Performance Quintile Rankings for COPD, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-Only Cohort to the FFS+MA Cohort, CC-Based Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| Overall | 44.0 | 83.4 | 0.73 |
| By Percent of MA Admissions | | | |
| Q1: 0.0% − 34.2% | 53.1 | 94.1 | 0.88 |
| Q2: 34.3% − 44.7% | 52.1 | 86.8 | 0.82 |
| Q3: 44.7% − 52.5% | 42.2 | 86.9 | 0.79 |
| Q4: 52.5% − 60.9% | 40.8 | 79.9 | 0.70 |
| Q5: 60.9% − 85.5% | 31.9 | 69.4 | 0.54 |
| By MA+FFS Admission Volume | | | |
| Q1: 25 − 61 admissions | 53.5 | 93.0 | 0.85 |
| Q2: 62 − 83 admissions | 44.7 | 84.7 | 0.76 |
| Q3: 84 − 106 admissions | 38.8 | 81.1 | 0.71 |
| Q4: 107 − 145 admissions | 39.2 | 78.5 | 0.72 |
| Q5: 146 − 670 admissions | 43.9 | 79.8 | 0.68 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions.
Total N=1,442, representing hospitals with 25 or more FFS admissions

**Table 4.2.9: Shifts in RSRR Hospital Performance Quintile Rankings for COPD, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-only Cohort with CC-Based Variables to the FFS+MA Cohort with Reselected ICD-10-Based Risk Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| Overall | 41.3 | 81.3 | 0.71 |
| By Percent of MA Admissions | | | |
| Q1: 0.0% − 34.2% | 49.0 | 89.2 | 0.85 |
| Q2: 34.3% − 44.7% | 46.2 | 83.0 | 0.78 |
| Q3: 44.7% − 52.5% | 42.6 | 84.1 | 0.77 |
| Q4: 52.5% − 60.9% | 36.7 | 79.9 | 0.65 |
| Q5: 60.9% − 85.5% | 32.3 | 70.5 | 0.52 |
| By MA+FFS Admission Volume | | | |
| Q1: 25 − 61 admissions | 49.0 | 89.9 | 0.83 |
| Q2: 62 − 83 admissions | 41.7 | 81.4 | 0.72 |
| Q3: 84 − 106 admissions | 38.8 | 81.1 | 0.69 |
| Q4: 107 − 145 admissions | 36.8 | 78.5 | 0.71 |
| Q5: 146 − 670 admissions | 40.4 | 76.0 | 0.65 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions and with reselected ICD-10-based risk variables.
Total N=1,442, representing hospitals with 25 or more FFS admissions

### 4.3. Heart Failure Readmission Results

*Heart Failure Admission Volume and Observed Readmission Rate*

As presented in Table 4.3.1, the FFS+MA cohort included 635,204 unique admissions from January 1 – December 30, 2022 (326,130 FFS and 309,074 MA). The observed (unadjusted) 30-day readmission rate for the FFS+MA cohort for Heart Failure was 19.4%. The observed readmission rate was 19.2% among FFS beneficiaries compared to 19.5% among MA beneficiaries (difference -0.3%).

**Table 4.3.1: Number of Admissions and Observed 30-Day Readmission Rate for Heart Failure, FFS versus MA Admissions, CY 2022**

| Heart Failure | MA + FFS | FFS | MA | Difference FFS – MA |
|---|---|---|---|---|
| N | 635,204 | 326,130 | 309,074 | NA |
| Readmission Rate (%) | 19.4 | 19.2 | 19.5 | -0.3 |

*Frequency of Heart Failure Risk Variables*

We examined the frequencies of variables used for risk adjustment in FFS and MA admissions. The variables from the original CC-based risk model are presented in Table 4.3.2, and the reselected ICD-10-based variables in Table 4.3.3. Frequencies of model variables were generally higher in MA than FFS admissions for both the CC- and ICD-10-based variables. The median difference in risk variable prevalence between FFS and MA (%FFS – %MA) was -2.0% for CC-based variables with a range from -12.8% to 2.0%. There was less of a difference overall in risk variable prevalence between FFS and MA for ICD-10-based variables with a median difference of -0.7% (range from -7.9% to 12.6%), however, for ICD-10 codes in the 12 months prior to admission (pre-index codes), the differences were more pronounced. Table 4.3.3 also presents adjusted OR and 95% confidence intervals for the hierarchical logistic regression model using FFS+MA admissions.

**Table 4.3.2: Frequency of CC-Based Risk Variables in the Heart Failure Cohort, FFS versus MA Admissions, CY 2022**

| Variable (% unless otherwise indicated) | MA + FFS (N= 635,204) | FFS (N= 326,130) | MA (N= 309,074) | FFS - MA |
|---|---|---|---|---|
| Age, mean (SD) | 79.7 (8.4) | 80.7 (8.4) | 78.7 (8.3) | 2.0 |
| Male | 45.7 | 45.5 | 45.9 | -0.4 |
| Coronary artery bypass graft surgery | 18.0 | 18.2 | 17.8 | 0.4 |
| Diabetes and DM complications (CC 17 to 19, 122, 123) | 58.7 | 55.1 | 62.6 | -7.5 |
| Disorders of fluid/electrolyte/acid-base (CC23, 24) | 57.5 | 54.2 | 61.0 | -6.8 |
| Iron deficiency and other/unspecified anemias and blood disease (CC 49) | 66.8 | 66.2 | 67.4 | -1.2 |
| Cardio-respiratory failure and shock (CC 84) | 53.2 | 48.9 | 57.6 | -8.7 |
| Congestive heart failure (CC 85) | 91.1 | 88.8 | 93.5 | -4.7 |
| Vascular or circulatory disease (CC 106 – 109) | 60.3 | 55.1 | 65.8 | -10.8 |
| Chronic obstructive pulmonary disease (CC 111) | 45.6 | 42.7 | 48.7 | -6.0 |
| Pneumonia (CC 114 – 116) | 44.7 | 41.6 | 47.9 | -6.3 |

| Variable (% unless otherwise indicated) | MA + FFS (N= 635,204) | FFS (N= 326,130) | MA (N= 309,074) | FFS - MA |
|---|---|---|---|---|
| Renal failure (CC 135 – 140) | 70.5 | 68.2 | 72.9 | -4.7 |
| Other urinary tract disorders (CC 145) | 26.9 | 24.5 | 29.5 | -5.0 |
| Decubitus ulcer or chronic skin ulcer (CC 157 – 161) | 15.9 | 16.3 | 15.5 | 0.9 |
| Other gastrointestinal disorders (CC 38) | 69.3 | 67.7 | 70.9 | -3.3 |
| Acute coronary syndrome (CC 86, 87) | 25.8 | 23.3 | 28.3 | -5.0 |
| Valvular or rheumatic heart disease (CC 91) | 59.9 | 59.3 | 60.6 | -1.2 |
| Arrhythmias (CC 96, 97) | 74.5 | 74.5 | 74.5 | 0.0 |
| Asthma (CC 113) | 13.7 | 12.0 | 15.6 | -3.6 |
| Peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 36) | 17.7 | 17.0 | 18.5 | -1.5 |
| Cancer (CC 9 – 14) | 22.6 | 22.8 | 22.4 | 0.4 |
| Drug/alcohol abuse/dependence/psychosis (CC 54 – 56) | 19.9 | 16.3 | 23.7 | -7.4 |
| Major psychiatric disorders (CC 57 – 59) | 16.2 | 12.5 | 20.1 | -7.5 |
| End-stage renal disease or dialysis (CC 134) | 6.0 | 5.7 | 6.2 | -0.5 |
| Severe hematological disorders (CC 46) | 1.8 | 1.9 | 1.8 | 0.1 |
| Nephritis (CC141) | 1.6 | 1.4 | 1.8 | -0.4 |
| Liver and biliary disease (CC 27 – 32) | 17.7 | 16.1 | 19.4 | -3.3 |
| Metastatic cancer and acute leukemia (CC 8) | 2.9 | 3.0 | 2.8 | 0.2 |
| Dementia and senility (CC 51 – 53) | 9.6 | 8.8 | 10.4 | -1.5 |
| Stroke (CC 99 – 100) | 24.1 | 23.4 | 24.8 | -1.4 |
| Chronic atherosclerosis (CC 88, 89) | 69.3 | 67.8 | 70.9 | -3.1 |
| Other and unspecified heart disease (CC 98) | 42.3 | 36.1 | 48.8 | -12.8 |
| Other psychiatric disorders (CC 63) | 27.4 | 27.1 | 27.7 | -0.6 |
| Hemiplegia, paralysis, functional disability (CC 70 – 74, 103,104, 189,190) | 9.2 | 8.2 | 10.3 | -2.1 |
| Fibrosis of lung and other chronic lung disorders (CC 112) | 10.7 | 9.8 | 11.7 | -1.9 |
| Protein-calorie malnutrition (CC 21) | 13.1 | 13.0 | 13.1 | -0.1 |
| Depression (CC 61) | 23.5 | 22.5 | 24.5 | -2.1 |
| History of COVID-19 | 21.4 | 21.2 | 21.6 | -0.3 |

**Table 4.3.3: Frequency of ICD-10-Based Risk Variables in the Heart Failure Cohort, FFS versus MA Admissions, and Adjusted OR and 95% Confidence Intervals for the Heart Failure Hierarchical Logistic Regression Model Using FFS+MA Admissions, CY 2022**

| Variable | Description | MA + FFS (%) (N= 635,204) | FFS (%) (N= 326,130) | MA (%) (N= 309,074) | FFS – MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| AGE | Age, mean (SD) | 79.7 (8.4) | 80.7 (8.4) | 78.7 (8.3) | 2.0 | 1.00 (1.00, 1.00) |
| ICD-10 codes during the index admission | | | | | | |
| B961 | Klebsiella pneumoniae as the cause of diseases classified elsewhere | 0.7 | 0.7 | 0.6 | 0.1 | 1.11 (1.04, 1.20) |
| C7951 | Secondary malignant neoplasm of bone | 0.6 | 0.6 | 0.5 | 0.1 | 1.32 (1.22, 1.43) |
| D469 | Myelodysplastic syndrome, unspecified | 0.5 | 0.6 | 0.4 | 0.2 | 1.30 (1.20, 1.41) |
| D539 | Nutritional anemia, unspecified | 2.0 | 2.2 | 1.9 | 0.1 | 1.09 (1.04, 1.14) |
| D631 | Anemia in chronic kidney disease | 14.4 | 14.2 | 14.5 | -0.3 | 1.09 (1.07, 1.11) |
| D638 | Anemia in other chronic diseases classified elsewhere | 3.9 | 3.9 | 3.8 | 0.0 | 1.12 (1.08, 1.15) |
| D649 | Anemia, unspecified | 11.5 | 11.6 | 11.4 | 0.2 | 1.07 (1.05, 1.09) |
| E119 | Type 2 diabetes mellitus without complications | 9.5 | 9.2 | 9.9 | -0.7 | 0.94 (0.92, 0.97) |
| E440 | Moderate protein-calorie malnutrition | 2.1 | 2.1 | 2.0 | 0.1 | 1.05 (1.01, 1.10) |
| E6601 | Morbid (severe) obesity due to excess calories | 10.3 | 9.3 | 11.3 | -2.0 | 0.92 (0.90, 0.94) |
| E669 | Obesity, unspecified | 12.2 | 11.9 | 12.7 | -0.8 | 0.92 (0.90, 0.94) |
| E871 | Hypo-osmolality and hyponatremia | 10.9 | 11.7 | 10.2 | 1.5 | 1.17 (1.14, 1.19) |
| E875 | Hyperkalemia | 7.4 | 7.3 | 7.6 | -0.3 | 1.09 (1.07, 1.12) |
| E8809 | Other disorders of plasma-protein metabolism, not elsewhere classified | 1.7 | 1.7 | 1.6 | 0.2 | 1.13 (1.08, 1.18) |
| F319 | Bipolar disorder, unspecified | 0.8 | 0.7 | 0.8 | -0.1 | 1.17 (1.09, 1.25) |
| G40909 | Epilepsy, unspecified, not intractable, without status epilepticus | 1.7 | 1.7 | 1.6 | 0.1 | 1.10 (1.05, 1.15) |
| I160 | Hypertensive urgency | 4.2 | 3.9 | 4.5 | -0.5 | 0.88 (0.85, 0.91) |
| I161 | Hypertensive emergency | 2.9 | 2.5 | 3.3 | -0.8 | 0.92 (0.88, 0.95) |
| I214 | Non-ST elevation (NSTEMI) myocardial infarction | 2.5 | 2.4 | 2.6 | -0.2 | 1.13 (1.09, 1.18) |
| I21A1 | Myocardial infarction type 2 | 7.3 | 7.1 | 7.4 | -0.2 | 1.07 (1.04, 1.09) |
| I248 | Other forms of acute ischemic heart disease | 6.3 | 6.2 | 6.3 | -0.1 | 1.04 (1.02, 1.07) |
| I428 | Other cardiomyopathies | 6.5 | 6.1 | 6.9 | -0.8 | 0.92 (0.90, 0.95) |

| Variable | Description | MA + FFS (%) (N= 635,204) | FFS (%) (N= 326,130) | MA (%) (N= 309,074) | FFS – MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| I493 | Ventricular premature depolarization | 2.9 | 2.9 | 2.9 | 0.0 | 0.92 (0.88, 0.96) |
| I5021 | Acute systolic (congestive) heart failure | 3.3 | 3.3 | 3.4 | -0.1 | 0.91 (0.87, 0.95) |
| I5031 | Acute diastolic (congestive) heart failure | 5.3 | 5.5 | 5.1 | 0.4 | 0.92 (0.89, 0.95) |
| I5041 | Acute combined systolic (congestive) and diastolic (congestive) heart failure | 1.0 | 1.0 | 1.0 | -0.1 | 0.87 (0.81, 0.94) |
| I959 | Hypotension, unspecified | 2.9 | 3.0 | 2.8 | 0.3 | 1.11 (1.07, 1.15) |
| J189 | Pneumonia, unspecified organism | 7.8 | 7.9 | 7.8 | 0.1 | 1.05 (1.02, 1.08) |
| J440 | Chronic obstructive pulmonary disease with (acute) lower respiratory infection | 3.8 | 3.7 | 3.9 | -0.2 | 0.94 (0.90, 0.97) |
| J441 | Chronic obstructive pulmonary disease with (acute) exacerbation | 9.9 | 9.0 | 10.7 | -1.7 | 1.12 (1.09, 1.14) |
| J918 | Pleural effusion in other conditions classified elsewhere | 3.6 | 3.8 | 3.4 | 0.4 | 1.13 (1.09, 1.17) |
| J9611 | Chronic respiratory failure with hypoxia | 3.6 | 3.6 | 3.6 | 0.0 | 1.09 (1.06, 1.13) |
| J9621 | Acute and chronic respiratory failure with hypoxia | 12.7 | 12.5 | 12.9 | -0.4 | 1.07 (1.05, 1.09) |
| K219 | Gastro-esophageal reflux disease without esophagitis | 23.8 | 24.3 | 23.2 | 1.1 | 0.98 (0.97, 1.00) |
| K5900 | Constipation, unspecified | 4.1 | 4.1 | 4.0 | 0.1 | 1.08 (1.05, 1.12) |
| N170 | Acute kidney failure with tubular necrosis | 1.4 | 1.3 | 1.4 | -0.1 | 1.21 (1.15, 1.28) |
| N179 | Acute kidney failure, unspecified | 28.3 | 27.6 | 29.0 | -1.4 | 1.16 (1.14, 1.17) |
| N189 | Chronic kidney disease, unspecified | 7.6 | 7.7 | 7.6 | 0.1 | 1.04 (1.01, 1.06) |
| R001 | Bradycardia, unspecified | 2.2 | 2.3 | 2.2 | 0.1 | 0.90 (0.86, 0.94) |
| R1310 | Dysphagia, unspecified | 1.7 | 1.9 | 1.6 | 0.3 | 1.12 (1.07, 1.18) |
| R7303 | Prediabetes | 1.2 | 1.1 | 1.3 | -0.3 | 0.88 (0.83, 0.94) |
| R791 | Abnormal coagulation profile | 1.9 | 2.0 | 1.8 | 0.2 | 1.09 (1.04, 1.14) |
| Z515 | Encounter for palliative care | 5.4 | 5.7 | 5.0 | 0.7 | 0.47 (0.46, 0.49) |
| Z66 | Do not resuscitate | 17.1 | 18.9 | 15.1 | 3.8 | 0.88 (0.86, 0.90) |
| Z7401 | Bed confinement status | 0.9 | 0.9 | 0.9 | 0.0 | 1.13 (1.06, 1.20) |
| Z794 | Long term (current) use of insulin | 15.2 | 14.0 | 16.5 | -2.5 | 1.03 (1.01, 1.05) |
| Z7984 | Long term (current) use of oral hypoglycemic drugs | 12.9 | 12.0 | 14.0 | -2.0 | 0.96 (0.94, 0.98) |
| Z79899 | Other long term (current) drug therapy | 30.8 | 31.3 | 30.3 | 1.1 | 0.95 (0.94, 0.97) |

| Variable | Description | MA + FFS (%) (N= 635,204) | FFS (%) (N= 326,130) | MA (%) (N= 309,074) | FFS − MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| Z85118 | Personal history of other malignant neoplasm of bronchus and lung | 1.0 | 1.1 | 0.9 | 0.2 | 1.08 (1.02, 1.15) |
| Z87891 | Personal history of nicotine dependence | 30.3 | 30.7 | 29.9 | 0.8 | 0.95 (0.94, 0.97) |
| ICD-10 codes in the 12 months prior to admission | | | | | | |
| A419 | Sepsis, unspecified organism | 11.9 | 11.3 | 12.6 | -1.3 | 1.08 (1.06, 1.10) |
| D509 | Iron deficiency anemia, unspecified | 19.7 | 19.5 | 20.0 | -0.5 | 1.07 (1.05, 1.08) |
| D649 | Anemia, unspecified | 37.4 | 35.1 | 39.7 | -4.6 | 1.06 (1.04, 1.07) |
| E11649 | Type 2 diabetes mellitus with hypoglycemia without coma | 5.5 | 4.9 | 6.2 | -1.4 | 1.08 (1.05, 1.11) |
| E871 | Hypo-osmolality and hyponatremia | 18.4 | 18.3 | 18.5 | -0.2 | 1.06 (1.04, 1.08) |
| E875 | Hyperkalemia | 16.9 | 15.6 | 18.3 | -2.7 | 1.08 (1.06, 1.10) |
| E876 | Hypokalemia | 20.4 | 19.5 | 21.3 | -1.9 | 1.07 (1.05, 1.08) |
| F17200 | Nicotine dependence, unspecified, uncomplicated | 5.2 | 3.7 | 6.7 | -2.9 | 1.10 (1.07, 1.14) |
| F17210 | Nicotine dependence, cigarettes, uncomplicated | 9.5 | 7.6 | 11.4 | -3.8 | 1.08 (1.06, 1.11) |
| F32A | Depression, unspecified | 12.5 | 11.7 | 13.5 | -1.8 | 1.08 (1.06, 1.10) |
| G4733 | Obstructive sleep apnea (adult) (pediatric) | 21.3 | 20.9 | 21.7 | -0.8 | 0.96 (0.94, 0.98) |
| I120 | Hypertensive chronic kidney disease with stage 5 chronic kidney disease or end-stage renal disease | 5.3 | 4.8 | 5.9 | -1.2 | 1.14 (1.10, 1.18) |
| I1310 | Hypertensive heart and chronic kidney disease without heart failure, with stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease | 3.2 | 2.2 | 4.3 | -2.1 | 0.94 (0.90, 0.97) |
| I132 | Hypertensive heart and chronic kidney disease with heart failure and with stage 5 chronic kidney disease, or end stage renal disease | 6.1 | 5.7 | 6.5 | -0.7 | 1.09 (1.05, 1.12) |
| I214 | Non-ST elevation (NSTEMI) myocardial infarction | 13.2 | 11.3 | 15.1 | -3.8 | 1.07 (1.05, 1.09) |
| I248 | Other forms of acute ischemic heart disease | 6.6 | 6.2 | 7.1 | -0.9 | 1.12 (1.09, 1.15) |
| I2510 | Atherosclerotic heart disease of native coronary artery without angina pectoris | 56.4 | 54.3 | 58.6 | -4.4 | 1.04 (1.02, 1.06) |
| I350 | Nonrheumatic aortic (valve) stenosis | 13.1 | 13.0 | 13.3 | -0.3 | 1.08 (1.06, 1.10) |
| I4891 | Unspecified atrial fibrillation | 48.6 | 47.8 | 49.4 | -1.7 | 1.03 (1.01, 1.04) |

| Variable | Description | MA + FFS (%) (N= 635,204) | FFS (%) (N= 326,130) | MA (%) (N= 309,074) | FFS − MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| I5022 | Chronic systolic (congestive) heart failure | 22.3 | 19.9 | 24.8 | -4.9 | 1.07 (1.05, 1.09) |
| I5032 | Chronic diastolic (congestive) heart failure | 28.2 | 26.8 | 29.7 | -3.0 | 1.06 (1.05, 1.08) |
| I5043 | Acute on chronic combined systolic (congestive) and diastolic (congestive) heart failure | 15.7 | 14.1 | 17.4 | -3.3 | 1.06 (1.04, 1.08) |
| I6782 | Cerebral ischemia | 4.4 | 3.7 | 5.0 | -1.3 | 1.07 (1.04, 1.10) |
| I959 | Hypotension, unspecified | 12.9 | 12.0 | 13.8 | -1.9 | 1.08 (1.06, 1.10) |
| J441 | Chronic obstructive pulmonary disease with (acute) exacerbation | 16.7 | 14.2 | 19.4 | -5.1 | 1.09 (1.07, 1.11) |
| J449 | Chronic obstructive pulmonary disease, unspecified | 34.8 | 31.1 | 38.7 | -7.6 | 1.07 (1.06, 1.09) |
| J811 | Chronic pulmonary edema | 19.7 | 15.8 | 23.7 | -7.9 | 1.06 (1.04, 1.07) |
| J9622 | Acute and chronic respiratory failure with hypercapnia | 4.4 | 3.8 | 4.9 | -1.1 | 1.13 (1.10, 1.17) |
| K5730 | Diverticulosis of large intestine without perforation or abscess without bleeding | 10.1 | 8.5 | 11.8 | -3.3 | 0.98 (0.96, 1.00) |
| K7460 | Unspecified cirrhosis of liver | 3.6 | 3.2 | 4.1 | -0.8 | 1.16 (1.12, 1.20) |
| K921 | Melena | 5.9 | 5.5 | 6.3 | -0.8 | 1.09 (1.06, 1.11) |
| L309 | Dermatitis, unspecified | 2.9 | 2.7 | 3.1 | -0.4 | 1.05 (1.01, 1.09) |
| M542 | Cervicalgia | 8.7 | 8.1 | 9.3 | -1.2 | 1.07 (1.05, 1.09) |
| N179 | Acute kidney failure, unspecified | 40.1 | 37.2 | 43.2 | -5.9 | 1.11 (1.09, 1.13) |
| R000 | Tachycardia, unspecified | 11.4 | 9.8 | 13.1 | -3.3 | 1.07 (1.05, 1.09) |
| R001 | Bradycardia, unspecified | 12.2 | 11.4 | 12.9 | -1.5 | 0.96 (0.95, 0.98) |
| R0603 | Acute respiratory distress | 4.6 | 3.6 | 5.6 | -2.0 | 1.09 (1.06, 1.12) |
| R072 | Precordial pain | 3.5 | 2.9 | 4.0 | -1.1 | 1.08 (1.05, 1.12) |
| R0789 | Other chest pain | 19.9 | 17.4 | 22.4 | -5.0 | 1.08 (1.06, 1.10) |
| R079 | Chest pain, unspecified | 40.0 | 36.7 | 43.4 | -6.7 | 1.05 (1.03, 1.06) |
| R188 | Other ascites | 5.0 | 4.1 | 5.8 | -1.7 | 1.11 (1.08, 1.14) |
| W19XXXA | Unspecified fall, initial encounter | 4.7 | 1.0 | 8.6 | -7.6 | 0.98 (0.96, 1.01) |
| Z006 | Encounter for examination for normal comparison and control in clinical research program | 2.6 | 2.8 | 2.3 | 0.5 | 0.89 (0.85, 0.92) |
| Z1231 | Encounter for screening mammogram for malignant neoplasm of breast | 8.9 | 8.3 | 9.7 | -1.4 | 0.96 (0.93, 0.98) |

| Variable | Description | MA + FFS (%) (N= 635,204) | FFS (%) (N= 326,130) | MA (%) (N= 309,074) | FFS − MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| Z23 | Encounter for immunization | 61.0 | 67.2 | 54.6 | 12.6 | 1.01 (1.00, 1.03) |
| Z515 | Encounter for palliative care | 5.2 | 4.5 | 5.9 | -1.4 | 1.10 (1.07, 1.13) |
| Z66 | Do not resuscitate | 13.6 | 14.9 | 12.3 | 2.6 | 0.98 (0.96, 1.00) |
| Z7952 | Long term (current) use of systemic steroids | 4.4 | 4.4 | 4.3 | 0.1 | 1.12 (1.09, 1.15) |
| Z87891 | Personal history of nicotine dependence | 38.3 | 37.6 | 39.0 | -1.4 | 1.06 (1.04, 1.07) |
| Z888 | Allergy status to other drugs, medicaments and biological substances | 11.6 | 12.4 | 10.9 | 1.5 | 1.07 (1.05, 1.09) |
| Z9114 | Patient's other noncompliance with medication regimen | 5.0 | 4.0 | 6.0 | -2.0 | 1.14 (1.11, 1.17) |
| Z9119 | Patient's noncompliance with other medical treatment and regimen | 4.5 | 3.6 | 5.5 | -1.9 | 1.15 (1.12, 1.18) |
| ICD-10 codes either during the index admission or 12 months prior to admission | | | | | | |
| E1122 | Type 2 diabetes mellitus with diabetic chronic kidney disease | 38.4 | 35.0 | 41.9 | -6.9 | 1.10 (1.09, 1.112) |
| I480 | Paroxysmal atrial fibrillation | 41.1 | 41.5 | 40.7 | 0.8 | 1.03 (1.02, 1.05) |
| I4820 | Chronic atrial fibrillation, unspecified | 23.2 | 23.4 | 22.9 | 0.6 | 1.01 (0.99, 1.03) |
| J90 | Pleural effusion, not elsewhere classified | 44.0 | 41.3 | 46.9 | -5.6 | 1.08 (1.07, 1.10) |
| N184 | Chronic kidney disease, stage 4 (severe) | 18.9 | 17.8 | 20.0 | -2.2 | 1.07 (1.05, 1.09) |
| N185 | Chronic kidney disease, stage 5 | 4.3 | 3.7 | 4.9 | -1.2 | 0.92 (0.89, 0.96) |
| Z952 | Presence of prosthetic heart valve | 8.6 | 9.2 | 7.9 | 1.2 | 1.09 (1.06, 1.11) |
| Z95810 | Presence of automatic (implantable) cardiac defibrillator | 11.4 | 10.8 | 12.0 | -1.3 | 1.10 (1.08, 1.12) |
| Other risk variables | | | | | | |
| MCCFI | Multiple Chronic Conditions Frailty Index | 49.3 | 48.9 | 49.7 | -0.9 | 1.12 (1.10, 1.14) |
| HX_COVID | History of COVID-19 | 21.4 | 21.2 | 21.6 | -0.3 | 1.02 (1.01, 1.04) |
| MA | MA (versus FFS) | 48.7 | NA | NA | NA | 0.92 (0.91, 0.93) |

*Heart Failure Model Performance*

Table 4.3.4 presents model performance for the Heart Failure measure across three scenarios: the FFS-only cohort with CC-based risk variables, the FFS+MA cohort with CC-based risk variables, and the FFS+MA cohort with ICD-10-based risk variables. Predictive ability and c-statistics were similar between the FFS-only and FFS+MA cohorts using the original CC-based variables. For the MA+FFS cohort, the model using reselected ICD-10-based risk variables had a slightly higher c-statistic compared to the original CC-based model and wider predictive ability. Calibration performance was generally acceptable across all modeling approaches in the overall cohort and in subgroups, including male versus female, MA versus FFS, and quartiles of hospital volume (figures not shown).

**Table 4.3.4: Heart Failure Readmission: Predictive Ability and C-Statistics Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Predictive Ability, % (lowest decile – highest decile) | 10.6 – 32.4 | 10.6 – 33.1 | 9.1 – 35.9 |
| c-statistic | 0.62 | 0.62 | 0.64 |

Note: These statistics were calculated using the patient-level logistic model.

*Risk-Standardized Readmission Rates for Heart Failure*

Tables 4.3.5 and 4.3.6 present distribution of hospital volume, SRR, and RSRR for all hospitals (Table 4.3.5) and for hospitals with 25 or more eligible admissions (Table 4.3.6). Numbers of hospitals and admissions were higher in the combined FFS+MA data compared to the FFS-only data. With the addition of MA data, 86 additional hospitals were included in the measure (4,304 versus 4,218) and 434 additional hospitals met the 25 or more admissions cutoff for public reporting (2,799 versus 2,365). For all hospitals, the mean RSRR was 19.2% for the FFS-only cohort with CC-based risk variables, 19.4% for the FFS+MA cohort with CC-based risk variables, and 19.4% for the FFS+MA cohort with reselected ICD-10-based risk variables. Among hospitals with 25 or more admissions, mean RSRRs were 19.2%, 19.4%, and 19.4%, respectively.

**Table 4.3.5: Heart Failure Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for All Hospitals**

| Value | FFS-Only cohort with CC-based risk variables (N= 4,218 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 4,304 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 4,304 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| Hospital Volume | 77.3 (104.9) | 34 (8, 110) | 147.6 (197.7) | 65 (13, 215) | 147.6 (197.7) | 65 (13, 215) |
| SRR | 1.00 (0.03) | 1.00 (0.99, 1.01) | 1.00 (0.05) | 1.00 (0.98, 1.02) | 1.00 (0.04) | 1.00 (0.98, 1.02) |
| RSRR (%) | 19.2 (0.6) | 19.2 (19.0, 19.5) | 19.4 (0.9) | 19.3 (19.0, 19.7) | 19.4 (0.8) | 19.3 (19.0, 19.7) |

**Table 4.3.6: Heart Failure Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-Only cohort with CC-based risk variables (N= 2,365 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 2,799 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 2,799 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| Hospital Volume | 131.0 (114.2) | 96 (51, 172) | 222.0 (210.4) | 159 (71, 310) | 222.0 (210.4) | 159 (71, 310) |
| SRR | 1.00 (0.04) | 1.00 (0.98, 1.03) | 1.00 (0.06) | 1.00 (0.97, 1.04) | 1.00 (0.05) | 1.00 (0.97, 1.03) |
| RSRR (%) | 19.2 (0.8) | 19.2 (18.8, 19.7) | 19.4 (1.1) | 19.3 (18.7, 20.1) | 19.4 (1.0) | 19.3 (18.8, 19.9) |

*Measure Reliability for Heart Failure*

Between hospital variance and STNR for the measure score comparing the addition of MA admissions to the FFS-only cohort and reselected ICD-10-based variables to the CC-based variables in the FFS+MA cohort are noted in Table 4.3.7. Median STNR, calculated based on between hospital variance and hospital volume, was 0.293 for the FFS-only cohort with CC-based risk variables, 0.450 for the FFS+MA cohort with CC-based risk variables, and 0.410 for the FFS+MA cohort with reselected ICD-10-based risk variables.

**Table 4.3.7: Heart Failure Readmission: Between Hospital Variance and Signal-to-Noise Reliability (STNR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Number of Hospitals | 2,365 | 2,799 | 2,799 |
| Between Hospital Variance | 0.014 | 0.017 | 0.014 |
| STNR: Median (Q1, Q3) | 0.293 (0.180, 0.426) | 0.450 (0.267, 0.614) | 0.410 (0.237, 0.576) |

*Change in Hospital Performance for Heart Failure*

Table 4.3.8 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the Heart Failure measure in the combined FFS+MA cohort as compared to the FFS-only cohort in hospitals for the model with the original CC-based variables. After adding MA admissions to the FFS-only cohort, about half (45.6%) of hospitals remained in the same performance quintile, and 85.7% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.76. As hospitals' proportion of MA admissions increased, fewer hospitals remained in the same performance quintile (62.2% among hospitals in the lowest quintile of percent MA admissions; 30.7% of hospitals in the highest quintile of percent of MA admissions). As hospital volume increased, there was not a notable trend in RSRR shifts.

Table 4.3.9 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the Heart Failure measure after both measure updates, comparing the combined FFS+MA cohort using the reselected ICD-10-based risk variables to the FFS-only cohort using the CC-based variables. With the addition of the MA admissions and the ICD-10-based risk variables, 44.9% of hospitals remained in the same performance quintile and 84.0% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.74. Stratified by proportion of MA admissions in a hospital, 58.6% of hospitals in the lowest quintile of percent MA admissions remained in the same performance quintile versus 32.6% in the highest quintile.

**Table 4.3.8: Shifts in RSRR Hospital Performance Quintile Rankings for Heart Failure, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-Only Cohort to the FFS+MA Cohort, CC-Based Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| Overall | 45.6 | 85.7 | 0.76 |
| By Percent of MA Admissions | | | |
| Q1: 0.0% – 31.9% | 62.2 | 95.3 | 0.92 |
| Q2: 31.9% – 41.7% | 47.8 | 89.9 | 0.84 |
| Q3: 41.7% – 50.2% | 44.0 | 86.0 | 0.76 |
| Q4: 50.2% – 58.7% | 43.6 | 84.1 | 0.75 |
| Q5:58.8.% – 90.4.2% | 30.7 | 72.9 | 0.55 |
| By MA+FFS Admission Volume | | | |
| Q1: 25 – 87 admissions | 48.1 | 94.1 | 0.81 |
| Q2: 88 – 150 admissions | 43.1 | 86.6 | 0.77 |
| Q3: 151 – 236 admissions | 43.8 | 82.7 | 0.74 |
| Q4: 237 – 373 admissions | 44.7 | 82.9 | 0.76 |
| Q5: 374 – 2,693admissions | 48.3 | 81.9 | 0.75 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions.
Total N=2,365, representing hospitals with 25 or more FFS admissions

**Table 4.3.9: Shifts in RSRR Hospital Performance Quintile Rankings for Heart Failure, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-only Cohort with CC-Based Variables to the FFS+MA Cohort with Reselected ICD-10-Based Risk Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| Overall | 44.9 | 84.0 | 0.74 |
| By Percent of MA Admissions | | | |
| Q1: 0.0% – 31.9% | 58.6 | 95.3 | 0.90 |
| Q2: 31.9% – 41.7% | 45.9 | 87.7 | 0.81 |
| Q3: 41.7% – 50.2% | 42.1 | 84.8 | 0.75 |
| Q4: 50.2% – 58.7% | 45.2 | 81.2 | 0.75 |
| Q5: 58.8% – 90.4% | 32.6 | 70.8 | 0.54 |
| By MA+FFS Admission Volume | | | |
| Q1: 25 – 87 admissions | 48.1 | 93.7 | 0.80 |
| Q2: 88 – 150 admissions | 41.6 | 86.2 | 0.76 |
| Q3: 151 – 236 admissions | 43.4 | 79.4 | 0.71 |
| Q4: 237 – 373 admissions | 43.9 | 81.6 | 0.74 |
| Q5: 374 – 2,693 admissions | 47.3 | 78.9 | 0.75 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions and with reselected ICD-10-based risk variables.
Total N= 2,365, representing hospitals with 25 or more FFS admissions

### 4.4. Pneumonia Readmission Results

*Pneumonia Admission Volume and Observed Readmission Rate*

As presented in Table 4.4.1, the FFS+MA cohort included 559,333 unique admissions from January 1 – December 30, 2022 (308,882 FFS and 250,451 MA). The observed (unadjusted) 30-day readmission rate for the FFS+MA cohort for Pneumonia was 15.6%. The observed readmission rate was 15.7% among FFS beneficiaries compared to 15.5% among MA beneficiaries (difference 0.2%).

**Table 4.4.1: Number of Admissions and Observed 30-Day Readmission Rate for Pneumonia, FFS versus MA Admissions, CY 2022**

| Pneumonia | MA + FFS | FFS | MA | Difference FFS - MA |
|---|---|---|---|---|
| N | 559,333 | 308,882 | 250,451 | NA |
| Readmission Rate (%) | 15.6 | 15.7 | 15.5 | 0.2 |

*Frequency of Pneumonia Risk Variables*

We examined the frequencies of variables used for risk adjustment in FFS and MA admissions. The variables from the original CC-based risk model are presented in Table 4.4.2, and the reselected ICD-10-based variables in Table 4.4.3. Frequencies of model variables were generally higher in MA than FFS admissions for both the CC- and ICD-10-based variables. The median difference in risk variable prevalence between FFS and MA (%FFS – %MA) was -1.6% for CC-based variables with a range from -11.5% to 1.6%. There was less of a difference overall in risk variable prevalence between FFS and MA for ICD-10-based variables with a median difference of -0.2% (range from -10.9% to 3.7%), however, for ICD-10 codes in the 12 months prior to admission (pre-index codes), the differences were more pronounced. Table 4.4.3 also presents adjusted OR and 95% confidence intervals for the hierarchical logistic regression model using FFS+MA admissions.

**Table 4.4.2: Frequency of CC-Based Risk Variables in the Pneumonia Cohort, FFS versus MA Admissions, CY 2022**

| Variable (% unless otherwise indicated) | MA + FFS (N= 559,333) | FFS (N= 308,882) | MA (N= 250,451) | FFS - MA |
|---|---|---|---|---|
| Age, mean (SD) | 79.1 (8.4) | 79.8 (8.5) | 78.2 (8.2) | 1.5 |
| Male | 47.3 | 47.7 | 46.7 | 1.0 |
| Coronary artery bypass graft surgery | 8.9 | 8.8 | 8.9 | 1.0 |
| History of infection (CC 1, 3 – 7) | 38.6 | 38.9 | 38.2 | 1.0 |
| Septicemia/shock (CC 2) | 34.1 | 32.2 | 36.5 | 1.0 |
| Metastatic cancer and acute leukemia (CC 8) | 7.1 | 7.0 | 7.3 | 1.0 |
| Lung cancer (CC 9) | 9.6 | 9.4 | 9.9 | 1.0 |
| Lymphatic, head and neck, brain, and other major cancers; breast, prostate, colorectal and other cancers and tumors (CC 10 – 12) | 18.8 | 18.9 | 18.6 | 1.0 |
| Diabetes and DM complications (CC 17 – 19, 122, 123) | 46.4 | 43.7 | 49.8 | -6.0 |
| Protein-calorie malnutrition (CC 21) | 21.5 | 21.3 | 21.7 | -0.4 |

| Variable (% unless otherwise indicated) | MA + FFS (N= 559,333) | FFS (N= 308,882) | MA (N= 250,451) | FFS - MA |
|---|---|---|---|---|
| Disorders of fluid/electrolyte/acid-base (CC 23, 24) | 50.6 | 48.1 | 53.8 | -5.7 |
| Other gastrointestinal disorders (CC 38) | 72.7 | 71.3 | 74.4 | -3.2 |
| Severe hematological disorders (CC 46) | 1.9 | 2.0 | 1.9 | 0.1 |
| Iron deficiency and other/unspecified anemias and blood disease (CC 49) | 60.9 | 60.0 | 62.0 | -1.9 |
| Dementia and senility (CC 51 – 53) | 33.6 | 33.9 | 33.3 | 0.6 |
| Drug/alcohol abuse/dependence/psychosis (CC 54 – 56) | 23.8 | 19.5 | 29.0 | -9.5 |
| Major psychiatric disorders (CC 57 – 59) | 20.9 | 17.7 | 24.9 | -7.2 |
| Other psychiatric disorders (CC 63) | 30.6 | 30.0 | 31.4 | -1.4 |
| Hemiplegia, paralysis, functional disability (CC 70 – 74, 103, 104, 189, 190) | 11.6 | 11.2 | 12.0 | -0.8 |
| Respirator dependency/tracheostomy (CC 82) | 53.6 | 48.6 | 59.7 | -11.1 |
| Congestive heart failure (CC 85) | 44.6 | 41.9 | 48.0 | -6.1 |
| Acute coronary syndrome (CC 86, 87) | 13.5 | 12.4 | 14.9 | -2.6 |
| Chronic atherosclerosis (CC 88,8 9) | 48.2 | 46.6 | 50.2 | -3.6 |
| Valvular or rheumatic heart disease (CC 91) | 31.3 | 30.6 | 32.1 | -1.4 |
| Arrhythmias (CC 96, 97) | 50.7 | 50.7 | 50.6 | 0.1 |
| Stroke (CC 99 –100) | 11.0 | 10.7 | 11.4 | -0.8 |
| Vascular or circulatory disease (CC 106 –109) | 53.4 | 48.5 | 59.4 | -11.0 |
| Chronic obstructive pulmonary disease (CC 111) | 51.8 | 48.6 | 55.7 | -7.1 |
| Fibrosis of lung and other chronic lung disorders (CC 112) | 15.4 | 14.2 | 17.0 | -2.8 |
| Asthma (CC 113) | 14.4 | 12.9 | 16.3 | -3.4 |
| Pneumonia (CC 114 – 116) | 73.0 | 67.8 | 79.4 | -11.5 |
| Pleural effusion/pneumothorax (CC 117) | 26.8 | 24.7 | 29.3 | -4.5 |
| Other lung disorders (CC 118) | 55.3 | 52.8 | 58.3 | -5.6 |
| End-stage renal disease or dialysis (CC 134) | 3.9 | 3.7 | 4.0 | -0.3 |
| Renal failure (CC 135 – 140) | 49.9 | 47.2 | 53.1 | -5.9 |
| Urinary tract infection (CC 144) | 29.5 | 29.6 | 29.4 | 0.3 |
| Other urinary tract disorders (CC 145) | 23.5 | 21.5 | 25.8 | -4.3 |
| Decubitus ulcer or chronic skin ulcer (CC 157 – 161) | 14.7 | 15.4 | 13.8 | 1.6 |
| Vertebral fractures (CC 169) | 6.2 | 6.2 | 6.1 | 0.2 |
| Other injuries (CC 174) | 38.7 | 37.9 | 39.6 | -1.8 |
| Cardio-respiratory failure and shock (CC 83, 84) | 2.2 | 1.9 | 2.5 | -0.5 |
| History of COVID-19 | 24.5 | 24.7 | 24.2 | 0.5 |

**Table 4.4.3: Frequency of ICD-10-Based Risk Variables in the Pneumonia Cohort, FFS versus MA Admissions, and Adjusted OR and 95% Confidence Intervals for the Pneumonia Hierarchical Logistic Regression Model Using FFS+MA Admissions, CY 2022**

| Variable | Description | MA + FFS (%) (N= 559,333) | FFS (%) (N= 308,882) | MA (%) (N= 250,451) | FFS – MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| AGE | Age, mean (SD) | 79.1 (8.4) | 79.8 (8.5) | 78.2 (8.2) | 1.5 | 1.00 (1.00, 1.00) |
| ICD-10 codes during the index admission | | | | | | |
| A0472 | Enterocolitis due to Clostridium difficile, not specified as recurrent | 0.5 | 0.6 | 0.5 | 0.1 | 1.31 (1.20, 1.43) |
| B965 | Pseudomonas (aeruginosa) (mallei) (pseudomallei) as the cause of diseases classified elsewhere | 0.7 | 0.7 | 0.6 | 0.1 | 1.18 (1.09, 1.28) |
| B9789 | Other viral agents as the cause of diseases classified elsewhere | 0.8 | 0.8 | 0.8 | 0.0 | 0.77 (0.70, 0.85) |
| C7800 | Secondary malignant neoplasm of unspecified lung | 0.5 | 0.6 | 0.5 | 0.1 | 1.22 (1.12, 1.34) |
| C787 | Secondary malignant neoplasm of liver and intrahepatic bile duct | 1.0 | 1.0 | 1.0 | 0.0 | 1.20 (1.12, 1.29) |
| D469 | Myelodysplastic syndrome, unspecified | 0.6 | 0.6 | 0.5 | 0.1 | 1.30 (1.19, 1.43) |
| D61818 | Other pancytopenia | 1.3 | 1.4 | 1.3 | 0.0 | 1.29 (1.22, 1.37) |
| D62 | Acute posthemorrhagic anemia | 1.5 | 1.4 | 1.5 | -0.1 | 1.19 (1.13, 1.26) |
| D638 | Anemia in other chronic diseases classified elsewhere | 3.9 | 3.9 | 3.8 | 0.2 | 1.13 (1.09, 1.17) |
| D649 | Anemia, unspecified | 12.1 | 12.3 | 12.0 | 0.3 | 1.10 (1.08, 1.13) |
| E11649 | Type 2 diabetes mellitus with hypoglycemia without coma | 1.3 | 1.2 | 1.4 | -0.2 | 1.19 (1.12, 1.26) |
| E222 | Syndrome of inappropriate secretion of antidiuretic hormone | 1.2 | 1.2 | 1.2 | 0.0 | 1.20 (1.12, 1.28) |
| E43 | Unspecified severe protein-calorie malnutrition | 6.8 | 6.9 | 6.7 | 0.1 | 1.10 (1.07, 1.13) |
| E440 | Moderate protein-calorie malnutrition | 3.5 | 3.5 | 3.5 | 0.0 | 1.10 (1.06, 1.14) |
| E870 | Hyperosmolality and hypernatremia | 3.3 | 3.6 | 2.9 | 0.7 | 1.12 (1.08, 1.17) |
| E875 | Hyperkalemia | 4.7 | 4.7 | 4.8 | -0.2 | 1.18 (1.14, 1.22) |
| E876 | Hypokalemia | 12.4 | 12.3 | 12.5 | -0.2 | 0.94 (0.92, 0.96) |
| G893 | Neoplasm related pain (acute) (chronic) | 0.5 | 0.5 | 0.5 | 0.0 | 1.32 (1.20, 1.44) |
| I080 | Rheumatic disorders of both mitral and aortic valves | 0.8 | 0.9 | 0.8 | 0.1 | 1.24 (1.15, 1.33) |

| Variable | Description | MA + FFS (%) (N= 559,333) | FFS (%) (N= 308,882) | MA (%) (N= 250,451) | FFS – MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| I130 | Hypertensive heart and chronic kidney disease with heart failure and stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease | 13.9 | 13.7 | 14.3 | -0.6 | 1.06 (1.04, 1.09) |
| I4891 | Unspecified atrial fibrillation | 10.6 | 11.1 | 9.9 | 1.2 | 1.05 (1.03, 1.08) |
| I5023 | Acute on chronic systolic (congestive) heart failure | 2.9 | 2.8 | 3.0 | -0.1 | 1.20 (1.15, 1.25) |
| I5031 | Acute diastolic (congestive) heart failure | 1.4 | 1.4 | 1.4 | -0.1 | 1.21 (1.14, 1.29) |
| I5033 | Acute on chronic diastolic (congestive) heart failure | 7.6 | 7.7 | 7.5 | 0.1 | 1.16 (1.13, 1.19) |
| I5042 | Chronic combined systolic (congestive) and diastolic (congestive) heart failure | 1.5 | 1.5 | 1.5 | 0.3 | 1.14 (1.08, 1.21) |
| I5043 | Acute on chronic combined systolic (congestive) and diastolic (congestive) heart failure | 2.0 | 1.9 | 2.1 | -0.1 | 1.19 (1.14, 1.25) |
| J13 | Pneumonia due to Streptococcus pneumoniae | 0.5 | 0.5 | 0.6 | -0.1 | 0.74 (0.66, 0.83) |
| J159 | Unspecified bacterial pneumonia | 3.9 | 3.9 | 3.9 | 0.0 | 0.93 (0.89, 0.97) |
| J40 | Bronchitis, not specified as acute or chronic | 0.6 | 0.6 | 0.5 | 0.0 | 0.80 (0.71, 0.89) |
| J441 | Chronic obstructive pulmonary disease with (acute) exacerbation | 16.8 | 15.3 | 18.7 | -3.4 | 1.05 (1.03, 1.07) |
| J45909 | Unspecified asthma, uncomplicated | 3.4 | 3.4 | 3.4 | 0.0 | 0.94 (0.90, 0.98) |
| J90 | Pleural effusion, not elsewhere classified | 5.4 | 5.5 | 5.3 | 0.2 | 1.26 (1.22, 1.30) |
| J910 | Malignant pleural effusion | 0.5 | 0.5 | 0.5 | 0.0 | 1.52 (1.38, 1.66) |
| J918 | Pleural effusion in other conditions classified elsewhere | 2.2 | 2.2 | 2.1 | 0.1 | 1.21 (1.16, 1.27) |
| J9601 | Acute respiratory failure with hypoxia | 33.0 | 32.8 | 33.3 | -0.4 | 0.97 (0.95, 0.98) |
| J9602 | Acute respiratory failure with hypercapnia | 2.5 | 2.3 | 2.7 | -0.4 | 1.12 (1.07, 1.17) |
| J9622 | Acute and chronic respiratory failure with hypercapnia | 4.7 | 4.4 | 5.1 | -0.7 | 1.14 (1.10, 1.18) |
| K5900 | Constipation, unspecified | 4.7 | 4.8 | 4.5 | 0.3 | 1.07 (1.03, 1.10) |
| K7460 | Unspecified cirrhosis of liver | 1.2 | 1.1 | 1.4 | -0.2 | 1.17 (1.10, 1.24) |
| L89154 | Pressure ulcer of sacral region, stage 4 | 0.6 | 0.7 | 0.5 | 0.2 | 1.23 (1.13, 1.33) |
| N170 | Acute kidney failure with tubular necrosis | 1.6 | 1.6 | 1.7 | -0.1 | 1.20 (1.13, 1.26) |
| N179 | Acute kidney failure, unspecified | 21.8 | 21.3 | 22.3 | -0.9 | 1.07 (1.05, 1.09) |

| Variable | Description | MA + FFS (%) (N= 559,333) | FFS (%) (N= 308,882) | MA (%) (N= 250,451) | FFS − MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| R0902 | Hypoxemia | 6.7 | 7.0 | 6.3 | 0.7 | 0.91 (0.88, 0.94) |
| R1310 | Dysphagia, unspecified | 6.7 | 7.3 | 6.0 | 1.4 | 1.10 (1.07, 1.14) |
| R1312 | Dysphagia, oropharyngeal phase | 2.1 | 2.2 | 1.9 | 0.3 | 1.16 (1.10, 1.22) |
| R188 | Other ascites | 0.7 | 0.7 | 0.8 | 0.0 | 1.19 (1.10, 1.29) |
| R338 | Other retention of urine | 1.3 | 1.3 | 1.3 | 0.0 | 1.18 (1.11, 1.25) |
| R339 | Retention of urine, unspecified | 1.6 | 1.6 | 1.5 | 0.1 | 1.12 (1.05, 1.18) |
| T451X5A | Adverse effect of antineoplastic and immunosuppressive drugs, initial encounter | 1.3 | 1.3 | 1.2 | 0.1 | 1.17 (1.09, 1.24) |
| Z515 | Encounter for palliative care | 7.5 | 7.9 | 7.1 | 0.8 | 0.43 (0.41, 0.44) |
| Z66 | Do not resuscitate | 19.8 | 21.5 | 17.8 | 3.7 | 0.86 (0.84, 0.88) |
| Z6820 | Body mass index [BMI] 20.0 − 20.9, adult | 0.7 | 0.8 | 0.7 | 0.1 | 1.04 (0.96, 1.13) |
| Z6843 | Body mass index [BMI] 50.0 − 59.9, adult | 0.8 | 0.7 | 0.9 | -0.2 | 1.09 (1.01, 1.18) |
| Z7401 | Bed confinement status | 2.2 | 2.3 | 2.1 | 0.2 | 1.19 (1.14, 1.25) |
| Z7901 | Long term (current) use of anticoagulants | 20.0 | 20.7 | 19.1 | 1.6 | 1.03 (1.01, 1.05) |
| Z9981 | Dependence on supplemental oxygen | 10.8 | 10.4 | 11.4 | -1.0 | 1.05 (1.02, 1.08) |
| ICD-10 codes in the 12 months prior to admission | | | | | | |
| D649 | Anemia, unspecified | 31.4 | 30.1 | 32.9 | -2.7 | 1.11 (1.09, 1.13) |
| D72829 | Elevated white blood cell count, unspecified | 12.8 | 10.5 | 15.7 | -5.2 | 1.06 (1.04, 1.09) |
| E860 | Dehydration | 16.0 | 15.9 | 16.2 | -0.2 | 1.07 (1.05, 1.09) |
| E871 | Hypo-osmolality and hyponatremia | 16.9 | 16.1 | 17.9 | -1.8 | 1.10 (1.08, 1.13) |
| E875 | Hyperkalemia | 10.9 | 10.2 | 11.7 | -1.5 | 1.08 (1.05, 1.10) |
| E876 | Hypokalemia | 17.7 | 16.9 | 18.7 | -1.8 | 1.05 (1.03, 1.07) |
| F17210 | Nicotine dependence, cigarettes, uncomplicated | 11.3 | 9.1 | 14.1 | -5.0 | 1.11 (1.08, 1.13) |
| F419 | Anxiety disorder, unspecified | 20.1 | 18.9 | 21.4 | -2.5 | 1.06 (1.04, 1.08) |
| I120 | Hypertensive chronic kidney disease with stage 5 chronic kidney disease or end stage renal disease | 3.5 | 3.2 | 3.8 | -0.6 | 1.22 (1.17, 1.27) |
| I160 | Hypertensive urgency | 3.5 | 3.1 | 4.0 | -1.0 | 1.13 (1.09, 1.17) |
| I5033 | Acute on chronic diastolic (congestive) heart failure | 9.3 | 8.8 | 10.0 | -1.2 | 1.08 (1.05, 1.10) |
| I509 | Heart failure, unspecified | 28.4 | 25.7 | 31.6 | -5.8 | 1.09 (1.07, 1.11) |
| I6529 | Occlusion and stenosis of unspecified carotid artery | 2.7 | 2.1 | 3.4 | -1.3 | 0.94 (0.90, 0.99) |
| J069 | Acute upper respiratory infection, unspecified | 7.2 | 6.6 | 8.0 | -1.4 | 0.93 (0.90, 0.95) |

| Variable | Description | MA + FFS (%) (N= 559,333) | FFS (%) (N= 308,882) | MA (%) (N= 250,451) | FFS – MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| J101 | Influenza due to other identified influenza virus with other respiratory manifestations | 2.6 | 2.0 | 3.3 | -1.3 | 0.78 (0.74, 0.83) |
| J441 | Chronic obstructive pulmonary disease with (acute) exacerbation | 21.4 | 18.1 | 25.5 | -7.4 | 1.09 (1.06, 1.11) |
| J690 | Pneumonitis due to inhalation of food and vomit | 11.1 | 11.3 | 10.9 | 0.4 | 1.09 (1.06, 1.11) |
| J849 | Interstitial pulmonary disease, unspecified | 4.3 | 3.8 | 4.9 | -1.0 | 1.09 (1.05, 1.13) |
| J90 | Pleural effusion, not elsewhere classified | 25.6 | 23.7 | 28.1 | -4.4 | 1.14 (1.12, 1.16) |
| J9622 | Acute and chronic respiratory failure with hypercapnia | 4.2 | 3.7 | 4.9 | -1.2 | 1.17 (1.13, 1.21) |
| M47812 | Spondylosis without myelopathy or radiculopathy, cervical region | 5.5 | 4.6 | 6.5 | -1.8 | 1.00 (0.97, 1.04) |
| M7989 | Other specified soft tissue disorders | 10.9 | 10.0 | 12.0 | -2.1 | 1.06 (1.04, 1.09) |
| N179 | Acute kidney failure, unspecified | 26.7 | 24.6 | 29.3 | -4.7 | 1.04 (1.02, 1.06) |
| N390 | Urinary tract infection, site not specified | 26.2 | 26.3 | 26.1 | 0.1 | 1.06 (1.04, 1.08) |
| R000 | Tachycardia, unspecified | 14.6 | 13.2 | 16.4 | -3.2 | 1.09 (1.07, 1.11) |
| R0600 | Dyspnea, unspecified | 24.2 | 21.7 | 27.2 | -5.5 | 1.05 (1.03, 1.07) |
| R0602 | Shortness of breath | 55.3 | 51.6 | 59.9 | -8.3 | 1.08 (1.06, 1.10) |
| R0789 | Other chest pain | 15.4 | 13.8 | 17.3 | -3.5 | 1.06 (1.04, 1.08) |
| R079 | Chest pain, unspecified | 31.7 | 29.2 | 34.8 | -5.6 | 1.05 (1.03, 1.07) |
| R109 | Unspecified abdominal pain | 17.1 | 15.9 | 18.7 | -2.8 | 1.09 (1.07, 1.11) |
| R4182 | Altered mental status, unspecified | 22.6 | 22.4 | 22.9 | -0.6 | 1.08 (1.06, 1.10) |
| R509 | Fever, unspecified | 15.9 | 13.7 | 18.7 | -5.0 | 0.97 (0.95, 0.99) |
| R627 | Adult failure to thrive | 4.5 | 4.4 | 4.7 | -0.2 | 1.09 (1.06, 1.13) |
| R630 | Anorexia | 3.5 | 3.0 | 4.0 | -1.1 | 1.08 (1.04, 1.12) |
| R918 | Other nonspecific abnormal finding of lung field | 50.5 | 46.8 | 55.1 | -8.3 | 1.06 (1.04, 1.07) |
| R9389 | Abnormal findings on diagnostic imaging of other specified body structures | 4.0 | 3.1 | 5.1 | -2.0 | 1.10 (1.06, 1.14) |
| R9431 | Abnormal electrocardiogram [ECG] [EKG] | 22.3 | 20.4 | 24.7 | -4.3 | 1.06 (1.04, 1.08) |
| Z0000 | Encounter for general adult medical examination without abnormal findings | 19.1 | 14.2 | 25.1 | -10.9 | 0.98 (0.96, 1.00) |

| Variable | Description | MA + FFS (%) (N= 559,333) | FFS (%) (N= 308,882) | MA (%) (N= 250,451) | FFS − MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| Z1211 | Encounter for screening for malignant neoplasm of colon | 4.4 | 3.2 | 5.7 | -2.5 | 0.92 (0.89, 0.96) |
| Z1231 | Encounter for screening mammogram for malignant neoplasm of breast | 10.1 | 9.3 | 10.9 | -1.6 | 0.85 (0.83, 0.88) |
| Z5111 | Encounter for antineoplastic chemotherapy | 4.6 | 4.5 | 4.7 | -0.2 | 1.18 (1.14, 1.23) |
| Z7952 | Long term (current) use of systemic steroids | 6.3 | 6.2 | 6.3 | 0.0 | 1.14 (1.11, 1.17) |
| Z87440 | Personal history of urinary (tract) infections | 4.7 | 5.0 | 4.3 | 0.6 | 1.09 (1.06, 1.13) |
| Z87891 | Personal history of nicotine dependence | 36.9 | 35.7 | 38.5 | -2.9 | 1.05 (1.04, 1.07) |
| Z881 | Allergy status to other antibiotic agents | 6.0 | 6.5 | 5.3 | 1.3 | 1.07 (1.04, 1.11) |
| Z95810 | Presence of automatic (implantable) cardiac defibrillator | 2.9 | 2.8 | 3.1 | -0.3 | 1.11 (1.06, 1.15) |
| ICD-10 codes either during the index admission or 12 months prior to admission | | | | | | |
| C3490 | Malignant neoplasm of unspecified part of unspecified bronchus or lung | 4.8 | 4.4 | 5.2 | -0.8 | 1.19 (1.15, 1.23) |
| D631 | Anemia in chronic kidney disease | 12.7 | 12.3 | 13.2 | -0.9 | 1.11 (1.08, 1.14) |
| E1122 | Type 2 diabetes mellitus with diabetic chronic kidney disease | 21.1 | 19.0 | 23.8 | -4.8 | 1.10 (1.07, 1.12) |
| I480 | Paroxysmal atrial fibrillation | 24.5 | 24.7 | 24.1 | 0.6 | 1.07 (1.05, 1.09) |
| J8410 | Pulmonary fibrosis, unspecified | 6.3 | 5.4 | 7.4 | -1.9 | 1.11 (1.08, 1.14) |
| N184 | Chronic kidney disease, stage 4 (severe) | 7.7 | 7.2 | 8.4 | -1.2 | 1.07 (1.04, 1.10) |
| Z931 | Gastrostomy status | 3.6 | 4.0 | 3.1 | 0.9 | 1.36 (1.31, 1.41) |
| Other risk variables | | | | | | |
| MCCFI | Multiple Chronic Conditions Frailty Index | 52.4 | 51.8 | 53.0 | -1.2 | 1.19 (1.17, 1.21) |
| HX_COVID | History of COVID-19 | 24.5 | 24.7 | 24.2 | 0.5 | 0.98 (0.97, 1.00) |
| MA | MA (versus FFS) | 44.8 | NA | NA | NA | 0.90 (0.89, 0.91) |

*Pneumonia Model Performance*

Table 4.4.4 presents model performance for the Pneumonia measure across three scenarios: the FFS-only cohort with CC-based risk variables, the FFS+MA cohort with CC-based risk variables, and the FFS+MA cohort with ICD-10-based risk variables. Predictive ability and c-statistics were similar between the FFS-only and FFS+MA cohorts using the original CC-based variables. For the MA+FFS cohort, the model using reselected ICD-10-based risk variables had a slightly higher c-statistic compared to the original CC-based model and wider predictive ability. Calibration performance was generally acceptable across all modeling approaches in the overall cohort and in subgroups, including male versus female, MA versus FFS, and quartiles of hospital volume (figures not shown).

**Table 4.4.4: Pneumonia Readmission: Predictive Ability and C-Statistics Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Predictive Ability, % (lowest decile – highest decile) | 7.5 – 29.4 | 7.3 – 29.3 | 6.0 – 32.3 |
| c-statistic | 0.64 | 0.64 | 0.66 |

Note: These statistics were calculated using the patient-level logistic model.

*Risk-Standardized Readmission Rates for Pneumonia*

Tables 4.4.5 and 4.4.6 present distribution of hospital volume, SRR, and RSRR for all hospitals (Table 4.4.5) and for hospitals with 25 or more eligible admissions (Table 4.4.6). Numbers of hospitals and admissions were higher in the combined FFS+MA data compared to the FFS-only data. With the addition of MA data, 53 additional hospitals were included in the measure (4,390 versus 4,337) and 492 additional hospitals met the 25 or more admissions cutoff for public reporting (3,121 versus 2,629). For all hospitals, the mean RSRR was 15.7% for the FFS-only cohort with CC-based risk variables, 15.6% for the FFS+MA cohort with CC-based risk variables, and 15.6% for the FFS+MA cohort with reselected ICD-10-based risk variables. Among hospitals with 25 or more admissions, mean RSRRs were 15.8%, 15.7%, and 15.6%, respectively.

**Table 4.4.5: Pneumonia Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for All Hospitals**

| Value | FFS-Only cohort with CC-based risk variables (N= 4,337 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 4,390 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 4,390 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| **Hospital Volume** | 71.2 (86.9) | 38 (14, 101) | 127.4 (152.1) | 69 (21, 188) | 127.4 (152.1) | 69 (21, 188) |
| **SRR** | 1.00 (0.05) | 1.00 (0.98, 1.02) | 1.00 (0.05) | 1.00 (0.97, 1.02) | 1.00 (0.04) | 1.00 (0.98, 1.02) |
| **RSRR (%)** | 15.7 (0.7) | 15.7 (15.3, 16.0) | 15.6 (0.8) | 15.6 (15.2, 16.0) | 15.6 (0.7) | 15.6 (15.3, 15.9) |

**Table 4.4.6: Pneumonia Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-Only cohort with CC-based risk variables (N= 2,629 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 3,121 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 3,121 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| Hospital Volume | 110.2 (92.6) | 83 (46, 144) | 174.4 (157.8) | 131 (59, 239) | 174.4 (157.8) | 131 (59, 239) |
| SRR | 1.00 (0.06) | 1.00 (0.97, 1.04) | 1.00 (0.06) | 1.00 (0.96, 1.04) | 1.00 (0.05) | 1.00 (0.97, 1.03) |
| RSRR (%) | 15.8 (0.9) | 15.7 (15.2, 16.3) | 15.7 (1.0) | 15.6 (15.0, 16.2) | 15.6 (0.8) | 15.6 (15.1, 16.1) |

*Measure Reliability for Pneumonia*

Between hospital variance and STNR for the measure score comparing the addition of MA admissions to the FFS-only cohort and reselected ICD-10-based variables to the CC-based variables in the FFS+MA cohort are noted in Table 4.4.7. Median STNR, calculated based on between hospital variance and hospital volume, was 0.356 for the FFS-only cohort with CC-based risk variables, 0.447 for the FFS+MA cohort with CC-based risk variables, and 0.401 for the FFS+MA cohort with reselected ICD-10-based risk variables.

**Table 4.4.7: Pneumonia Readmission: Between Hospital Variance and Signal-to-Noise Reliability (STNR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Number of Hospitals | 2,629 | 3,121 | 3,121 |
| Between Hospital Variance | 0.022 | 0.020 | 0.017 |
| STNR: Median (Q1, Q3) | 0.356 (0.234, 0.489) | 0.447 (0.267, 0.596) | 0.401 (0.232, 0.550) |

*Change in Hospital Performance for Pneumonia*

Table 4.4.8 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the Pneumonia measure in the combined FFS+MA cohort as compared to the FFS-only cohort in hospitals for the model with the original CC-based variables. After adding MA admissions to the FFS-only cohort, half (50.0%) of hospitals remained in the same performance quintile, and 88.4% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.81. As hospitals' proportion of MA admissions increased, fewer hospitals remained in the same performance quintile (64.9% among hospitals in the lowest quintile of percent MA admissions; 40.1% of hospitals in the highest quintile of percent of MA admissions). As hospital volume increased, there was not a notable trend in RSRR shifts.

Table 4.4.9 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the Pneumonia measure after both measure updates, comparing the combined FFS+MA cohort using the reselected ICD-10-based risk variables to the FFS-only cohort using the CC-based variables. With the addition of the MA admissions and the ICD-10-based risk variables, 48.3% of hospitals remained in the same performance quintile and 86.3% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.78. Stratified by proportion of MA admissions in a hospital, 61.5% of hospitals in the lowest quintile of percent MA admissions remained in the same performance quintile versus 38.6% in the highest quintile.

**Table 4.4.8: Shifts in RSRR Hospital Performance Quintile Rankings for Pneumonia, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-Only Cohort to the FFS+MA Cohort, CC-Based Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| Overall | 50.0 | 88.4 | 0.81 |
| By Percent of MA Admissions | | | |
| Q1: 0.0% – 28.1% | 64.9 | 96.8 | 0.93 |
| Q2: 28.2% – 38.2% | 52.3 | 91.8 | 0.88 |
| Q3: 38.2% – 46.9% | 48.7 | 88.8 | 0.82 |
| Q4: 46.9% – 55.0% | 44.1 | 85.7 | 0.77 |
| Q5: 55.0% – 86.3% | 40.1 | 78.9 | 0.67 |
| By MA+FFS Admission Volume | | | |
| Q1: 25 – 71 admissions | 55.5 | 94.7 | 0.85 |
| Q2: 72 – 125 admissions | 48.0 | 89.7 | 0.78 |
| Q3: 126 – 193 admissions | 46.8 | 86.0 | 0.77 |
| Q4: 194 – 298 admissions | 46.8 | 86.1 | 0.79 |
| Q5: 299 – 2414 admissions | 53.1 | 85.5 | 0.85 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions.
Total N=2,629, representing hospitals with 25 or more FFS admissions

**Table 4.4.9: Shifts in RSRR Hospital Performance Quintile Rankings for Pneumonia, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-only Cohort with CC-Based Variables to the FFS+MA Cohort with Reselected ICD-10-Based Risk Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| Overall | 48.3 | 86.3 | 0.78 |
| By Percent of MA Admissions | | | |
| Q1: 0.0% − 28.1% | 61.5 | 94.5 | 0.90 |
| Q2: 28.2% − 38.2% | 48.9 | 89.1 | 0.84 |
| Q3: 38.2% − 46.9% | 46.0 | 87.1 | 0.80 |
| Q4: 46.9% − 55.0% | 46.4 | 83.7 | 0.75 |
| Q5: 55.0% − 86.3% | 38.6 | 77.0 | 0.65 |
| By MA+FFS Admission Volume | | | |
| Q1: 25 − 40 admissions | 53.0 | 94.3 | 0.83 |
| Q2: 41 − 66 admissions | 45.9 | 85.5 | 0.76 |
| Q3: 67 − 102 admissions | 43.9 | 83.9 | 0.74 |
| Q4: 103 − 164 admissions | 46.2 | 82.4 | 0.76 |
| Q5: 165 −1256 admissions | 52.3 | 85.1 | 0.82 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions and with reselected ICD-10-based risk variables.

Total N=2,629, representing hospitals with 25 or more FFS admissions

### 4.5.  Isolated Coronary Artery Bypass Graft (CABG) Surgery Readmission Results

*CABG Admission Volume and Observed Readmission Rate*

As presented in Table 4.5.1, the FFS+MA cohort included 71,873 unique admissions from January 1 – December 30, 2022 (36,121 FFS and 35,752 MA). The observed (unadjusted) 30-day readmission rate for the FFS+MA cohort for CABG was 10.1%. The observed readmission rate was 9.7% among FFS beneficiaries compared to 10.5% among MA beneficiaries (difference -0.7%).

**Table 4.5.1: Number of Admissions and Observed 30-Day Readmission Rate for CABG, FFS versus MA Admissions, CY 2022**

| CABG | MA + FFS | FFS | MA | Difference FFS - MA |
|---|---|---|---|---|
| N | 71,873 | 36,121 | 35,752 | NA |
| Readmission Rate (%) | 10.1 | 9.7 | 10.5 | -0.7 |

*Frequency of CABG Risk Variables*

We examined the frequencies of variables used for risk adjustment in FFS and MA admissions. The variables from the original CC-based risk model are presented in Table 4.5.2, and the reselected ICD-10-based variables in Table 4.5.3. Frequencies of model variables were generally higher in MA than FFS admissions for both the CC- and ICD-10-based variables. The median difference in risk variable prevalence between FFS and MA (%FFS – %MA) was -1.7% for CC-based variables with a range from -11.4% to 2.9%. There was less of a difference overall in risk variable prevalence between FFS and MA for ICD-10-based variables with a median difference of -0.3% (range from -13.4% to 2.9%), however, for ICD-10 codes in the 12 months prior to admission (pre-index codes), the differences were more pronounced. Table 4.5.3 also presents adjusted OR and 95% confidence intervals for the hierarchical logistic regression model using FFS+MA admissions.

**Table 4.5.2: Frequency of CC-Based Risk Variables in the CABG Cohort, FFS versus MA Admissions, CY 2022**

| Variable (% unless otherwise indicated) | MA + FFS (N= 71,873) | FFS (N= 36,121) | MA (N= 35,752) | FFS - MA |
|---|---|---|---|---|
| Age, mean (SD) | 73.3 (5.2) | 73.5 (5.2) | 73.1 (5.1) | 0.4 |
| Male | 74.3 | 75.7 | 72.8 | 2.9 |
| Cardiogenic shock | 15.9 | 12.5 | 19.4 | -6.9 |
| History of prior CABG or valve surgery | 7.8 | 7.7 | 8.0 | -0.3 |
| Chronic obstructive pulmonary disease (CC 111) | 22.3 | 19.4 | 25.1 | -5.7 |
| Cancer (CC 8 – 14) | 19.4 | 19.8 | 19.0 | 0.8 |
| Diabetes and DM complications (CC 17 – 19, 122 – 123) | 55.7 | 52.4 | 59.0 | -6.7 |
| Protein-calorie malnutrition (CC 21) | 3.2 | 2.8 | 3.6 | -0.8 |
| Disorders of fluid/electrolyte/acid-base (CC 23 – 24) | 29.7 | 27.7 | 31.8 | -4.2 |
| Obesity/disorders of thyroid, cholesterol, lipids (CC 22, 25 – 26) | 97.3 | 96.8 | 97.7 | -0.9 |
| Severe hematological disorders (CC 46) | 0.5 | 0.4 | 0.5 | 0.0 |
| Dementia or senility (CC 51 – 53) | 6.4 | 5.3 | 7.6 | -2.3 |

| Variable (% unless otherwise indicated) | MA + FFS (N= 71,873) | FFS (N= 36,121) | MA (N= 35,752) | FFS - MA |
|---|---|---|---|---|
| Major psychiatric disorders (CC 57 – 59) | 8.3 | 5.2 | 11.4 | -6.2 |
| Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190) | 4.6 | 3.8 | 5.5 | -1.7 |
| Polyneuropathy (CC 75, 81) | 18.5 | 16.6 | 20.3 | -3.7 |
| Congestive heart failure (CC 85) | 43.1 | 40.0 | 46.2 | -6.2 |
| Arrhythmias (CC 96 – 97) | 51.9 | 51.5 | 52.2 | -0.6 |
| Stroke (CC 99 – 100) | 5.2 | 4.5 | 5.8 | -1.3 |
| Cerebrovascular disease (CC 101 – 102, 105) | 41.0 | 39.4 | 42.5 | -3.1 |
| Vascular or circulatory disease (CC 106 – 109) | 49.9 | 44.2 | 55.6 | -11.4 |
| Fibrosis of lung and other chronic lung disorders (CC 112) | 5.4 | 4.5 | 6.2 | -1.7 |
| Pneumonia (CC 114 – 116) | 11.9 | 10.2 | 13.6 | -3.4 |
| Other lung disorders (CC 118) | 40.0 | 38.1 | 41.9 | -3.8 |
| End-stage renal disease or dialysis (CC 134) | 2.3 | 2.3 | 2.3 | 0.0 |
| Renal failure (CC 135 – 140) | 37.7 | 34.7 | 40.7 | -6.0 |
| Decubitus ulcer or chronic skin ulcer (CC 157 – 161) | 3.6 | 3.4 | 3.8 | -0.4 |
| History of COVID-19 | 16.7 | 16.6 | 16.7 | -0.1 |

**Table 4.5.3: Frequency of ICD-10-Based Risk Variables in the CABG Cohort, FFS versus MA Admissions, and Adjusted OR and 95% Confidence Intervals for the CABG Hierarchical Logistic Regression Model Using FFS+MA Admissions, CY 2022**

| Variable | Description | MA + FFS (%) (N=71,873) | FFS (%) (N=36,121) | MA (%) (N=35,752) | FFS − MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| AGE | Age, mean (SD) | 73.3 (5.2) | 73.5 (5.2) | 73.1 (5.1) | 0.4 | 1.02 (1.02, 1.03) |
| ICD-10 codes during the index admission | | | | | | |
| E8339 | Other disorders of phosphorus metabolism | 1.0 | 0.9 | 1.0 | -0.1 | 1.46 (1.19, 1.79) |
| I10 | Essential (primary) hypertension | 47.0 | 48.2 | 45.8 | 2.4 | 0.87 (0.82, 0.92) |
| I161 | Hypertensive emergency | 1.2 | 1.0 | 1.3 | -0.3 | 1.35 (1.12, 1.63) |
| I2109 | ST elevation (STEMI) myocardial infarction involving other coronary artery of anterior wall | 0.7 | 0.8 | 0.7 | 0.0 | 1.45 (1.13, 1.85) |
| I313 | Pericardial effusion (noninflammatory) | 0.6 | 0.6 | 0.7 | -0.1 | 1.38 (1.06, 1.79) |
| I319 | Disease of pericardium, unspecified | 0.6 | 0.5 | 0.6 | -0.1 | 1.39 (1.05, 1.85) |
| J189 | Pneumonia, unspecified organism | 1.2 | 1.0 | 1.3 | -0.3 | 1.33 (1.11, 1.59) |
| J441 | Chronic obstructive pulmonary disease with (acute) exacerbation | 0.6 | 0.5 | 0.7 | -0.2 | 1.43 (1.11, 1.84) |
| J449 | Chronic obstructive pulmonary disease, unspecified | 11.4 | 10.6 | 12.1 | -1.6 | 1.13 (1.04, 1.23) |
| K5900 | Constipation, unspecified | 2.6 | 2.6 | 2.7 | -0.1 | 1.15 (1.00, 1.33) |
| M1990 | Unspecified osteoarthritis, unspecified site | 8.2 | 8.6 | 7.9 | 0.6 | 0.84 (0.76, 0.93) |
| N170 | Acute kidney failure with tubular necrosis | 1.1 | 1.1 | 1.2 | -0.1 | 1.27 (1.05, 1.53) |
| N179 | Acute kidney failure, unspecified | 7.9 | 7.2 | 8.6 | -1.5 | 1.17 (1.08, 1.27) |
| Z6842 | Body mass index [BMI] 45.0 − 49.9, adult | 0.9 | 0.8 | 0.9 | 0.0 | 1.33 (1.06, 1.67) |
| Z7901 | Long term (current) use of anticoagulants | 9.3 | 9.7 | 8.8 | 0.9 | 1.36 (1.26, 1.47) |
| Z7982 | Long term (current) use of aspirin | 48.1 | 48.8 | 47.4 | 1.4 | 0.83 (0.78, 0.87) |
| Z79899 | Other long term (current) drug therapy | 32.8 | 33.4 | 32.1 | 1.3 | 0.88 (0.83, 0.94) |
| Z87891 | Personal history of nicotine dependence | 33.6 | 34.6 | 32.6 | 2.0 | 0.92 (0.87, 0.97) |
| Z9114 | Patient's other noncompliance with medication regimen | 0.7 | 0.6 | 0.8 | -0.2 | 1.51 (1.18, 1.93) |
| ICD-10 codes in the 12 months prior to admission | | | | | | |
| D649 | Anemia, unspecified | 12.5 | 10.8 | 14.2 | -3.3 | 1.21 (1.13, 1.30) |

| Variable | Description | MA + FFS (%) (N=71,873) | FFS (%) (N=36,121) | MA (%) (N=35,752) | FFS − MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| E1140 | Type 2 diabetes mellitus with diabetic neuropathy, unspecified | 7.3 | 5.6 | 9.0 | -3.4 | 1.21 (1.11, 1.32) |
| E1169 | Type 2 diabetes mellitus with other specified complication | 8.5 | 4.5 | 12.6 | -8.1 | 1.08 (0.99, 1.18) |
| E860 | Dehydration | 3.4 | 3.2 | 3.6 | -0.4 | 1.27 (1.13, 1.42) |
| I081 | Rheumatic disorders of both mitral and tricuspid valves | 3.5 | 3.4 | 3.5 | 0.0 | 1.16 (1.02, 1.31) |
| I160 | Hypertensive urgency | 3.1 | 2.4 | 3.9 | -1.4 | 1.26 (1.12, 1.43) |
| I739 | Peripheral vascular disease, unspecified | 14.2 | 11.1 | 17.2 | -6.1 | 1.10 (1.03, 1.18) |
| I959 | Hypotension, unspecified | 3.7 | 3.0 | 4.3 | -1.3 | 1.22 (1.09, 1.36) |
| J449 | Chronic obstructive pulmonary disease, unspecified | 13.4 | 10.7 | 16.2 | -5.5 | 1.22 (1.13, 1.32) |
| N289 | Disorder of kidney and ureter, unspecified | 3.1 | 2.7 | 3.6 | -0.9 | 0.91 (0.80, 1.04) |
| R059 | Cough, unspecified | 9.2 | 8.0 | 10.4 | -2.5 | 1.15 (1.06, 1.24) |
| R0602 | Shortness of breath | 37.8 | 34.3 | 41.3 | -7.1 | 1.12 (1.06, 1.18) |
| R109 | Unspecified abdominal pain | 7.6 | 6.5 | 8.7 | -2.2 | 1.24 (1.14, 1.35) |
| R300 | Dysuria | 3.0 | 2.9 | 3.1 | -0.2 | 0.95 (0.83, 1.09) |
| Z0000 | Encounter for general adult medical examination without abnormal findings | 24.8 | 18.2 | 31.6 | -13.4 | 0.91 (0.86, 0.97) |
| Z125 | Encounter for screening for malignant neoplasm of prostate | 10.7 | 10.5 | 10.8 | -0.3 | 0.92 (0.84, 1.01) |
| ICD-10 codes either during the index admission or 12 months prior to admission | | | | | | |
| E1151 | Type 2 diabetes mellitus with diabetic peripheral angiopathy without gangrene | 12.0 | 9.5 | 14.4 | -4.9 | 1.17 (1.09, 1.26) |
| E1165 | Type 2 diabetes mellitus with hyperglycemia | 26.6 | 23.7 | 29.5 | -5.8 | 1.10 (1.03, 1.16) |
| E6601 | Morbid (severe) obesity due to excess calories | 11.2 | 9.3 | 13.1 | -3.8 | 1.17 (1.08, 1.28) |
| E871 | Hypo-osmolality and hyponatremia | 8.1 | 7.7 | 8.5 | -0.8 | 1.21 (1.11, 1.31) |

| Variable | Description | MA + FFS (%) (N=71,873) | FFS (%) (N=36,121) | MA (%) (N=35,752) | FFS – MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| I130 | Hypertensive heart and chronic kidney disease with heart failure and stage 1 through stage 4 chronic kidney disease, or unspecified chronic kidney disease | 12.3 | 10.9 | 13.7 | -2.8 | 1.31 (1.21, 1.40) |
| I25118 | Atherosclerotic heart disease of native coronary artery with other forms of angina pectoris | 31.9 | 31.9 | 31.9 | 0.0 | 0.89 (0.84, 0.94) |
| Z6841 | Body mass index [BMI] 40.0 – 44.9, adult | 4.8 | 4.1 | 5.4 | -1.2 | 1.26 (1.12, 1.42) |
| Other risk variables | | | | | | |
| MCCFI | Multiple Chronic Conditions Frailty Index | 7.2 | 6.4 | 8.0 | -1.6 | 1.19 (1.09, 1.29) |
| MALE | Male | 74.3 | 75.7 | 72.8 | 2.9 | 0.78 (0.74, 0.83) |
| HX_SHOCK | Cardiogenic Shock | 7.8 | 7.7 | 8.0 | -0.3 | 1.22 (1.12, 1.32) |
| HX_COVID | History of COVID-19 | 16.7 | 16.6 | 16.7 | -0.1 | 0.98 (0.91, 1.05) |
| MA | MA (versus FFS) | 49.7 | NA | NA | NA | 0.97 (0.92, 1.02) |

*CABG Model Performance*

Table 4.5.4 presents model performance for the CABG measure across three scenarios: the FFS-only cohort with CC-based risk variables, the FFS+MA cohort with CC-based risk variables, and the FFS+MA cohort with ICD-10-based risk variables. Predictive ability and c-statistics were similar between the FFS-only and FFS+MA cohorts using the original CC-based variables. For the MA+FFS cohort, the model using reselected ICD-10-based risk variables had a slightly higher c-statistic compared to the original CC-based model and slightly wider predictive ability. Calibration performance was generally acceptable across all modeling approaches in the overall cohort and in subgroups, including male versus female, MA versus FFS, and quartiles of hospital volume (figures not shown).

**Table 4.5.4: CABG Readmission: Predictive Ability and C-Statistics Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Predictive Ability, % (lowest decile – highest decile) | 4.5 – 19.4 | 4.6 – 20.9 | 4.9 – 22.1 |
| c-statistic | 0.62 | 0.63 | 0.65 |

Note: These statistics were calculated using the patient-level logistic model.

*Risk-Standardized Readmission Rates for CABG*

Tables 4.5.5 and 4.5.6 present distribution of hospital volume, SRR, and RSRR for all hospitals (Table 4.5.5) and for hospitals with 25 or more eligible admissions (Table 4.5.6). Numbers of hospitals and admissions were higher in the combined FFS+MA data compared to the FFS-only data. With the addition of MA data, 34 additional hospitals were included in the measure (1,070 versus 1,036) and 302 additional hospitals met the 25 or more admissions cutoff for public reporting (851 versus 549). For all hospitals, the mean RSRR was 9.8% for the FFS-only cohort with CC-based risk variables, 10.1% for the FFS+MA cohort with CC-based risk variables, and 10.1% for the FFS+MA cohort with reselected ICD-10-based risk variables. Among hospitals with 25 or more admissions, mean RSRRs were 9.8%, 10.1%, and 10.1%, respectively.

**Table 4.5.5: CABG Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for All Hospitals**

| Value | FFS-Only cohort with CC-based risk variables (N= 1,036 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 1,070 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 1,070 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| **Hospital Volume** | 34.9 (32.2) | 26 (14, 45) | 67.2 (57.7) | 52 (28, 90) | 67.2 (57.7) | 52 (28, 90) |
| **SRR** | 1.00 (0.08) | 0.99 (0.95, 1.04) | 1.00 (0.10) | 0.99 (0.94, 1.06) | 1.00 (0.10) | 1.00 (0.94, 1.05) |
| **RSRR (%)** | 9.8 (0.8) | 9.7 (9.3, 10.2) | 10.1 (1.0) | 10.0 (9.5, 10.7) | 10.1 (1.0) | 10.1 (9.5, 10.6) |

**Table 4.5.6: CABG Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-Only cohort with CC-based risk variables (N= 549 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 851 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 851 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| Hospital Volume | 54.6 (32.9) | 43 (33, 64) | 81.5 (56.3) | 65 (42, 103) | 81.5 (56.3) | 65 (42, 103) |
| SRR | 1.00 (0.10) | 0.99 (0.93, 1.06) | 1.00 (0.11) | 0.99 (0.93, 1.06) | 1.00 (0.10) | 0.99 (0.93, 1.06) |
| RSRR (%) | 9.8 (1.0) | 9.6 (9.1, 10.3) | 10.1 (1.1) | 10.0 (9.4, 10.7) | 10.1 (1.1) | 10.0 (9.4, 10.7) |

*Measure Reliability for CABG*

Between hospital variance and STNR for the measure score comparing the addition of MA admissions to the FFS-only cohort and reselected ICD-10-based variables to the CC-based variables in the FFS+MA cohort are noted in Table 4.5.7. Median STNR, calculated based on between hospital variance and hospital volume, was 0.446 for the FFS-only cohort with CC-based risk variables, 0.524 for the FFS+MA cohort with CC-based risk variables, and 0.519 for the FFS+MA cohort with reselected ICD-10-based risk variables.

**Table 4.5.7: CABG Readmission: Between Hospital Variance and Signal-to-Noise Reliability (STNR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Number of Hospitals | 549 | 851 | 851 |
| Between Hospital Variance | 0.062 | 0.056 | 0.055 |
| STNR: Median (Q1, Q3) | 0.446 (0.382, 0.545) | 0.524 (0.416, 0.636) | 0.519 (0.411, 0.631) |

*Change in Hospital Performance for CABG*

Table 4.5.8 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the CABG measure in the combined FFS+MA cohort as compared to the FFS-only cohort in hospitals for the model with the original CC-based variables. After adding MA admissions to the FFS-only cohort, about half (47.0%) of hospitals remained in the same performance quintile, and 86.7% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.81. As hospitals' proportion of MA admissions increased, fewer hospitals remained in the same performance quintile (58.7% among hospitals in the lowest quintile of percent MA admissions; 45.5% of hospitals in the highest quintile of percent of MA admissions). As hospital volume increased, there was not a notable trend in RSRR shifts.

Table 4.5.9 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the CABG measure after both measure updates, comparing the combined FFS+MA cohort using the reselected ICD-10-based risk variables to the FFS-only cohort using the CC-based variables. With the addition of the MA admissions and the ICD-10-based risk variables, 47.0% of hospitals remained in the same performance quintile and 86.0% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.81. Stratified by proportion of MA admissions in a hospital, 59.6% of hospitals in the lowest quintile of percent MA admissions remained in the same performance quintile versus 48.2% in the highest quintile.

**Table 4.5.8: Shifts in RSRR Hospital Performance Quintile Rankings for CABG, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-Only Cohort to the FFS+MA Cohort, CC-Based Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| Overall | 47.0 | 86.7 | 0.81 |
| By Percent of MA Admissions | | | |
| Q1: 0.0% − 32.6% | 58.7 | 95.4 | 0.93 |
| Q2: 32.7% − 41.1% | 46.4 | 90.0 | 0.82 |
| Q3: 41.3% − 49.5% | 43.6 | 83.6 | 0.77 |
| Q4: 49.5 − 56.9% | 40.9 | 81.8 | 0.81 |
| Q5: 57.0% − 84.5% | 45.5 | 82.7 | 0.74 |
| By MA+FFS Admission Volume | | | |
| Q1: 27 − 59 admissions | 50.0 | 94.5 | 0.82 |
| Q2: 60 − 77 admissions | 50.0 | 88.9 | 0.79 |
| Q3: 78 − 100 admissions | 38.1 | 79.6 | 0.75 |
| Q4: 101 − 134 admissions | 46.8 | 83.5 | 0.82 |
| Q5: 136 − 491 admissions | 50.5 | 87.2 | 0.85 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions.
Total N=549, representing hospitals with 25 or more FFS admissions

**Table 4.5.9: Shifts in RSRR Hospital Performance Quintile Rankings for CABG, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-only Cohort with CC-Based Variables to the FFS+MA Cohort with Reselected ICD-10-Based Risk Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| Overall | 47.0 | 86.0 | 0.81 |
| By Percent of MA Admissions | | | |
| Q1: 0.0% − 32.6% | 59.6 | 95.4 | 0.92 |
| Q2: 32.7% − 41.1% | 45.5 | 88.2 | 0.82 |
| Q3: 41.3% − 49.5% | 41.8 | 85.5 | 0.76 |
| Q4: 49.5% − 56.9% | 40.0 | 80.9 | 0.80 |
| Q5: 57.0% − 84.5% | 48.2 | 80.0 | 0.75 |
| By MA+FFS Admission Volume | | | |
| Q1: 27 − 59 admissions | 51.8 | 95.5 | 0.82 |
| Q2: 60 − 77 admissions | 43.5 | 89.8 | 0.78 |
| Q3: 78 − 100 admissions | 40.7 | 78.8 | 0.75 |
| Q4: 101 − 134 admissions | 45.0 | 81.7 | 0.83 |
| Q5: 136 − 491 admissions | 54.1 | 84.4 | 0.85 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions and with reselected ICD-10-based risk variables.

Total N=549, representing hospitals with 25 or more FFS admissions

### 4.6. Elective Primary Total Hip Arthroplasty (THA) and/or Total Knee Arthroplasty (TKA) Readmission Results

*THA/TKA Admission Volume and Observed Readmission Rate*

As presented in Table 4.6.1, the FFS+MA cohort included 170,841 unique admissions from January 1 – December 30, 2022 (106,894 FFS and 63,947 MA). The observed (unadjusted) readmission rate for the FFS+MA cohort for THA/TKA was 4.7%. The observed readmission rate was 4.5% among FFS beneficiaries compared to 5.0% among MA beneficiaries (difference -0.5%).

**Table 4.6.1: Number of Admissions and Observed Readmission Rate for THA/TKA, FFS versus MA Admissions, CY 2022**

| THA/TKA | MA + FFS | FFS | MA | Difference FFS – MA |
|---|---|---|---|---|
| N | 170,841 | 106,894 | 63,947 | NA |
| Readmission Rate (%) | 4.7 | 4.5 | 5.0 | -0.5 |

*Frequency of THA/TKA Risk Variables*

We examined the frequencies of variables used for risk adjustment in FFS and MA admissions. The variables from the original CC-based risk model are presented in Table 4.6.2, and the reselected ICD-10-based variables in Table 4.6.3. Frequencies of model variables were generally higher in MA than FFS admissions for both the CC- and ICD-10-based variables. The median difference in risk variable prevalence between FFS and MA (%FFS – %MA) was -1.6% for CC-based variables with a range from -12.2% to 1.8%. There was less of a difference overall in risk variable prevalence between FFS and MA for ICD-10-based variables with a median difference of -0.8% (range from -7.8% to 1.5%), however, for ICD-10 codes in the 12 months prior to admission (pre-index codes), the differences were more pronounced. Table 4.6.3 also presents adjusted OR and 95% confidence intervals for the hierarchical logistic regression model using FFS+MA admissions.

**Table 4.6.2: Frequency of CC-Based Risk Variables in the THA/TKA Cohort, FFS versus MA Admissions, CY 2022**

| Variable (% unless otherwise indicated) | MA + FFS (N= 170,841) | FFS (N= 106,894) | MA (N= 63,947) | FFS - MA |
|---|---|---|---|---|
| Age, mean (SD) | 75.1 (6.3) | 75.3 (6.3) | 74.9 (6.3) | 0.4 |
| Male | 34.0 | 34.7 | 32.9 | 1.8 |
| Elective THA procedure | 43.7 | 20.4 | 45.3 | -2.6 |
| Number of procedures (two vs. one) | 1.8 | 29.4 | 1.9 | -0.1 |
| Morbid (severe) obesity (CC 22) | 14.6 | 1.9 | 18.7 | -6.6 |
| Severe infection; other infectious diseases (CC 1, 3 – 7) | 20.8 | 21.4 | 21.9 | -1.8 |
| Metastatic cancer or acute leukemia (CC 8) | 1.4 | 20.4 | 1.4 | 0.0 |
| Cancer (CC 9 – 14) | 20.2 | 20.4 | 20.0 | 0.4 |
| Diabetes mellitus (DM) or DM complications (CC 17 – 19, 122 – 123) | 32.4 | 29.4 | 37.5 | -8.1 |
| Protein-calorie malnutrition (CC 21) | 2.2 | 1.9 | 2.8 | -0.8 |

| Variable (% unless otherwise indicated) | MA + FFS (N= 170,841) | FFS (N= 106,894) | MA (N= 63,947) | FFS - MA |
|---|---|---|---|---|
| Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23 – 24) | 22.5 | 21.4 | 24.3 | -2.9 |
| Rheumatoid arthritis and inflammatory connective tissue disease (CC 40) | 12.9 | 11.8 | 14.7 | -2.9 |
| Severe hematological disorders (CC 46) | 0.6 | 0.5 | 0.7 | -0.2 |
| Dementia or other specified brain disorders (CC 51 – 53) | 8.7 | 7.6 | 10.5 | -2.9 |
| Major psychiatric disorders (CC 57 – 59) | 13.0 | 9.4 | 19.1 | -9.7 |
| Hemiplegia, paraplegia, paralysis, functional disability (CC 70 – 74, 103 – 104, 189 – 190) | 3.2 | 2.7 | 4.1 | -1.4 |
| Polyneuropathy; other neuropathies (CC 75, 81) | 23.9 | 22.6 | 26.0 | -3.4 |
| Congestive heart failure (CC 85) | 17.3 | 15.3 | 20.5 | -5.2 |
| Coronary atherosclerosis or angina (CC 88 – 89) | 28.3 | 27.9 | 29.0 | -1.1 |
| Hypertension and hypertensive disease (CC 95) | 80.7 | 78.9 | 83.6 | -4.7 |
| Specified arrhythmias and other heart rhythm disorders (CC 96 – 97) | 33.5 | 33.6 | 33.3 | 0.3 |
| Stroke (CC 99 – 100) | 3.3 | 3.0 | 3.7 | -0.7 |
| Vascular or circulatory disease (CC 106 – 109) | 34.8 | 30.2 | 42.4 | -12.2 |
| Chronic obstructive pulmonary disease (COPD) (CC 111) | 15.1 | 13.1 | 18.6 | -5.5 |
| Pneumonia (CC 114 – 116) | 4.9 | 4.6 | 5.5 | -0.9 |
| Dialysis status (CC 134) | 0.5 | 0.4 | 0.5 | -0.1 |
| Renal failure (CC 135 – 140) | 25.1 | 22.4 | 29.7 | -7.3 |
| Decubitus ulcer or chronic skin ulcer (CC 157 – 161) | 3.5 | 3.4 | 3.7 | -0.3 |
| Cellulitis, local skin infection (CC 164) | 7.3 | 7.3 | 7.5 | -0.2 |
| Other injuries (CC 174) | 31.7 | 29.9 | 34.7 | -4.8 |
| Major symptoms, abnormalities (CC 178) | 76.0 | 73.2 | 80.7 | -7.5 |
| Skeletal deformities (ICD-9 code 755.63, ICD-10 code Q65.89, Q65.9 – CC 204) | 3.4 | 1.1 | 7.2 | -6.1 |
| Post traumatic osteoarthritis (ICD-9 codes 716.15, 716.16, ICD-10 code M12.551, M12.552, M12.559 – CC 205) | 1.8 | 1.7 | 1.9 | -0.2 |
| History of COVID-19 | 13.7 | 14.1 | 12.9 | 1.2 |

**Table 4.6.3: Frequency of ICD-10-Based Risk Variables in the THA/TKA Cohort, FFS versus MA Admissions, and Adjusted OR and 95% Confidence Intervals for the THA/TKA Hierarchical Logistic Regression Model Using FFS+MA Admissions, CY 2022**

| Variable | Description | MA + FFS (%) (N=170,841) | FFS (%) (N=106,894) | MA (%) (N=63,947) | FFS - MA (%) | FFS + MA OR (95% CI) |
|----------|-------------|--------------------------|---------------------|-------------------|--------------|----------------------|
| AGE | Age, mean (SD) | 75.1 (6.3) | 75.3 (6.3) | 74.9 (6.3) | 0.4 | 1.03 (1.03, 1.04) |
| ICD-10 codes during the index admission | | | | | | |
| E7800 | Pure hypercholesterolemia, unspecified | 13.4 | 14.0 | 12.5 | 1.5 | 0.90 (0.83, 0.96) |
| F0390 | Unspecified dementia without behavioral disturbance | 1.7 | 1.6 | 1.8 | -0.2 | 1.35 (1.18, 1.54) |
| F17210 | Nicotine dependence, cigarettes, uncomplicated | 3.3 | 2.7 | 4.2 | -1.4 | 1.15 (1.01, 1.31) |
| F319 | Bipolar disorder, unspecified | 0.9 | 0.8 | 1.0 | -0.2 | 1.58 (1.30, 1.92) |
| G20 | Parkinson's disease | 1.3 | 1.4 | 1.2 | 0.2 | 1.44 (1.23, 1.69) |
| G40909 | Epilepsy, unspecified, not intractable, without status epilepticus | 1.0 | 0.9 | 1.1 | -0.1 | 1.33 (1.10, 1.60) |
| H3530 | Unspecified macular degeneration | 0.7 | 0.8 | 0.6 | 0.2 | 1.23 (0.99, 1.54) |
| I110 | Hypertensive heart disease with heart failure | 4.2 | 4.0 | 4.4 | -0.3 | 1.30 (1.18, 1.44) |
| I509 | Heart failure, unspecified | 2.1 | 2.1 | 2.2 | -0.1 | 0.98 (0.85, 1.12) |
| M25761 | Osteophyte, right knee | 1.8 | 1.9 | 1.5 | 0.4 | 0.71 (0.56, 0.89) |
| N179 | Acute kidney failure, unspecified | 2.5 | 2.2 | 3.0 | -0.8 | 1.83 (1.65, 2.02) |
| R338 | Other retention of urine | 0.8 | 0.8 | 0.8 | 0.0 | 1.26 (1.03, 1.54) |
| R339 | Retention of urine, unspecified | 0.8 | 0.8 | 0.8 | 0.0 | 1.46 (1.21, 1.78) |
| Z6842 | Body mass index [BMI] 45.0 – 49.9, adult | 1.3 | 1.2 | 1.4 | -0.1 | 1.39 (1.16, 1.66) |
| Z955 | Presence of coronary angioplasty implant and graft | 5.5 | 5.7 | 5.1 | 0.6 | 1.19 (1.09, 1.30) |
| Z9981 | Dependence on supplemental oxygen | 0.8 | 0.8 | 0.9 | -0.1 | 1.26 (1.05, 1.51) |
| ICD-10 codes in the 12 months prior to admission | | | | | | |
| D649 | Anemia, unspecified | 13.6 | 12.7 | 15.2 | -2.5 | 1.22 (1.15, 1.29) |
| E875 | Hyperkalemia | 2.6 | 2.4 | 3.0 | -0.6 | 1.47 (1.32, 1.64) |
| F17210 | Nicotine dependence, cigarettes, uncomplicated | 3.6 | 2.9 | 4.7 | -1.8 | 1.18 (1.04, 1.33) |
| F331 | Major depressive disorder, recurrent, moderate | 3.2 | 2.4 | 4.4 | -2.0 | 1.19 (1.06, 1.33) |
| H2513 | Age-related nuclear cataract, bilateral | 10.2 | 9.6 | 11.2 | -1.6 | 0.88 (0.80, 0.95) |

| Variable | Description | MA + FFS (%) (N=170,841) | FFS (%) (N=106,894) | MA (%) (N=63,947) | FFS - MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| H5203 | Hypermetropia, bilateral | 2.9 | 1.8 | 4.6 | -2.8 | 0.84 (0.72, 0.98) |
| I10 | Essential (primary) hypertension | 74.6 | 71.7 | 79.5 | -7.8 | 1.18 (1.11, 1.25) |
| M25552 | Pain in left hip | 18.5 | 17.4 | 20.3 | -2.8 | 0.95 (0.89, 1.01) |
| M542 | Cervicalgia | 7.4 | 6.6 | 8.8 | -2.2 | 1.02 (0.94, 1.11) |
| M545 | Low back pain | 8.5 | 7.7 | 9.8 | -2.1 | 0.95 (0.88, 1.03) |
| M549 | Dorsalgia, unspecified | 5.1 | 4.5 | 6.0 | -1.5 | 1.24 (1.14, 1.36) |
| M79605 | Pain in left leg | 4.9 | 4.3 | 5.8 | -1.5 | 1.16 (1.06, 1.27) |
| N390 | Urinary tract infection, site not specified | 11.6 | 11.2 | 12.2 | -1.0 | 1.13 (1.06, 1.21) |
| R000 | Tachycardia, unspecified | 3.3 | 3.0 | 3.9 | -0.9 | 1.23 (1.11, 1.36) |
| R001 | Bradycardia, unspecified | 6.4 | 6.2 | 6.8 | -0.6 | 0.97 (0.89, 1.05) |
| S0990XA | Unspecified injury of head, initial encounter | 5.0 | 4.6 | 5.6 | -1.1 | 1.28 (1.18, 1.39) |
| Z1231 | Encounter for screening mammogram for malignant neoplasm of breast | 29.9 | 30.2 | 29.4 | 0.8 | 0.79 (0.75, 0.83) |
| Z885 | Allergy status to narcotic agent | 4.1 | 4.3 | 3.6 | 0.7 | 1.23 (1.12, 1.36) |
| ICD-10 codes either during the index admission or 12 months prior to admission | | | | | | |
| D696 | Thrombocytopenia, unspecified | 3.4 | 3.1 | 4.0 | -0.9 | 1.25 (1.13, 1.39) |
| E6601 | Morbid (severe) obesity due to excess calories | 13.1 | 10.7 | 17.0 | -6.2 | 1.21 (1.13, 1.30) |
| E871 | Hypo-osmolality and hyponatremia | 7.5 | 7.4 | 7.6 | -0.2 | 1.28 (1.19, 1.38) |
| G2581 | Restless legs syndrome | 3.9 | 3.9 | 3.9 | 0.0 | 1.19 (1.07, 1.31) |
| I480 | Paroxysmal atrial fibrillation | 11.5 | 11.8 | 11.1 | 0.6 | 1.32 (1.24, 1.40) |
| I739 | Peripheral vascular disease, unspecified | 8.5 | 6.4 | 12.0 | -5.5 | 1.25 (1.16, 1.34) |
| J449 | Chronic obstructive pulmonary disease, unspecified | 13.1 | 11.3 | 16.1 | -4.8 | 1.37 (1.29, 1.46) |
| M069 | Rheumatoid arthritis, unspecified | 5.0 | 4.6 | 5.6 | -1.0 | 1.24 (1.13, 1.36) |
| Z20822 | Contact with and (suspected) exposure to COVID-19 | 56.9 | 56.1 | 58.1 | -2.0 | 1.12 (1.06, 1.18) |
| Other risk variables | | | | | | |
| MCCFI | Multiple Chronic Conditions Frailty Index | 56.9 | 21.2 | 24.7 | -3.5 | 1.16 (1.10, 1.22) |
| PROC_THA | Elective THA procedure | 43.7 | 42.7 | 45.3 | -2.6 | 1.15 (1.09, 1.21) |

| Variable | Description | MA + FFS (%) (N=170,841) | FFS (%) (N=106,894) | MA (%) (N=63,947) | FFS - MA (%) | FFS + MA OR (95% CI) |
|---|---|---|---|---|---|---|
| HX_COVID | History of COVID-19 | 13.7 | 14.1 | 12.9 | 1.2 | 1.00 (0.94, 1.07) |
| MA | MA (versus FFS) | 37.4 | NA | NA | NA | 1.00 (0.95, 1.04) |

*THA/TKA Model Performance*

Table 4.6.4 presents model performance for the THA/TKA measure across three scenarios: the FFS-only cohort with CC-based risk variables, the FFS+MA cohort with CC-based risk variables, and the FFS+MA cohort with ICD-10-based risk variables. Predictive ability and c-statistics were similar between the FFS-only and FFS+MA cohorts using the original CC-based variables. For the MA+FFS cohort, the model using reselected ICD-10-based risk variables also had a similar c-statistic and predictive ability compared to the original CC-based model. Calibration performance was generally acceptable across all modeling approaches in the overall cohort and in subgroups, including male versus female, MA versus FFS, and quartiles of hospital volume (figures not shown).

**Table 4.6.4: THA/TKA Readmission: Predictive Ability and C-Statistics Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Predictive Ability, % (lowest decile – highest decile) | 1.4 – 11.2 | 1.3 – 11.9 | 1.5 – 11.7 |
| c-statistic | 0.68 | 0.68 | 0.67 |

Note: These statistics were calculated using the patient-level logistic model.

*Risk-Standardized Readmission Rates for THA/TKA*

Tables 4.6.5 and 4.6.6 present distribution of hospital volume, SRR, and RSRR for all hospitals (Table 4.6.5) and for hospitals with 25 or more eligible admissions (Table 4.6.6). Numbers of hospitals and admissions were higher in the combined FFS+MA data compared to the FFS-only data. With the addition of MA data, 149 additional hospitals were included in the measure (3,116 versus 2,967) and 461 additional hospitals met the 25 or more admissions cutoff for public reporting (1,483 versus 1,022). For all hospitals, the mean RSRR was 4.5% for the FFS-only cohort with CC-based risk variables, 4.7% for the FFS+MA cohort with CC-based risk variables, and 4.7% for the FFS+MA cohort with reselected ICD-10-based risk variables. Among hospitals with 25 or more admissions, mean RSRRs were 4.5%, 4.7%, and 4.7%, respectively.

**Table 4.6.5: THA/TKA Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for All Hospitals**

| Value | FFS-Only cohort with CC-based risk variables (N= 2,967 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 3,116 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 3,116 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| **Hospital Volume** | 36.0 (89.4) | 14 (5, 36) | 54.8 (113.4) | 23 (8, 58) | 54.8 (113.4) | 23 (8, 58) |
| **SRR** | 1.00 (0.10) | 0.99 (0.95, 1.05) | 1.00 (0.09) | 0.99 (0.96, 1.05) | 1.00 (0.09) | 0.99 (0.96, 1.04) |
| **RSRR (%)** | 4.5 (0.5) | 4.5 (4.3, 4.8) | 4.7 (0.4) | 4.7 (4.5, 4.9) | 4.7 (0.4) | 4.7 (4.5, 4.9) |

**Table 4.6.6: THA/TKA Readmission: Hospital Volume, Standardized Readmission Ratio (SRR), and Risk-Standardized Readmission Rate (RSRR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-Only cohort with CC-based risk variables (N= 1,022 hospitals) | | FFS+MA cohort with CC-based risk variables (N= 1,483 hospitals) | | FFS+MA cohort with ICD-10-based risk variables (N= 1,483 hospitals) | |
|---|---|---|---|---|---|---|
| | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) | Mean (SD) | Median (25% Q1, 75% Q3) |
| Hospital Volume | 88.4 (137.7) | 54 (34, 93) | 104.5 (149.2) | 61 (39, 113) | 104.5 (149.2) | 61 (39, 113) |
| SRR | 1.00 (0.15) | 0.98 (0.90, 1.07) | 1.00 (0.12) | 0.99 (0.92, 1.06) | 1.00 (0.12) | 0.99 (0.93, 1.06) |
| RSRR (%) | 4.5 (0.7) | 4.4 (4.1, 4.8) | 4.7 (0.6) | 4.6 (4.4, 5.0) | 4.7 (0.5) | 4.7 (4.4, 5.0) |

*Measure Reliability for THA/TKA*

Between hospital variance and STNR for the measure score comparing the addition of MA admissions to the FFS-only cohort and reselected ICD-10-based variables to the CC-based variables in the FFS+MA cohort are noted in Table 4.6.7. Median STNR, calculated based on between hospital variance and hospital volume, was 0.637 for the FFS-only cohort with CC-based risk variables, 0.580 for the FFS+MA cohort with CC-based risk variables, and 0.570 for the FFS+MA cohort with reselected ICD-10-based risk variables.

**Table 4.6.7: THA/TKA Readmission: Between Hospital Variance and Signal-to-Noise Reliability (STNR) Comparing FFS-only and FFS+MA Cohorts with CC-Based and ICD-10-Based Risk Variables, CY 2022, for Hospitals with 25 or More Admissions**

| Value | FFS-only cohort with CC-based risk variables | FFS+MA cohort with CC-based risk variables | FFS+MA cohort with ICD-10-based risk variables |
|---|---|---|---|
| Number of Hospitals | 1,022 | 1,483 | 1,483 |
| Between Hospital Variance | 0.107 | 0.075 | 0.072 |
| STNR: Median (Q1, Q3) | 0.637 (0.524, 0.751) | 0.580 (0.469, 0.719) | 0.570 (0.459, 0.711) |

*Change in Hospital Performance for THA/TKA*

Table 4.6.8 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the THA/TKA measure in the combined FFS+MA cohort as compared to the FFS-only cohort in hospitals for the model with the original CC-based variables. After adding MA admissions to the FFS-only cohort, about half (52.3%) of hospitals remained in the same performance quintile, and 89.8% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.83. As hospitals' proportion of MA admissions increased, fewer hospitals remained in the same performance quintile (73.0% among hospitals in the lowest quintile of percent MA admissions; 36.8% of hospitals in the highest quintile of percent of MA admissions). As hospital volume increased, the trend in RSRR shifts was less pronounced.

Table 4.6.9 shows the quintile shifts in RSRR across hospitals with at least 25 FFS admissions for the THA/TKA measure after both measure updates, comparing the combined FFS+MA cohort using the reselected ICD-10-based risk variables to the FFS-only cohort using the CC-based variables. With the addition of the MA admissions and the ICD-10-based risk variables, 52.5% of hospitals remained in the same performance quintile and 89.1% remained within +/- 1 quintile. Correlation between hospital RSRRs was 0.82. Stratified by proportion of MA admissions in a hospital, 73.0% of hospitals in the lowest quintile of percent MA admissions remained in the same performance quintile versus 39.2% in the highest quintile.

**Table 4.6.8: Shifts in RSRR Hospital Performance Quintile Rankings for THA/TKA, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-Only Cohort to the FFS+MA Cohort, CC-Based Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| Overall | 52.3 | 89.8 | 0.83 |
| By Percent of MA Admissions | | | |
| Q1: 0.0% – 15.6% | 73.0 | 99.0 | 0.96 |
| Q2: 15.8% – 26.2% | 56.4 | 93.6 | 0.93 |
| Q3: 26.3% – 35.4% | 45.4 | 90.7 | 0.82 |
| Q4: 35.5% – 46.6% | 49.8 | 87.3 | 0.79 |
| Q5: 46.7% – 88.7% | 36.8 | 78.4 | 0.61 |
| By MA+FFS Admission Volume | | | |
| Q1: 27 – 49 admissions | 58.5 | 96.1 | 0.85 |
| Q2: 50 – 69 admissions | 50.2 | 91.5 | 0.83 |
| Q3: 70 – 100 admissions | 49.8 | 88.6 | 0.79 |
| Q4: 101 – 174 admissions | 49.3 | 86.6 | 0.84 |
| Q5: 175 – 3,662 admissions | 53.4 | 86.3 | 0.81 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions.
Total N=1,022, representing hospitals with 25 or more FFS admissions

**Table 4.6.9: Shifts in RSRR Hospital Performance Quintile Rankings for THA/TKA, Overall and Based on Hospitals' Percentages of MA Admissions and Total Admission Volume, Comparing FFS-only Cohort with CC-Based Variables to the FFS+MA Cohort with Reselected ICD-10-Based Risk Variables, CY 2022**

| Description | Same quintile (%) | ±1 quintile (%) | Correlation |
|---|---|---|---|
| **Overall** | 52.5 | 89.1 | 0.82 |
| **By Percent of MA Admissions** | | | |
| Q1: 0.0% − 15.6% | 73.0 | 99.0 | 0.95 |
| Q2: 15.8% − 26.2% | 57.4 | 94.1 | 0.92 |
| Q3: 26.3% − 35.4% | 45.4 | 89.8 | 0.81 |
| Q4: 35.5% − 46.6% | 47.8 | 85.4 | 0.79 |
| Q5: 46.7% − 88.7% | 39.2 | 77.5 | 0.60 |
| **By MA+FFS Admission Volume** | | | |
| Q1: 27 − 49 admissions | 56.1 | 96.1 | 0.84 |
| Q2: 50 − 69 admissions | 53.2 | 92.0 | 0.83 |
| Q3: 70 − 100 admissions | 48.3 | 88.2 | 0.77 |
| Q4: 101 − 174 admissions | 49.8 | 87.1 | 0.83 |
| Q5: 175 − 3,662 admissions | 55.4 | 82.4 | 0.81 |

Note: Quintile percentages represent the percent of hospitals that stayed in their same (1st column) or within one (2nd column) performance quintile ranking after the addition of MA admissions and with reselected ICD-10-based risk variables.

Total N=1,022, representing hospitals with 25 or more FFS admissions

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