

# **2020 Condition-Specific Excess Days in Acute Care Measures Updates and Specifications Report**

**Acute Myocardial Infarction – Version 5.0**  
**Heart Failure – Version 5.0**  
**Pneumonia – Version 4.0**

**Submitted By:**

Yale New Haven Health Services Corporation – Center for Outcomes Research and Evaluation  
(YNHHSC/CORE)

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## Center for Outcomes Research and Evaluation Project Team

Jo DeBuhr, R.N., B.S.N. – Technical Writer  
Kerry McDowell, M.S., M.Phil. – Annual Updates Team Lead  
Jacqueline N. Grady, M.S. – Reevaluation Analytic Director  
Chandni Vasisht, M.P.H. – Reevaluation Division Project Manager  
Danielle Purvis, M.P.H. – Reevaluation Division Technical Support  
Madeline L. Parisi, B.A. – Research Project Coordinator  
Kristina Gaffney, B.S. – Research Assistant  
Leora I. Horwitz, M.D., M.H.S.\* – Measure and Clinical Expert for HWR and EDAC  
Xin Xin, M.A., M.S.\*\* – Measure Reevaluation Lead Analyst  
Elizabeth Triche, Ph.D. – Reevaluation Division Director  
Lisa G. Suter, M.D.\*\* – Project Director  
Susannah Bernheim, M.D., M.H.S. – Senior Project Director  
Harlan M. Krumholz, M.D., S.M.\*\* – Principal Investigator

## Measure Reevaluation Team Contributors

Alexander Ferrante, B.S. – Research Associate  
Alexandra Harris, M.P.H. – Content Expert for ICD-10  
Magdalyne Kucharski Schwartz, B.A. – Research Associate  
Sydnée Stackland, M.P.H. – Additional Team Member  
Huihui Yu, Ph.D.\*\* – Measure Reevaluation Analyst  
Yixin Li, M.S.\*\* – Measure Reevaluation Analyst

\*New York University School of Medicine

\*\*Yale School of Medicine

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## 1. HOW TO USE THIS REPORT

This report describes the Centers for Medicare & Medicaid Services' (CMS's) condition-specific excess days in acute care (EDAC) measures that are publicly reported. The measures are used to calculate hospital-level 30-day risk-standardized EDAC following acute myocardial infarction (AMI), heart failure (HF), and pneumonia admissions. This report serves as a single source of information about these measures for a wide range of readers. Reports describing other outcome measures can be found here on *QualityNet*.

**Specifications that define cohort inclusions and exclusions, risk-adjustment variables, and the planned readmission algorithm described in this report are detailed in the following supplemental files:**

- 2020 AMI EDAC Measure Code Specifications
- 2020 HF EDAC Measure Code Specifications
- 2020 Pneumonia EDAC Measure Code Specifications

These supplemental files are posted here on *QualityNet*.

This report includes:

- **Section 2 – An overview of the AMI, HF, and pneumonia EDAC measures:**
  - Background
  - Cohort inclusions and exclusions
    - Included and excluded hospitalizations
    - How transferred patients are handled
  - Outcome
  - Risk-adjustment variables
  - Data sources
  - EDAC calculation
  - Categorization of hospitals' performance score
- **Section 3 – 2020 measure updates**
- **Section 4 – 2020 measure results**
- **Section 5 – Glossary**

The appendices include:

- Appendix A: Statistical approach to calculating EDAC;
- Appendix B: Data quality assurance (QA);
- Appendix C: Annual updates to the measures since measure development;
- Appendix D: Cohort inclusion/exclusion criteria, outcome criteria, and emergency department (ED) visit and observation stay definition codes; and,
- Appendix E: Overview of the planned readmission algorithm.

The measure methodology reports as well as the prior updates and specifications reports are available in the 'Methodology' and 'Archived Measure Methodology' sections on the EDAC measures page [here](#) on *QualityNet*.



## 2. BACKGROUND AND OVERVIEW OF MEASURE METHODOLOGY

### 2.1. Background on EDAC Measures

In July 2017, CMS began publicly reporting 30-day EDAC for AMI and HF for the nation's non-federal short-term acute care hospitals (including Indian Health Service hospitals) and critical access hospitals. In July 2018, CMS began publicly reporting an additional EDAC measure; namely, pneumonia. This measure also includes admissions to non-federal short-term acute care hospitals (including Indian Health Service hospitals) and critical access hospitals.

In 2020, CMS and the Veterans Health Administration (VHA) collaborated to include admissions in Veterans Administration (VA) hospitals in all three EDAC measures.

CMS contracted with the Yale New Haven Health Services Corporation – Center for Outcomes Research and Evaluation (CORE) to update the AMI, HF, and pneumonia EDAC measures for 2020 public reporting through a process of measure reevaluation.

### 2.2. Overview of Measure Methodology

The 2020 risk-adjusted EDAC measures use specifications from the initial measure methodology reports posted here on *QualityNet*, with refinements to the measures as listed in Appendix C and described in the measures' updated measure methodology reports and prior updates and specifications reports posted here on *QualityNet*. An overview of the methodology is presented in this section.

For more information on the CMS programs that use these measures for fiscal year (FY) 2021, as well as their use in future FYs, please refer to the FY 2020 Inpatient Prospective Payment System (IPPS) Final Rule posted here on the CMS website.

#### 2.2.1 Cohort

##### Index Admissions Included in the Measures

An index admission is the hospitalization to which the EDAC outcome is attributed and includes admissions for patients:

- Having a principal discharge diagnosis of AMI, HF, or pneumonia for each respective measure;
  - The pneumonia measure cohort also includes admissions with a principal discharge diagnosis of sepsis (not including severe sepsis) that have a secondary discharge diagnosis of pneumonia coded as present on admission (POA) and no secondary diagnosis of severe sepsis coded as POA.
- Enrolled in Medicare Fee-For-Service (FFS) Part A and Part B for the 12 months prior to the date of the admission and Part A during the index admission, or those who are VA beneficiaries;
- Aged 65 or over;
- Discharged alive from a non-federal short-term acute care hospital or VA hospital; and,

- Not transferred to another acute care facility.

VA beneficiaries are eligible for inclusion in the measure cohorts regardless of Medicare FFS enrollment or whether they were hospitalized in a VA hospital or non-VA short-term acute care hospital.

The International Classification of Diseases, 10th Revision, Clinical Modification (ICD-10-CM) codes used to define the cohort inclusions for each measure are listed in the supplemental files posted [here](#) on *QualityNet*.

#### Index Admissions Excluded from the Measures

The EDAC measures exclude index admissions for patients:

- Without at least 30 days of post-discharge enrollment in Medicare FFS (in the case of patients who are not VA beneficiaries); or,
- Discharged against medical advice.

An additional exclusion criterion for the AMI cohort is that patients admitted and discharged from a hospital on the same calendar day are excluded as index admissions because it is unlikely that these patients had clinically significant AMIs.

Additionally, for the HF cohort, patients with a procedure code for left ventricular assist device (LVAD) implantation or heart transplantation either during the index admission or in the 12 months prior to the index admission are excluded as index admissions because these patients represent a clinically distinct group. The International Classification of Diseases, 10th Revision, Procedure Coding System (ICD-10-PCS) codes used to identify LVAD and heart transplant procedures in claims are provided in the 2020 HF EDAC Measure Code Specifications supplemental file posted [here](#) on *QualityNet*. The International Classification of Diseases, 9th Revision (ICD-9) code lists for discharges prior to October 1, 2015 can be found in the HF updated measure methodology report posted [here](#) on *QualityNet*.

Admissions for a condition within 30 days of discharge from an index admission for that same condition are excluded as index admissions.

As a part of data processing prior to the measure calculation, records are removed for non-short-term acute care facilities, such as psychiatric facilities, rehabilitation facilities, or long-term care hospitals. Additional data cleaning steps include removing claims with stays longer than one year, claims with overlapping dates, claims for patients not listed in the Medicare Enrollment Database, and records with invalid provider IDs.

The percentage of admissions excluded based on each criterion is shown in Section 4 in [Figure 4.2.1](#), [Figure 4.3.1](#), and [Figure 4.4.1](#), for AMI, HF, and pneumonia, respectively.

### Patients Transferred between Hospitals

The measures consider multiple hospitalizations that result from hospital-to-hospital transfers as a single acute episode of care. Transfer patients are identified by tracking claims for inpatient short-term acute care hospitalizations over time. To qualify as a transfer, the second inpatient admission must occur on the same day or the next calendar day following discharge from the first inpatient admission at a short-term acute care hospital. Cases that meet this criterion are considered transfers regardless of whether the first institution indicates intent to transfer the patient in the discharge disposition code or whether the second inpatient admission is for the same condition.

To include an admission in the measure cohort, the patient must ultimately be discharged to a non-acute care setting (for example, to home or a skilled nursing facility). Thus, for patients transferred from one short-term acute care hospital to another, only the last admission in the series of transfers is eligible for inclusion in the cohort. The previous admissions are not included. For example, if a patient is admitted to Hospital A, transferred to Hospital B, and then discharged from Hospital B to a non-acute care setting, the Hospital B admission would be included in the cohort, and all ED visits, observation stays, and unplanned readmissions within 30 days of discharge from the Hospital B admission would be counted in Hospital B's outcome.

### **2.2.2 Outcome**

#### All-Cause Days in Acute Care

The measures assess the number of days the patient spends in acute care in the 30 days after discharge. Days in acute care are defined as days spent in an ED, admitted to observation status, or admitted as an unplanned readmission for any cause to a short-term acute care hospital.

Each ED visit is counted as one half-day (0.5 days). See Table D.4.1 in Appendix D for the code definitions for ED visits.

Observation stays are recorded in terms of hours and converted for the measure into half-days (rounded up). See Table D.4.1 in Appendix D for the code definitions for observation stays. The codes capture post-discharge observation stays using facility and, in the case of Medicare FFS, physician data. Physician claims are used only in cases when facility claims are not available.

A readmission is defined as any unplanned short-term acute care hospitalization within 30 days of the discharge date for the index admission. Note that if a patient is readmitted to the **same** hospital on the **same** calendar day of discharge for the **same condition** as the index admission, the measure considers the patient to have had one single continuous admission (that is, one index admission). However, if the condition is **different** from the index admission, this is considered a readmission in the measure.

“Planned” readmissions are those planned by providers for anticipated medical treatment or procedures that must be provided in the inpatient setting. To exclude planned readmissions, the planned readmission algorithm developed for the publicly

reported CMS 30-day AMI, HF, and pneumonia readmission measures is used, as described in the condition-specific readmission measures updates and specifications report posted [here](#) on *QualityNet*. For more detail about how planned readmissions are defined, refer to [Figure PR.1](#) in Appendix E. Each unplanned readmission is counted according to the length of stay, which is calculated as the discharge date minus the admission date. Admissions that extend beyond the 30-day follow-up period are truncated on day 30. An unplanned readmission that follows a planned readmission is still counted.

When an ED visit, observation stay, or readmission overlaps with another event on the same day, only the most severe of the overlapping events is counted. For example, only a readmission day is counted if the readmission and either an observation stay or ED visit happens on the same day; only an observation day is counted if an observation stay and an ED visit happen on the same day.

The EDAC measures capture ED visits and observation stays in addition to readmissions for several reasons:

- Having to return to the ED or spend time in the hospital under observation matters to patients.
- Including all types of acute care will provide more detailed information to patients on what to expect following discharge.
- By capturing a range of outcomes that are important to patients, a more complete picture of post-discharge outcomes can be produced that better informs patients about care quality and incentivizes global improvement in transitional care.
- The increasing use of ED visits and observation stays have raised concerns that the current CMS 30-day readmission measures do not capture the full range of unplanned acute care in the post-discharge period. In particular, there exists concern that high use of observation stays could in some cases replace readmissions, and hospitals with high rates of observation stays in the post-discharge period may therefore have low readmission rates that do not accurately reflect the quality of care.
- Current readmission measures report readmissions only as a binary outcome (that is, any versus no readmission). However, some readmissions reflect severe deterioration requiring prolonged hospitalization while others involve only a brief, less acute hospitalization. Some patients have multiple visits in 30 days. Additionally, binary metrics do not account for each patient's opportunity for readmission: Patients who die post-discharge have less opportunity for readmission, but are counted as being at the same risk for readmission as those who survive the full measurement period. The EDAC measures address all of these gaps by including other outcomes (that is, ED visits and observation stays), by capturing the total amount of time patients spend in acute care, and by accounting for time at risk of an event (that is, survival time).

There are a number of reasons for assessing all-cause acute care utilization in the CMS EDAC measures. First, from the patient's perspective, acute care utilization for any cause is an adverse event. In addition, making inferences about quality issues based solely on the documented cause of an acute care event is difficult. For example, a patient with HF who develops a hospital-acquired infection may ultimately be

readmitted for sepsis. In this context, considering the readmission to be unrelated to the care that the patient received for HF during the index admission would be inappropriate.

### Multiple Events

All eligible outcomes occurring in the 30-day period are counted, even if they are repeat occurrences. For example, if a patient returns to the ED three times on three different days, we count each ED visit as a half-day. Similarly, if a patient has two hospitalizations within 30 days, the days spent in each are counted. This approach is taken in order to capture the full patient experience in the post-discharge period.

### 30-Day Time Frame

The measures assess eligible outcomes within a 30-day period from the date of discharge from an index admission. The measures use a 30-day time frame because older adult patients are more vulnerable to adverse health outcomes during this time.<sup>1</sup> Acute care in the post-discharge period can be influenced by hospital care and the early transition to the non-acute care setting. The 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities in an effort to reduce acute care events.<sup>2-8</sup>

The 30-day time frame is consistent with the existing CMS 30-day AMI, HF, and pneumonia readmission measures endorsed by the National Quality Forum (NQF) and publicly reported by CMS. Note that if a readmission or observation stay extends beyond 30 days, only that portion of the stay that occurs during the 30 days is included in the outcome.

### Exposure Time

Because some patients do not survive 30 days, not all patients are at risk for an acute event for the same amount of time. ‘Exposure time’ is calculated as the number of days each patient survived after discharge, up to 30. This exposure time was incorporated as part of the outcome to reflect differential risk for EDAC after discharge. This differs from the existing CMS AMI, HF, and pneumonia 30-day readmission measures, which consider all patients to be equally at risk for a hospital event regardless of survival time.

## **2.2.3 Risk-Adjustment Variables**

To account for differences in case mix among hospitals, the measures include an adjustment for factors such as age, comorbid diseases, and indicators of patient frailty, which are clinically relevant and have relationships with the outcome. For each patient, risk-adjustment variables are obtained from inpatient, outpatient, and physician Medicare administrative claims data extending 12 months prior to the index admission, and all claims for the index admission itself. The risk-adjustment variables for the measures are also obtained from VA administrative data for VA beneficiaries.

The measures’ adjustment for case mix differences among hospitals is based on the clinical status of the patient at the time of the index admission. Accordingly, only

comorbidities that convey information about the patient at the time of the index admission, or any time within the preceding 12 months, are included in risk adjustment. Complications that arise during the course of the hospitalization are not used in risk adjustment.

The measures do not include an adjustment for social risk factors because the association between social risk factors and health outcomes can be due, in part, to differences in the quality of health care that groups of patients with varying social risk factors receive. The intent is for the measures to adjust for patient demographic and clinical characteristics while illuminating important quality differences. The NQF re-endorsed the measures without adjustment for patient-level social risk factors in the last endorsement maintenance submission prior to 2020.

Refer to the supplemental files posted [here](#) on *QualityNet* for the list of comorbidity risk-adjustment variables and the list of potential complications that are excluded from risk adjustment if they occur only during the index admission for each measure. The Condition Categories (CCs) outlined in the tables are used to identify risk-adjustment variables in claims for discharges on or after October 1, 2015 as well as discharges prior to October 1, 2015. The ICD-10 codes provided in the tables are used to identify certain risk-adjustment variables (for example, ‘History of percutaneous transluminal coronary angioplasty (PTCA)’ in discharges on or after October 1, 2015. For a list of ICD-9 codes used to identify these variables in discharges prior to October 1, 2015, please refer to the measure methodology reports posted [here](#) on *QualityNet*.

Note that CC mappings to ICD-10-CM codes (for discharges on or after October 1, 2015) and ICD-9-CM codes (for discharges prior to October 1, 2015) are available [here](#) on *QualityNet*.

#### **2.2.4 Data Sources**

The data sources for these analyses are Medicare administrative claims, VA administrative data, and enrollment information for patients with hospitalizations between July 1, 2016 and June 30, 2019. The datasets also contain associated inpatient and outpatient Medicare and VA administrative claims as well as physician Medicare administrative claims for both the 12 month-period prior to the index admission as well as the 30-day period after discharge from the index admission, for patients admitted in this time period. Refer to the original methodology reports posted [here](#) on *QualityNet* for further descriptions of these data sources and an explanation of the three-year measurement period.

#### **2.2.5 Measure Calculation**

The hospital-level 30-day all-cause EDAC for each measure is estimated using a random effects hurdle model.

Specifically, CMS calculates EDAC, for each hospital, as the difference (“excess”) between a hospital’s “predicted days” and “expected days” per 100 discharges. “Predicted days” is the average number of days a hospital’s patients spent in acute care after adjusting for the risk factors (outlined in the supplemental files posted [here](#) on

*QualityNet*). “Expected days” is the average number of risk-adjusted days in acute care a hospital’s patients would have been expected to spend if discharged from an average performing hospital with the same case mix. To be consistent with the reporting of the CMS 30-day AMI, HF, and pneumonia readmission measures, CMS multiplies the measure result by 100 such that the final EDAC measures represent EDAC per 100 discharges.

To assess hospital performance for each reporting period, we re-estimate the parameter estimates using the years of data in that period.

The random effects hurdle models are described fully in [Appendix A](#) and in the original measure methodology reports posted [here](#) on *QualityNet*.

## **2.2.6 Categorizing Hospital Performance**

To categorize hospital performance, CMS estimates each hospital’s excess “days” in acute care and the corresponding 95% credible interval (CI). Excess “days” refers to the difference between the hospital’s predicted days and expected days, per 100 discharges. CMS assigns hospitals to a performance category by comparing each hospital’s CI surrounding the hospital’s excess “days” to zero. The reference to zero reflects the expectation that the hospital’s “days” will be no different than an average-performing hospital with a similar case mix. Comparative performance for hospitals with 25 or more eligible cases is classified as follows:

- “Fewer days than average” if the entire 95% CI surrounding the hospital’s days is below zero. [Patients who are discharged from a hospital in this category spend fewer days in acute care than patients discharged from an average-performing hospital with a similar case mix.]
- “Average” if the 95% CI surrounding the hospital’s days includes zero. [Patients who are discharged from a hospital in this category spend about the same number of days in acute care after discharge as patients discharged from an average-performing hospital with a similar case mix.]
- “More days than average” if the entire 95% CI surrounding the hospital’s days is above zero. [Patients who are discharged from a hospital in this category spend more days in acute care than patients discharged from an average-performing hospital with a similar case mix.]

In sum, these performance categories describe how different a hospital’s performance is compared to an average-performing hospital with a similar case mix.

If a hospital has fewer than 25 eligible cases for a measure, CMS assigns the hospital to a separate category, “Number of cases too small.” This category is used when the number of cases is too small (fewer than 25) to reliably conclude how the hospital is performing. If a hospital has fewer than 25 eligible cases, the hospital’s EDAC and parameter estimates will not be publicly reported for the measure.

The distribution of hospitals by performance category in the U.S. for this reporting period is described in [Section 4.2.5](#), [Section 4.3.5](#), and [Section 4.4.5](#), for AMI, HF, and pneumonia, respectively.



### 3. UPDATES TO MEASURES FOR 2020 PUBLIC REPORTING

#### 3.1. Rationale for Measure Updates

Annual measure reevaluation ensures that the risk-standardized days in acute care models are continually assessed and remain valid, given possible changes in clinical practice and coding standards over time. Modifications made to measure cohorts, risk models, and outcomes are informed by review of the most recent literature related to measure conditions or outcomes, feedback from various stakeholders, and empirical analyses, including assessment of coding trends that reveal shifts in clinical practice or billing patterns. Input is solicited from a workgroup composed of up to 20 clinical and measure experts, inclusive of internal and external consultants and subcontractors. As this report describes, for 2020 public reporting, we made the following modifications to the measures:

- Updated the ICD-10 code-based specifications used in the measures. Specifically:
  - Incorporated the code changes that occurred in the FY 2019 version of the ICD-10-CM/PCS (effective with October 1, 2018+ discharges) into the cohort definitions and risk models;
  - Applied version 2019.1 (beta version) of the Agency for Healthcare Research and Quality (AHRQ) Clinical Classification Software (CCS) for ICD-10-CM/PCS to the planned readmission algorithm; and,
  - Applied a modified version of the FY 2019 V22 CMS-Hierarchical Condition Category (HCC) crosswalk that is maintained by RTI International to the risk models.

As a part of annual reevaluation, we also undertook the following activities:

- Monitored code frequencies to identify any warranted specification changes due to possible changes in coding practices and patterns;
- Reviewed potentially clinically relevant codes that “neighbor” existing codes used in the measures to identify any warranted specification changes;
- Reviewed select pre-existing ICD-10 code-based specifications with our workgroup to confirm the appropriateness of specifications unaffected by the updates;
- Updated the measures’ SAS analytic packages (SAS packs) and documentation;
- Evaluated and validated model performance for the three years combined (July 2016-June 2019); and,
- Evaluated the stability of the risk-adjustment models over the three-year measurement period by examining the model variable frequencies, model coefficients, and the performance of the risk-adjustment model in each year (July 2016-June 2017, July 2017-June 2018, and July 2018-June 2019).

## 3.2. Detailed Discussion of Measure Updates

### 3.2.1 Updates to ICD-10 Code-Based Measure Specifications

#### Cohort Definitions

We examined the FY 2019 version of the ICD-10-CM/PCS, with particular attention to newly added codes and codes that were removed. We then solicited input from our workgroup to determine which, if any, of the newly implemented ICD-10 codes in the FY 2019 code set should be added to the cohort definitions. We reviewed approximately 280 new ICD-10-CM codes and 390 new ICD-10-PCS codes.

These processes, in addition to the surveillance and workgroup processes described above in the Rationale for Measure Updates section, led to the following change:

- The addition of ICD-10-CM codes to the pneumonia cohort inclusion list.

#### Planned Readmission Algorithm

We examined version 2019.1 (beta version) of the AHRQ CCS for ICD-10-CM/PCS to determine how the newly implemented ICD-10 codes in the FY 2019 code set were categorized, and to examine codes which were reclassified from one CCS category to another when the 2018 versions of the AHRQ CCS were updated to the 2019.1 version. Review of this version of the AHRQ CCS was extensive, and included:

- Examination of approximately 280 new ICD-10-CM codes and 390 new ICD-10-PCS codes added by AHRQ into 34 AHRQ CCS diagnosis categories and 21 AHRQ CCS procedure categories, respectively, to determine how the newly implemented ICD-10 codes should be incorporated into the planned readmission algorithm specifications; and,
- Examination of two ICD-10-CM codes and approximately 50 ICD-10-PCS codes that AHRQ shifted during the update into two different CCS diagnosis categories and nine different CCS procedure categories, respectively, to investigate where shifts may affect the planned readmission algorithm.

We then solicited input from our workgroup to confirm the clinical appropriateness of the AHRQ CCS categorization of the newly implemented ICD-10 codes and any changes warranted due to the code shifts that occurred. The workgroup also reviewed the newly implemented ICD-10 codes in the FY 2019 version of the ICD-10-CM/PCS to determine which, if any, should be added to the singular ICD-10 code lists that are also used in the algorithm (conditions that are not captured by AHRQ CCS categories). The intent was to maintain the clinical integrity of the algorithm.

These processes, in addition to the surveillance and workgroup processes described above in the Rationale for Measure Updates section, led to the following changes in the algorithm:

- Potentially planned procedures:

- The addition of AHRQ CCS procedure category 162 ('Other OR therapeutic procedures on joints');
  - The removal of AHRQ CCS procedure category 202 ('Electrocardiogram');
  - The removal of AHRQ CCS procedure category 112 ('Other OR therapeutic procedures of urinary tract') as a whole category, and a subset of ICD-10-PCS codes that fell under this category in the singular ICD-10-PCS code list was retained as potentially planned procedures;
  - The addition of three AHRQ CCS procedure categories as whole categories (AHRQ CCS 96, 118, and 163), and the previous subsets of ICD-10-PCS codes that fell under these categories in the singular ICD-10-PCS code list were removed; and,
  - The removal of the ICD-10-PCS codes associated with AHRQ CCS procedure categories 95 and 174 that were previously in the singular ICD-10-PCS code list.
- Acute diagnoses:
    - The addition of AHRQ CCS diagnosis category 100 ('Acute myocardial infarction') as a whole category, and the previous subset of ICD-10-CM codes that fell under this category in the singular ICD-10-CM code list was removed; and,
    - The addition of ICD-10-CM codes (associated with AHRQ CCS diagnosis categories 97, 101, 106, 108, 115, and 133) to the singular ICD-10-CM code list. The singular ICD-10-CM code list previously had ICD-10-CM codes associated with AHRQ CCS diagnosis categories 97, 106, 108, 115, and 133 in the list; new codes were added. The addition of ICD-10-CM codes associated with AHRQ CCS diagnosis category 101 ('Coronary atherosclerosis and other heart disease') is new to the singular ICD-10-CM code list.

Note that AHRQ publishes periodic updates to the ICD-10 code to CCS mappings. For our annual reporting, we utilize the version of the AHRQ CCS that aligns with the timing of the claims data for that measurement period. For 2020 public reporting, version 2019.1 (beta version) of the AHRQ CCS for ICD-10-CM/PCS was used.

### Risk Adjustment

The process of updating the risk-adjustment variables was similar to the planned readmission algorithm process described above. We examined the FY 2019 version of the V22 CMS-HCC crosswalk released in July 2019 for use in 2020 public reporting to determine how the newly implemented ICD-10 codes in the FY 2019 code set were classified, and to examine codes which were reclassified from one HCC to another when the FY 2018 version was updated to the FY 2019 version. We then solicited input from our workgroup to confirm the clinical appropriateness of the HCC classifications of the newly implemented ICD-10 codes and any changes warranted due to the code shifts that occurred. The workgroup also reviewed the newly implemented ICD-10 codes in the FY 2019 version of the ICD-10-CM/PCS to determine which, if any, should be added to the singular ICD-10 code lists that are also used in risk adjustment (conditions that are not captured by CCs).

These processes, in addition to the surveillance and workgroup processes described above in the Rationale for Measure Updates section, led to the following change:

- The addition of ICD-10-CM codes to the code list used to define the ‘History of coronary artery bypass graft (CABG) surgery’ risk-adjustment variable (used in all three EDAC measures), if present in Medicare claims or VA administrative data within 12 months prior to the index admission.

#### Additional Notes

The goal of these specification updates was to maintain the intent of the measures.

**All changes made to the ICD-10 code-based specifications are detailed in the following supplemental files that accompany this report:**

- 2020 AMI EDAC Measure Code Specifications
- 2020 HF EDAC Measure Code Specifications
- 2020 Pneumonia EDAC Measure Code Specifications

These supplemental files are posted [here](#) on *QualityNet*.

Changes are effective in claims for discharges on or after October 1, 2015.

Note that ICD-10 code listings in this report and the supplemental files reflect the current (FY 2019) labels or narrative descriptions for each code.

### **3.3. Changes to SAS Packs**

We revised the measure SAS packs to accommodate the specification updates discussed in [Section 3.1](#) and [Section 3.2](#) above. The new SAS packs and documentation are available upon request by emailing [cmsedacmeasures@yale.edu](mailto:cmsedacmeasures@yale.edu). **Do NOT submit patient-identifiable information (for example, date of birth, Social Security number, health insurance claim number) to this address.**

The SAS packs include descriptions of the data files and data elements that feed the model software. Please be aware that CMS does not provide training or technical support for the software. CMS has made the SAS packs available to be completely transparent regarding the measure calculation methodology. However, note that even with the SAS packs, it is not possible to replicate the EDAC calculations without the data files, which contain the longitudinal patient data from the entire national sample of acute care hospitals that is used to calculate results.

## 4. RESULTS FOR 2020 PUBLIC REPORTING

### 4.1. Assessment of Updated Models

The hospital-level 30-day all-cause EDAC for each measure is estimated using random effects hurdle models. Refer to [Section 2](#) for a summary of the measure methodology and model risk-adjustment variables. Refer to the prior methodology and updates and specifications reports on the EDAC measures page [here](#) on *QualityNet* for further details.

We evaluated the performance of the models using the July 2016 to June 2019 data for the 2020 reporting period. We examined the differences in the frequencies of patient risk factors and the model parameter estimates.

For each of the conditions, we assessed the overall fit of the model using posterior predictive checking (PPC) for the three-year combined period. For the logit model of zero versus non-zero days, which includes all patients in the cohort, we calculated the c-statistic. For the truncated Poisson model of non-zero days, which includes only patients with any acute care days, we calculated the deviance  $R^2$ . The deviance  $R^2$  is computed from the difference in the log-likelihoods between the final model and an empty model (no covariates) attributed to each observation, averaged over all observations.<sup>9</sup>

The results of these analyses for each of the measures (AMI, HF, and pneumonia) are presented in [Section 4.2](#), [Section 4.3](#), and [Section 4.4](#), respectively.

## **4.2. AMI EDAC 2020 Model Results**

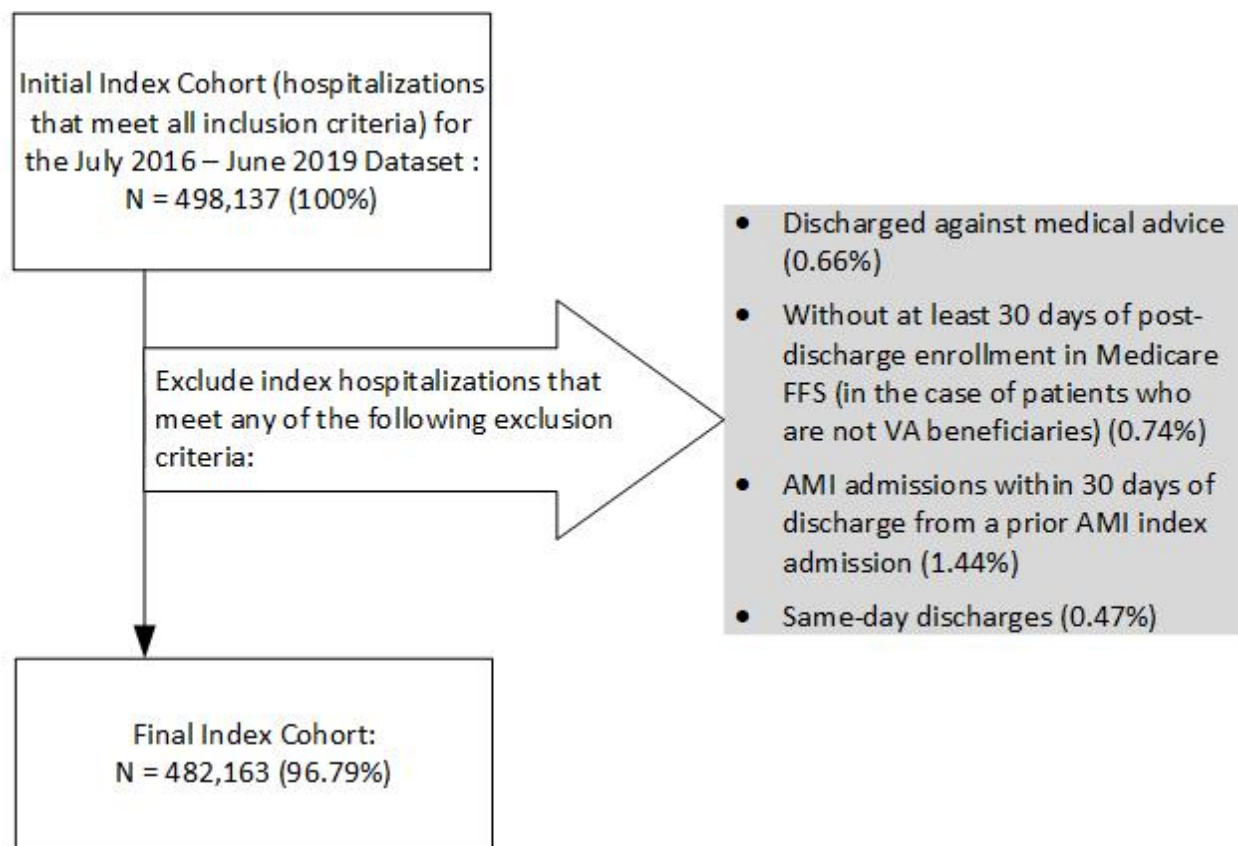
### **4.2.1 Index Cohort Exclusions**

The exclusion criteria for this measure are presented in [Section 2.2.1](#). The percentage of AMI admissions that met each exclusion criterion in the July 2016-June 2019 dataset is presented in [Figure 4.2.1](#).

Admissions may have been counted in more than one exclusion category because they are not mutually exclusive. The index cohort includes short-term acute care hospitalizations for patients:

- Aged 65 or over;
- With a principal discharge diagnosis of AMI;
- Enrolled in Medicare FFS Part A and Part B for the 12 months prior to the date of admission and Part A during the index admission, or those who are VA beneficiaries;
- Who were not transferred to another acute care facility; and,
- Were alive at discharge.

**Figure 4.2.1 – AMI Cohort Exclusions in the July 2016-June 2019 Dataset**



#### 4.2.2 Frequency of AMI Model Variables

We examined the change in the frequencies of clinical and demographic variables. Frequencies of model variables were quite stable over the measurement period. The largest changes in the frequencies (those greater than 2% absolute change) include decreases in 'Chronic obstructive pulmonary disease' (29.8% to 27.6%) and 'Pneumonia' (20.4% to 18.2%).

Refer to [Table 4.2.1](#) for more detail.

#### 4.2.3 AMI Model Parameters and Performance

[Table 4.2.2](#) shows the parameter estimates and 95% CIs for the AMI days in acute care model for the combined three-year dataset. [Table 4.2.3](#) shows the PPC results for the combined three-year dataset. The c-statistic for the logistic part and the deviance  $R^2$  for the truncated Poisson part are provided in [Table 4.2.4](#).

#### 4.2.4 Distribution of Hospital Volumes and EDAC for AMI

Between July 2016-June 2017 and July 2018-June 2019, the *observed* days in acute care decreased from 108.49 to 105.07.

[Table 4.2.5](#) shows both unadjusted (observed) days of post-discharge events per 100 discharges and EDAC per 100 discharges for AMI. [Figure 4.2.2](#) shows the overall distribution of the hospital EDAC for the three-year dataset. The data are normally distributed.

#### 4.2.5 Distribution of Hospitals by Performance Category in the Three-Year Dataset

Of 4,074 hospitals in the study cohort, 255 had "Fewer days than average," 1,406 were "Average," and 481 had "More days than average." 1,932 were classified as "Number of cases too small" (fewer than 25) to reliably conclude how the hospital is performing.

**Table 4.2.1 – Frequency of AMI Model Variables over Different Time Periods**

Variable (% unless otherwise indicated)	07/2016-06/2017	07/2017-06/2018	07/2018-06/2019	07/2016-06/2019
Total N	172,148	160,182	149,833	482,163
Mean age (standard deviation [SD]), in years	77.9 (8.3)	77.7 (8.2)	77.5 (8.1)	77.7 (8.2)
Male	54.9	56.0	56.9	55.9
Anterior myocardial infarction	6.4	6.5	7.1	6.7
Non-anterior location of myocardial infarction	13.0	13.5	14.0	13.5
History of coronary artery bypass graft (CABG) surgery	18.8	18.6	18.0	18.5
History of percutaneous transluminal coronary angioplasty (PTCA)	26.7	27.7	28.1	27.5
Severe infection; other infectious diseases (CC 1, 3-7)	25.8	25.2	24.3	25.1



Variable (% unless otherwise indicated)	07/2016-06/2017	07/2017-06/2018	07/2018-06/2019	07/2016-06/2019
Metastatic cancer and acute leukemia (CC 8)	2.2	2.2	2.2	2.2
Cancer (CC 9-14)	19.1	19.1	19.3	19.2
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	47.6	47.2	47.1	47.3
Protein-calorie malnutrition (CC 21)	6.8	6.7	6.7	6.7
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	28.1	27.7	27.5	27.8
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	46.8	46.4	45.6	46.3
Dementia or other specified brain disorders (CC 51-53)	18.7	17.6	17.0	17.8
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	5.9	5.9	5.8	5.9
Congestive heart failure (CC 85)	30.7	29.8	29.2	29.9
Acute coronary syndrome (CC 86-87)	22.2	22.1	21.9	22.1
Angina pectoris (CC 88)	18.7	19.9	20.3	19.6
Coronary atherosclerosis/other chronic ischemic heart disease (CC 89)	81.5	80.7	81.0	81.1
Valvular and rheumatic heart disease (CC 91)	32.2	32.1	31.8	32.1
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	35.3	34.8	34.9	35.0
Stroke (CC 99-100)	6.4	6.3	6.2	6.3
Cerebrovascular disease (CC 101-102, 105)	19.5	19.0	18.9	19.2
Vascular or circulatory disease (CC 106-109)	36.1	35.8	35.7	35.9
Chronic obstructive pulmonary disease (COPD) (CC 111)	29.8	28.7	27.6	28.8
Asthma (CC 113)	9.8	8.6	8.1	8.9
Pneumonia (CC 114-116)	20.4	19.4	18.2	19.4
Dialysis status (CC 134)	3.9	3.8	4.0	3.9
Renal failure (CC 135-140)	41.8	41.6	41.7	41.7
Other urinary tract disorders (CC 145)	17.7	17.2	16.8	17.3
Decubitus ulcer or chronic skin ulcer (CC 157-161)	7.1	7.0	6.9	7.0

**Table 4.2.2 – Median Parameter Estimates and CIs of Risk Variables from the Logit and Poisson Models for AMI (July 2016-June 2019)**

Variable	Part 1: Logit Model		Part 2: Poisson Model	
	Median	CI	Median	CI
Age minus 65 (years above 65, continuous)	0.007	(0.006, 0.008)	0.003	(0.002, 0.003)
Male	-0.095	(-0.110, -0.081)	0.019	(0.013, 0.025)
Anterior myocardial infarction	0.202	(0.176, 0.229)	0.096	(0.084, 0.108)
Non-anterior location of myocardial infarction	0.051	(0.030, 0.069)	-0.038	(-0.046, -0.030)
History of coronary artery bypass graft (CABG) surgery	0.001	(-0.017, 0.019)	-0.035	(-0.043, -0.027)
History of percutaneous transluminal coronary angioplasty (PTCA)	-0.019	(-0.034, -0.005)	-0.037	(-0.044, -0.030)

Variable	Part 1: Logit Model		Part 2: Poisson Model	
	Median	CI	Median	CI
Severe infection; other infectious diseases (CC 1, 3–7)	0.050	(0.036, 0.066)	-0.010	(-0.017, -0.004)
Metastatic cancer and acute leukemia (CC 8)	0.255	(0.213, 0.301)	0.087	(0.069, 0.103)
Cancer (CC 9–14)	0.060	(0.043, 0.077)	-0.012	(-0.020, -0.003)
Diabetes mellitus (DM) or DM complications (CC 17–19, 122–123)	0.107	(0.093, 0.122)	0.098	(0.092, 0.104)
Protein-calorie malnutrition (CC 21)	0.129	(0.106, 0.155)	0.153	(0.144, 0.162)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23–24)	0.140	(0.123, 0.156)	0.031	(0.023, 0.037)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	0.163	(0.150, 0.177)	0.182	(0.176, 0.188)
Dementia or other specified brain disorders (CC 51–53)	0.081	(0.063, 0.096)	-0.001	(-0.008, 0.006)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70–74, 103–104, 189–190)	0.106	(0.080, 0.133)	0.038	(0.027, 0.049)
Congestive heart failure (CC 85)	0.113	(0.097, 0.131)	0.068	(0.062, 0.076)
Acute coronary syndrome (CC 86–87)	0.018	(-0.000, 0.034)	-0.051	(-0.058, -0.043)
Angina pectoris (CC 88)	0.041	(0.022, 0.059)	-0.024	(-0.032, -0.017)
Coronary atherosclerosis/other chronic ischemic heart disease (CC 89)	0.075	(0.057, 0.093)	0.010	(0.001, 0.018)
Valvular and rheumatic heart disease (CC 91)	0.072	(0.057, 0.087)	0.083	(0.076, 0.090)
Specified arrhythmias and other heart rhythm disorders (CC 96–97)	0.090	(0.075, 0.104)	0.004	(-0.003, 0.011)
Stroke (CC 99–100)	0.029	(0.001, 0.057)	0.022	(0.009, 0.032)
Cerebrovascular disease (CC 101–102, 105)	0.052	(0.034, 0.071)	0.013	(0.006, 0.022)
Vascular or circulatory disease (CC 106–109)	0.096	(0.082, 0.111)	0.026	(0.020, 0.033)
Chronic obstructive pulmonary disease (COPD) (CC 111)	0.191	(0.176, 0.207)	0.118	(0.110, 0.125)
Asthma (CC 113)	0.057	(0.034, 0.079)	-0.040	(-0.050, -0.030)
Pneumonia (CC 114–116)	0.110	(0.092, 0.128)	0.113	(0.106, 0.120)
Dialysis status (CC 134)	0.353	(0.320, 0.386)	-0.015	(-0.028, -0.003)
Renal failure (CC 135–140)	0.144	(0.128, 0.160)	0.169	(0.161, 0.176)
Other urinary tract disorders (CC 145)	0.087	(0.069, 0.103)	0.019	(0.013, 0.026)
Decubitus ulcer or chronic skin ulcer (CC 157–161)	0.070	(0.040, 0.092)	0.093	(0.084, 0.103)

**Table 4.2.3 – PPC Results for AMI (July 2016-June 2019)**

Statistic	Observed Days in Acute Care	MCMC 95% CI for Predicted Days in Acute Care	P-Value
Variance	1.064	(0.612 – 0.808)	<0.001
Median	0.978	(0.763 – 0.788)	<0.001
Interquartile range (IQR)	0.801	(0.583 – 0.631)	<0.001

Statistic	Observed Days in Acute Care	MCMC 95% CI for Predicted Days in Acute Care	P-Value
Coefficient of variation	0.991	(0.885 – 0.993)	0.058

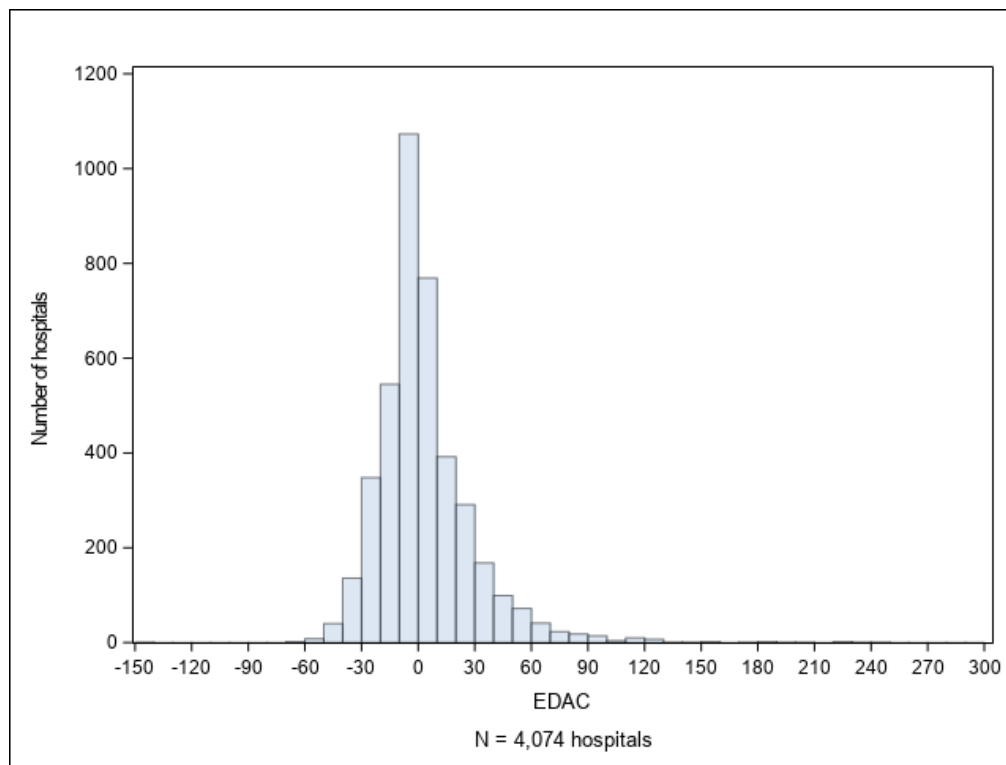
**Table 4.2.4 – AMI Generalized Linear Regression Model Performance (July 2016-June 2019)**

Characteristic	07/2016-06/2019
C-statistic (Logit part)	0.60
Deviance R <sup>2</sup> (Poisson part)	0.061

**Table 4.2.5 – Hospital-Level Unadjusted Distribution of Overall Acute Care, ED Visits, Observation Stays, and Readmissions per 100 AMI Discharges, and Distribution of EDAC (July 2016-June 2019)**

Description	Mean ± SD	Median (Q1, Q3)	Range
Observed days in acute care	104.13 (103.14)	97.77 (50.42, 130.56)	2,800
Days of ED visits	10.92 (11.74)	9.07 (5.19, 12.94)	150
Days of observation stays	13.85 (25.15)	9.09 (0.00, 16.30)	475
Days of readmissions	84.44 (98.64)	76.06 (26.67, 109.69)	2,800
EDAC	3.55 (26.27)	-0.27 (-11.03, 13.08)	389.65
Days of predicted	109.04 (40.35)	103.80 (84.16, 128.04)	398.50
Days of expected	105.49 (30.16)	103.33 (92.25, 116.64)	436.94

**Figure 4.2.2 – Hospital-Level EDAC per 100 Discharges for AMI for the July 2016-June 2019 Dataset**



### **4.3. HF EDAC 2020 Model Results**

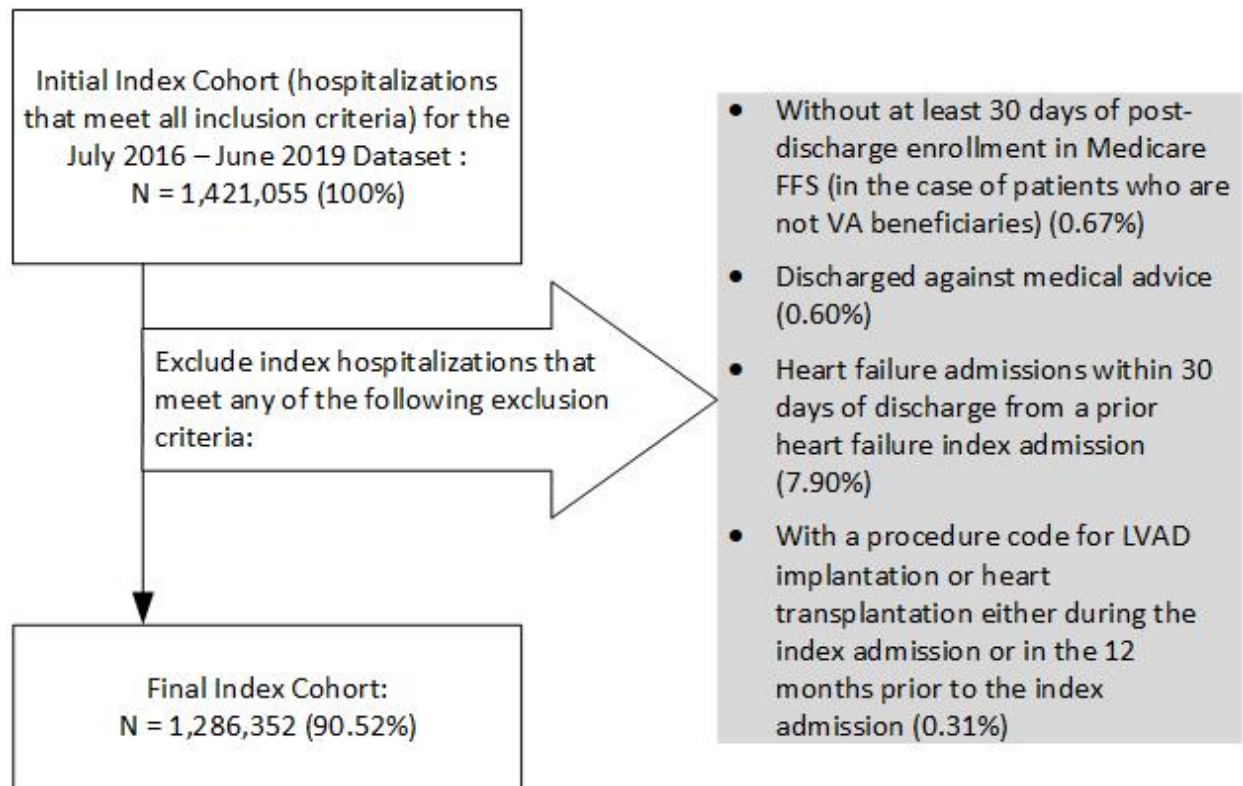
#### **4.3.1 Index Cohort Exclusions**

The exclusion criteria for this measure are presented in [Section 2.2.1](#). The percentage of HF admissions that met each exclusion criterion in the July 2016-June 2019 dataset is presented in [Figure 4.3.1](#).

Admissions may have been counted in more than one exclusion category because they are not mutually exclusive. The index cohort includes short-term acute care hospitalizations for patients:

- Aged 65 or over;
- With a principal discharge diagnosis of HF;
- Enrolled in Medicare FFS Part A and Part B for the 12 months prior to the date of admission and Part A during the index admission, or those who are VA beneficiaries;
- Who were not transferred to another acute care facility; and,
- Were alive at discharge.

**Figure 4.3.1 – HF Cohort Exclusions in the July 2016-June 2019 Dataset**



#### 4.3.2 Frequency of HF Model Variables

We examined the change in the frequencies of clinical and demographic variables. Frequencies of model variables were quite stable over the measurement period. The largest changes in the frequencies (those greater than 2% absolute change) include:

- An increase in 'Cardio-respiratory failure and shock' (35.4% to 37.5%)
- Decreases in 'Other and unspecified heart disease' (34.4% to 32.3%) and 'Asthma' (15.1% to 12.0%)

Refer to [Table 4.3.1](#) for more detail.

#### 4.3.3 HF Model Parameters and Performance

[Table 4.3.2](#) shows the parameter estimates and 95% CIs for the HF days in acute care model for the combined three-year dataset. [Table 4.3.3](#) shows the PPC results for the combined three-year dataset. The c-statistic for the logistic part and the deviance  $R^2$  for the truncated Poisson part are provided in [Table 4.3.4](#).

#### 4.3.4 Distribution of Hospital Volumes and EDAC for HF

Between July 2016-June 2017 and July 2018-June 2019, the *observed* days in acute care increased from 148.21 to 149.69.

[Table 4.3.5](#) shows both unadjusted (observed) days of post-discharge events per 100 discharges and EDAC per 100 discharges for HF. [Figure 4.3.2](#) shows the overall distribution of the hospital EDAC for the three-year dataset. The data are normally distributed.

#### 4.3.5 Distribution of Hospitals by Performance Category in the Three-Year Dataset

Of 4,642 hospitals in the study cohort, 447 had "Fewer days than average," 2,467 were "Average," and 799 had "More days than average." 929 were classified as "Number of cases too small" (fewer than 25) to reliably conclude how the hospital is performing.

**Table 4.3.1 – Frequency of HF Model Variables over Different Time Periods**

Variable (% unless otherwise indicated)	07/2016-06/2017	07/2017-06/2018	07/2018-06/2019	07/2016-06/2019
Total N	420,222	434,269	431,861	1,286,352
Mean age (SD), in years	80.5 (8.5)	80.5 (8.6)	80.4 (8.5)	80.5 (8.5)
Male	48.0	48.5	48.6	48.4
History of coronary artery bypass graft (CABG) surgery	24.4	23.7	22.7	23.6
Metastatic cancer and acute leukemia (CC 8)	2.4	2.5	2.7	2.6
Cancer (CC 9-14)	21.7	21.8	22.1	21.8
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	54.7	54.3	54.1	54.4

Variable (% unless otherwise indicated)	07/2016-06/2017	07/2017-06/2018	07/2018-06/2019	07/2016-06/2019
Protein-calorie malnutrition (CC 21)	11.3	12.0	12.2	11.8
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	51.0	52.0	52.6	51.9
Liver or biliary disease (CC 27-32)	12.5	13.2	13.8	13.2
Peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 36)	16.2	16.7	16.8	16.6
Other gastrointestinal disorders (CC 38)	67.2	67.4	67.7	67.4
Severe hematological disorders (CC 46)	2.2	2.1	2.1	2.1
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	64.2	64.4	64.6	64.4
Dementia or other specified brain disorders (CC 51-53)	24.4	23.9	23.6	24.0
Drug/alcohol abuse/dependence/psychosis (CC 54-56)	16.0	16.6	16.9	16.5
Major psychiatric disorders (CC 57-59)	9.0	9.7	10.5	9.8
Depression (CC 61)	22.4	22.5	22.7	22.5
Other psychiatric disorders (CC 63)	24.7	25.1	25.9	25.2
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	7.9	8.1	8.3	8.1
Cardio-respiratory failure and shock (CC 84 plus ICD-10-CM codes R09.01 and R09.02, for discharges on or after October 1, 2015; CC 84 plus ICD-9-CM diagnosis codes 799.01 and 799.02, for discharges prior to October 1, 2015)	35.4	36.5	37.5	36.5
Congestive heart failure (CC 85)	75.7	75.7	75.6	75.7
Acute coronary syndrome (CC 86-87)	18.6	19.4	19.8	19.3
Coronary atherosclerosis or angina (CC 88-89)	71.6	71.0	70.2	70.9
Valvular and rheumatic heart disease (CC 91)	54.2	54.4	54.9	54.5
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	69.5	69.8	70.1	69.8
Other and unspecified heart disease (CC 98)	34.4	32.7	32.3	33.1
Stroke (CC 99-100)	8.4	8.4	8.6	8.5
Vascular or circulatory disease (CC 106-109)	54.7	55.2	55.8	55.3
Chronic obstructive pulmonary disease (COPD) (CC 111)	49.6	49.2	48.5	49.1
Fibrosis of lung or other chronic lung disorders (CC 112)	8.7	8.8	9.1	8.8
Asthma (CC 113)	15.1	13.2	12.0	13.4
Pneumonia (CC 114-116)	43.4	43.0	41.5	42.7
Dialysis status (CC 134)	5.0	5.5	5.7	5.4
Renal failure (CC 135-140)	67.3	68.6	69.2	68.4
Nephritis (CC 141)	10.9	10.6	10.3	10.6
Other urinary tract disorders (CC 145)	26.8	26.3	25.7	26.2
Decubitus ulcer or chronic skin ulcer (CC 157-161)	14.7	15.1	15.4	15.0



**Table 4.3.2 – Median Parameter Estimates and Credible Intervals (CIs) of Risk Variables from the Logit and Poisson Models for HF (July 2016-June 2019)**

Variable	Part 1: Logit Model		Part 2: Poisson Model	
	Median	CI	Median	CI
Age minus 65 (years above 65, continuous)	-0.001	(-0.001, -0.000)	-0.006	(-0.007, -0.006)
Male	0.026	(0.019, 0.035)	0.008	(0.005, 0.012)
History of coronary artery bypass graft (CABG) surgery	0.027	(0.019, 0.036)	0.005	(0.001, 0.009)
Metastatic cancer and acute leukemia (CC 8)	0.192	(0.167, 0.214)	0.051	(0.041, 0.060)
Cancer (CC 9-14)	0.027	(0.018, 0.037)	0.002	(-0.002, 0.005)
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	0.054	(0.046, 0.062)	0.020	(0.016, 0.023)
Protein-calorie malnutrition (CC 21)	0.113	(0.102, 0.125)	0.078	(0.074, 0.083)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	0.117	(0.108, 0.125)	0.027	(0.023, 0.031)
Liver or biliary disease (CC 27-32)	0.093	(0.082, 0.104)	0.045	(0.041, 0.048)
Peptic ulcer, hemorrhage, other specified gastrointestinal disorders (CC 36)	0.055	(0.044, 0.067)	0.011	(0.007, 0.015)
Other gastrointestinal disorders (CC 38)	0.092	(0.083, 0.104)	-0.012	(-0.016, -0.009)
Severe hematological disorders (CC 46)	0.181	(0.159, 0.204)	0.055	(0.046, 0.063)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	0.098	(0.088, 0.106)	0.079	(0.075, 0.083)
Dementia or other specified brain disorders (CC 51-53)	0.062	(0.053, 0.071)	-0.015	(-0.019, -0.012)
Drug/alcohol abuse/dependence/psychosis (CC 54-56)	0.121	(0.111, 0.132)	-0.025	(-0.029, -0.021)
Major psychiatric disorders (CC 57-59)	0.054	(0.040, 0.067)	-0.000	(-0.005, 0.005)
Depression (CC 61)	0.023	(0.012, 0.033)	-0.021	(-0.024, -0.017)
Other psychiatric disorders (CC 63)	0.108	(0.099, 0.118)	-0.000	(-0.004, 0.003)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	0.059	(0.046, 0.074)	0.024	(0.019, 0.030)
Cardio-respiratory failure and shock (CC 84 plus ICD-10-CM codes R09.01 and R09.02, for discharges on or after October 1, 2015; CC 84 plus ICD-9-CM diagnosis codes 799.01 and 799.02, for discharges prior to October 1, 2015)	0.071	(0.061, 0.080)	0.064	(0.061, 0.068)
Congestive heart failure (CC 85)	0.086	(0.076, 0.097)	0.019	(0.014, 0.023)
Acute coronary syndrome (CC 86-87)	0.123	(0.114, 0.133)	0.002	(-0.001, 0.005)
Coronary atherosclerosis or angina (CC 88-89)	0.062	(0.054, 0.072)	-0.017	(-0.021, -0.013)
Valvular and rheumatic heart disease (CC 91)	0.062	(0.055, 0.069)	0.039	(0.036, 0.042)
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	0.065	(0.056, 0.075)	0.016	(0.012, 0.019)
Other and unspecified heart disease (CC 98)	0.054	(0.044, 0.062)	-0.001	(-0.004, 0.002)
Stroke (CC 99-100)	0.045	(0.031, 0.061)	-0.020	(-0.025, -0.015)
Vascular or circulatory disease (CC 106-109)	0.063	(0.053, 0.070)	0.015	(0.012, 0.018)

Variable	Part 1: Logit Model		Part 2: Poisson Model	
	Median	CI	Median	CI
Chronic obstructive pulmonary disease (COPD) (CC 111)	0.109	(0.100, 0.116)	0.046	(0.043, 0.050)
Fibrosis of lung or other chronic lung disorders (CC 112)	0.067	(0.053, 0.081)	0.016	(0.011, 0.020)
Asthma (CC 113)	0.053	(0.043, 0.064)	-0.006	(-0.010, -0.001)
Pneumonia (CC 114-116)	0.062	(0.054, 0.070)	0.047	(0.044, 0.050)
Dialysis status (CC 134)	0.257	(0.240, 0.276)	-0.100	(-0.106, -0.094)
Renal failure (CC 135-140)	0.156	(0.147, 0.165)	0.120	(0.117, 0.124)
Nephritis (CC 141)	0.031	(0.020, 0.044)	0.011	(0.006, 0.015)
Other urinary tract disorders (CC 145)	0.072	(0.064, 0.080)	0.014	(0.010, 0.017)
Decubitus ulcer or chronic skin ulcer (CC 157-161)	0.073	(0.063, 0.084)	0.088	(0.084, 0.092)

**Table 4.3.3 – PPC Results for HF (July 2016-June 2019)**

Statistic	Observed Days in Acute Care	MCMC 95% CI for Predicted Days in Acute Care	P-Value
Variance	0.560	(0.250 – 0.328)	<0.001
Median	1.366	(1.096 – 1.116)	<0.001
IQR	0.610	(0.532 – 0.563)	<0.001
Coefficient of variation	0.544	(0.444 – 0.505)	<0.001

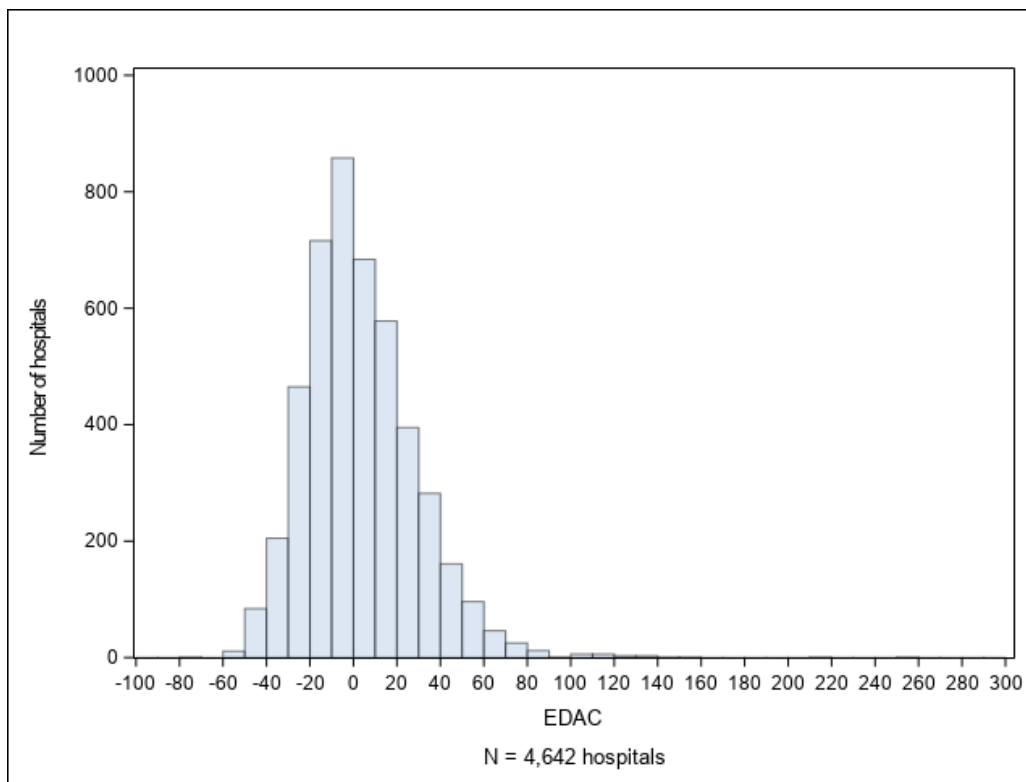
**Table 4.3.4 – HF Generalized Linear Regression Model Performance (July 2016-June 2019)**

Characteristic	07/2016-06/2019
C-statistic (Logit part)	0.59
Deviance R <sup>2</sup> (Poisson part)	0.027

**Table 4.3.5 – Hospital-Level Unadjusted Distribution of Overall Acute Care, ED Visits, Observation Stays, and Readmissions per 100 HF Discharges, and Distribution of EDAC (July 2016-June 2019)**

Description	Mean ± SD	Median (Q1, Q3)	Range
Observed days in acute care	137.59 (74.83)	136.61 (104.35, 165.34)	1,800
Days of ED visits	11.50 (7.73)	9.69 (7.14, 14.12)	163
Days of observation stays	10.90 (11.07)	9.05 (4.88, 13.99)	150
Days of readmissions	120.55 (74.03)	119.35 (87.96, 147.69)	1,800
EDAC	3.27 (25.54)	-0.25 (-14.09, 17.32)	329.08
Days of predicted	138.76 (34.04)	136.82 (114.94, 159.76)	495.98
Days of expected	135.50 (18.46)	137.09 (125.70, 146.67)	243.74

**Figure 4.3.2 – Hospital-Level EDAC per 100 Discharges for HF for the July 2016-June 2019 Dataset**



#### **4.4. Pneumonia EDAC 2020 Model Results**

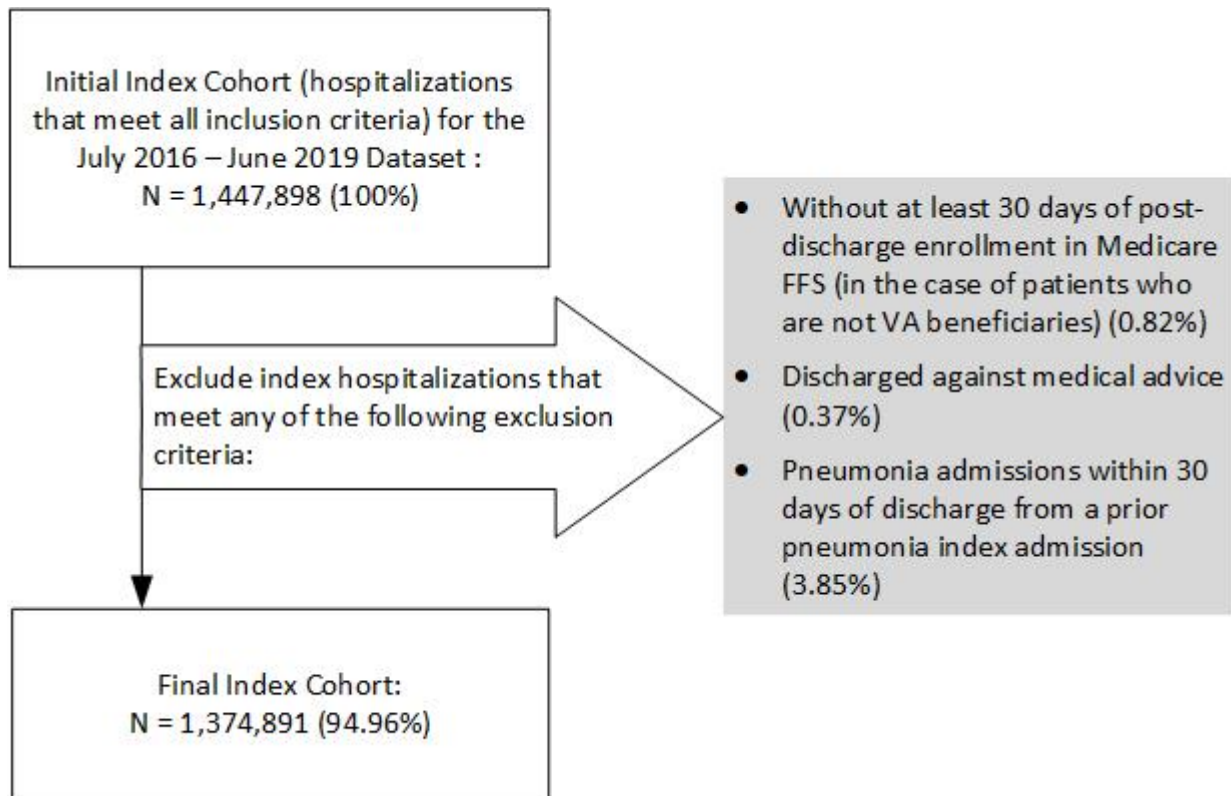
##### **4.4.1 Index Cohort Exclusions**

The exclusion criteria for this measure are presented in [Section 2.2.1](#). The percentage of pneumonia admissions that met each exclusion criterion in the July 2016-June 2019 dataset is presented in [Figure 4.4.1](#).

Admissions may have been counted in more than one exclusion category because they are not mutually exclusive. The index cohort includes short-term acute care hospitalizations for patients:

- Aged 65 or over;
- With either a principal discharge diagnosis of pneumonia or a principal discharge diagnosis of sepsis (not including severe sepsis) with a secondary diagnosis of pneumonia coded as POA and no secondary diagnosis of severe sepsis coded as POA;
- Enrolled in Medicare FFS Part A and Part B for the 12 months prior to the date of admission and Part A during the index admission, or those who are VA beneficiaries;
- Who were not transferred to another acute care facility; and,
- Were alive at discharge.

**Figure 4.4.1 – Pneumonia Cohort Exclusions in the July 2016-June 2019 Dataset**



#### 4.4.2 Frequency of Pneumonia Model Variables

We examined the change in the frequencies of clinical and demographic variables. Frequencies of model variables were quite stable over the measurement period. The largest changes in the frequencies (those greater than 2% absolute change) include:

- Increases in 'Drug/alcohol abuse/dependence/psychosis' (16.5% to 19.0%), 'Respiratory arrest; cardio-respiratory failure and shock' (27.3% to 30.9%), 'Chronic obstructive pulmonary disease' (45.9% to 50.9%), and 'Other respiratory disorders' (50.1% to 52.5%)
- Decreases in 'Dementia or other specified brain disorders' (36.8% to 34.3%) and 'Asthma' (15.2% to 12.9%)

Refer to [Table 4.4.1](#) for more detail.

#### 4.4.3 Pneumonia Model Parameters and Performance

[Table 4.4.2](#) shows the parameter estimates and 95% CIs for the pneumonia days in acute care model for the combined three-year dataset. [Table 4.4.3](#) shows the PPC results for the combined three-year dataset. The c-statistic for the logistic part and the deviance  $R^2$  for the truncated Poisson part are provided in [Table 4.4.4](#).

#### 4.4.4 Distribution of Hospital Volumes and EDAC for Pneumonia

Between July 2016-June 2017 and July 2018-June 2019, the *observed* days in acute care increased from 114.58 to 116.91.

[Table 4.4.5](#) shows both unadjusted (observed) days of post-discharge events per 100 discharges and EDAC per 100 discharges for pneumonia. [Figure 4.4.2](#) shows the overall distribution of the hospital EDAC for the three-year dataset. The data are normally distributed.

#### 4.4.5 Distribution of Hospitals by Performance Category in the Three-Year Dataset

Of 4,697 hospitals in the study cohort, 614 had "Fewer days than average," 2,521 were "Average," and 1,075 had "More days than average." 487 were classified as "Number of cases too small" (fewer than 25) to reliably conclude how the hospital is performing.

**Table 4.4.1 – Frequency of Pneumonia Model Variables over Different Time Periods**

Variable (% unless otherwise indicated)	07/2016-06/2017	07/2017-06/2018	07/2018-06/2019	07/2016-06/2019
Total N	443,917	476,746	454,228	1,374,891
Mean age (SD), in years	80.5 (8.7)	80.3 (8.7)	80.0 (8.6)	80.2 (8.7)
Male	48.7	48.4	49.1	48.7
History of coronary artery bypass graft (CABG) surgery	11.5	11.1	10.9	11.2

Variable (% unless otherwise indicated)	07/2016-06/2017	07/2017-06/2018	07/2018-06/2019	07/2016-06/2019
Severe infection; other infectious diseases (CC 1, 3-7)	41.5	40.6	40.7	40.9
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	17.0	17.2	18.3	17.5
Metastatic cancer and acute leukemia (CC 8)	5.7	5.8	6.4	6.0
Lung and other severe cancers (CC 9)	7.9	8.1	9.0	8.3
Lymphoma; other cancers (CC 10-12)	17.4	17.2	17.8	17.5
Diabetes mellitus (DM) or DM complications (CC 17-19, 122-123)	42.0	41.5	41.7	41.7
Protein-calorie malnutrition (CC 21)	18.2	18.8	19.6	18.9
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23-24)	43.2	43.5	44.7	43.8
Other gastrointestinal disorders (CC 38)	69.5	69.4	70.4	69.8
Severe hematological disorders (CC 46)	2.2	2.0	2.0	2.1
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	57.7	56.9	57.7	57.4
Dementia or other specified brain disorders (CC 51-53)	36.8	35.3	34.3	35.5
Drug/alcohol abuse/dependence/psychosis (CC 54-56)	16.5	17.8	19.0	17.8
Major psychiatric disorders (CC 57-59)	13.3	13.9	14.9	14.0
Other psychiatric disorders (CC 63)	26.8	27.6	28.8	27.8
Hemiplegia, paraplegia, paralysis, functional disability (CC 70-74, 103-104, 189-190)	10.7	10.6	10.8	10.7
Respirator dependence/tracheostomy status (CC 82)	1.4	1.4	1.6	1.5
Respiratory arrest; cardio-respiratory failure and shock (CC 83-84 plus ICD-10-CM codes R09.01 and R09.02, for discharges on or after October 1, 2015; CC 83-84 plus ICD-9-CM diagnosis codes 799.01 and 799.02, for discharges prior to October 1, 2015)	27.3	28.8	30.9	29.0
Congestive heart failure (CC 85)	37.0	37.5	38.7	37.7
Acute coronary syndrome (CC 86-87)	8.6	9.1	9.5	9.1
Coronary atherosclerosis or angina (CC 88-89)	46.6	46.4	46.8	46.6
Valvular and rheumatic heart disease (CC 91)	26.0	26.3	27.4	26.6
Specified arrhythmias and other heart rhythm disorders (CC 96-97)	44.7	45.0	46.0	45.2
Stroke (CC 99-100)	9.8	9.6	9.7	9.7
Vascular or circulatory disease (CC 106-109)	44.6	44.8	46.2	45.2
Chronic obstructive pulmonary disease (COPD) (CC 111)	45.9	48.4	50.9	48.4
Fibrosis of lung or other chronic lung disorders (CC 112)	11.0	11.4	12.4	11.6
Asthma (CC 113)	15.2	13.8	12.9	13.9
Pneumonia (CC 114-116)	39.3	39.2	39.9	39.5
Pleural effusion/pneumothorax (CC 117)	17.4	17.4	18.3	17.7
Other respiratory disorders (CC 118)	50.1	52.4	52.5	51.7
Dialysis status (CC 134)	3.7	3.8	4.0	3.8
Renal failure (CC 135-140)	42.8	43.4	44.8	43.7
Urinary tract infection (CC 144)	30.5	29.5	29.1	29.7

Variable (% unless otherwise indicated)	07/2016-06/2017	07/2017-06/2018	07/2018-06/2019	07/2016-06/2019
Other urinary tract disorders (CC 145)	21.0	20.9	21.1	21.0
Decubitus ulcer or chronic skin ulcer (CC 157-161)	13.5	13.3	13.6	13.5
Vertebral fractures without spinal cord injury (CC 169)	4.9	5.1	5.3	5.1
Other injuries (modified) (CC 174)	40.0	39.9	40.3	40.1

**Table 4.4.2 – Median Parameter Estimates and Credible Intervals (CIs) of Risk Variables from the Logit and Poisson Models for Pneumonia (July 2016-June 2019)**

Variable	Part 1: Logit Model		Part 2: Poisson Model	
	Median	CI	Median	CI
Age minus 65 (years above 65, continuous)	-0.001	(-0.001, -0.000)	-0.005	(-0.005, -0.004)
Male	0.074	(0.065, 0.083)	0.046	(0.043, 0.050)
History of coronary artery bypass graft (CABG) surgery	0.004	(-0.007, 0.018)	-0.012	(-0.017, -0.006)
Severe infection; other infectious diseases (CC 1, 3–7)	0.032	(0.025, 0.041)	0.009	(0.005, 0.012)
Septicemia, sepsis, systemic inflammatory response syndrome/shock (CC 2)	0.007	(-0.006, 0.019)	0.020	(0.015, 0.024)
Metastatic cancer and acute leukemia (CC 8)	0.287	(0.268, 0.307)	0.075	(0.067, 0.082)
Lung and other severe cancers (CC 9)	0.155	(0.140, 0.173)	0.044	(0.039, 0.050)
Lymphoma; other cancers (CC 10–12)	0.017	(0.007, 0.027)	0.006	(0.002, 0.011)
Diabetes mellitus (DM) or DM complications (CC 17–19, 122–123)	0.056	(0.047, 0.063)	0.022	(0.019, 0.026)
Protein-calorie malnutrition (CC 21)	0.176	(0.166, 0.187)	0.126	(0.121, 0.129)
Other significant endocrine and metabolic disorders; disorders of fluid/electrolyte/acid-base balance (CC 23–24)	0.137	(0.128, 0.146)	0.037	(0.032, 0.040)
Other gastrointestinal disorders (CC 38)	0.103	(0.093, 0.112)	-0.030	(-0.034, -0.025)
Severe hematological disorders (CC 46)	0.248	(0.221, 0.278)	0.094	(0.086, 0.104)
Iron deficiency or other/unspecified anemias and blood disease (CC 49)	0.127	(0.119, 0.137)	0.086	(0.083, 0.090)
Dementia or other specified brain disorders (CC 51–53)	0.061	(0.051, 0.069)	-0.008	(-0.011, -0.005)
Drug/alcohol abuse/dependence/psychosis (CC 54–56)	0.120	(0.110, 0.131)	-0.022	(-0.026, -0.018)
Major psychiatric disorders (CC 57–59)	0.042	(0.028, 0.055)	-0.001	(-0.005, 0.003)
Other psychiatric disorders (CC 63)	0.102	(0.094, 0.113)	-0.021	(-0.024, -0.018)
Hemiplegia, paraplegia, paralysis, functional disability (CC 70–74, 103–104, 189–190)	0.097	(0.081, 0.113)	0.056	(0.051, 0.060)
Respirator dependence/tracheostomy status (CC 82)	0.111	(0.082, 0.142)	0.037	(0.027, 0.047)
Respiratory arrest; cardio-respiratory failure and shock (CC 83–84), plus ICD-10-CM codes R09.01 and R09.02	0.098	(0.087, 0.109)	0.069	(0.065, 0.073)



Variable	Part 1: Logit Model		Part 2: Poisson Model	
	Median	CI	Median	CI
Congestive heart failure (CC 85)	0.105	(0.095, 0.115)	0.044	(0.040, 0.048)
Acute coronary syndrome (CC 86–87)	0.092	(0.079, 0.104)	0.001	(-0.004, 0.005)
Coronary atherosclerosis or angina (CC 88–89)	0.051	(0.043, 0.061)	-0.016	(-0.020, -0.012)
Valvular and rheumatic heart disease (CC 91)	0.060	(0.050, 0.069)	0.023	(0.019, 0.027)
Specified arrhythmias and other heart rhythm disorders (CC 96–97)	0.082	(0.073, 0.091)	0.015	(0.011, 0.019)
Stroke (CC 99–100)	0.050	(0.038, 0.063)	0.006	(-0.000, 0.012)
Vascular or circulatory disease (CC 106–109)	0.056	(0.047, 0.064)	-0.003	(-0.006, 0.001)
Chronic obstructive pulmonary disease (COPD) (CC 111)	0.099	(0.090, 0.109)	0.054	(0.050, 0.057)
Fibrosis of lung or other chronic lung disorders (CC 112)	0.067	(0.055, 0.079)	0.043	(0.039, 0.048)
Asthma (CC 113)	0.018	(0.006, 0.029)	-0.027	(-0.031, -0.022)
Pneumonia (CC 114–116)	0.064	(0.055, 0.075)	0.001	(-0.003, 0.004)
Pleural effusion/pneumothorax (CC 117)	0.095	(0.085, 0.105)	0.066	(0.062, 0.069)
Other respiratory disorders (CC 118)	0.020	(0.012, 0.029)	-0.010	(-0.013, -0.007)
Dialysis status (CC 134)	0.268	(0.248, 0.285)	-0.064	(-0.070, -0.057)
Renal failure (CC 135–140)	0.122	(0.113, 0.130)	0.077	(0.074, 0.081)
Urinary tract infection (CC 144)	0.071	(0.063, 0.082)	0.001	(-0.002, 0.005)
Other urinary tract disorders (CC 145)	0.063	(0.053, 0.074)	0.001	(-0.003, 0.005)
Decubitus ulcer or chronic skin ulcer (CC 157–161)	0.070	(0.058, 0.082)	0.082	(0.077, 0.086)
Vertebral fractures without spinal cord injury (CC 169)	0.058	(0.042, 0.076)	0.033	(0.026, 0.039)
Other injuries (modified) (CC 174)	0.094	(0.086, 0.102)	-0.037	(-0.041, -0.033)

**Table 4.4.3 – PPC Results for Pneumonia (July 2016-June 2019)**

Statistic	Observed Days in Acute Care	MCMC 95% CI for Predicted Days in Acute Care	P-Value
Variance	0.250	(0.149 – 0.186)	<0.001
Median	1.002	(0.767 – 0.782)	<0.001
IQR	0.520	(0.441 – 0.466)	<0.001
Coefficient of variation	0.489	(0.476 – 0.528)	0.612

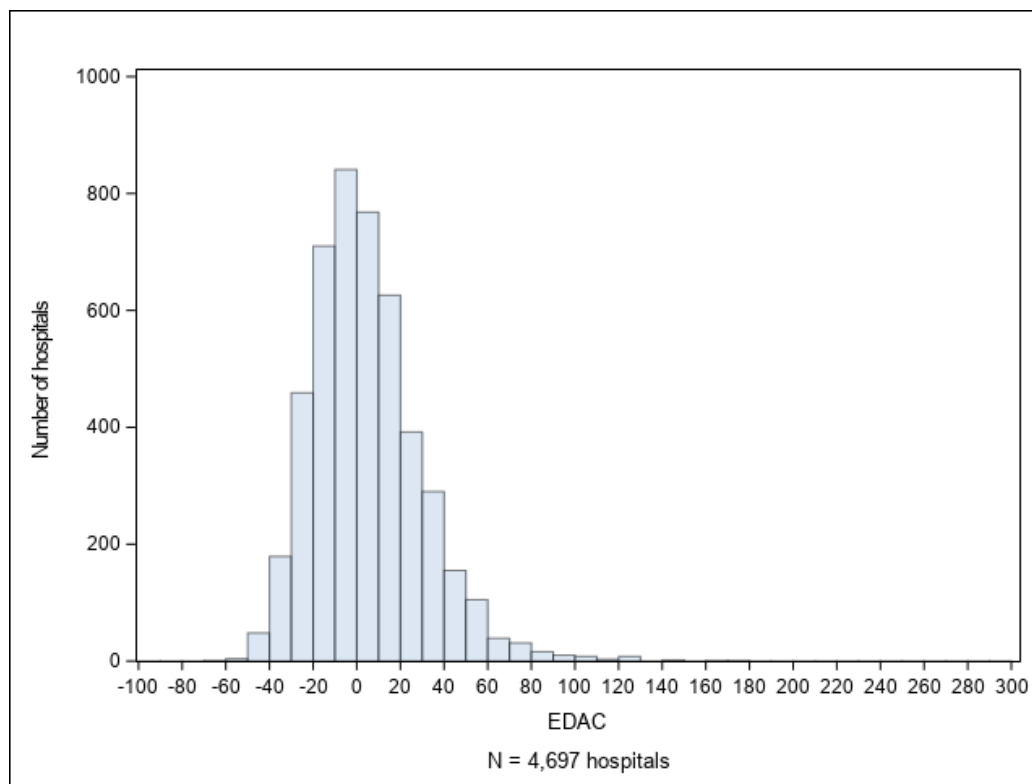
**Table 4.4.4 – Pneumonia Generalized Linear Regression Model Performance (July 2016-June 2019)**

Characteristic	07/2016-06/2019
C-statistic (Logit part)	0.62
Deviance R <sup>2</sup> (Poisson part)	0.038

**Table 4.4.5 – Hospital-Level Unadjusted Distribution of Overall Acute Care, ED Visits, Observation Stays, and Readmissions per 100 Pneumonia Discharges, and Distribution of EDAC (July 2016-June 2019)**

Description	Mean $\pm$ SD	Median (Q1, Q3)	Range
Observed days in acute care	102.20 (50.01)	100.20 (74.24, 126.21)	833
Days of ED visits	9.02 (5.86)	7.90 (6.03, 11.04)	200
Days of observation stays	7.29 (7.36)	6.17 (3.42, 9.52)	250
Days of readmissions	89.47 (49.42)	87.50 (60.49, 112.75)	833
EDAC	4.49 (25.09)	1.34 (-13.03, 17.75)	244.20
Days of predicted	105.83 (32.60)	102.38 (82.15, 124.45)	309.35
Days of expected	101.34 (15.06)	101.10 (92.40, 109.43)	276.81

**Figure 4.4.2 – Hospital-Level EDAC per 100 Discharges for Pneumonia for the July 2016-June 2019 Dataset**



## 5. GLOSSARY

**Acute care hospital:** A hospital that provides inpatient medical care for surgery and acute medical conditions or injuries. Short-term acute care hospitals provide care for short-term illnesses and conditions. In contrast, long-term acute care hospitals generally treat medically complex patients who require long-stay hospital-level care, which is generally defined as an inpatient length of stay greater than 25 days.

**C-statistic:** An indicator of the model's discriminant ability or ability to correctly classify those patients who have and have not had a qualifying event within 30 days. Potential values range from 0.5, meaning no better than chance, to 1.0, an indication of perfect prediction. Perfect prediction implies that patients' outcomes can be predicted completely by their risk factors, and physicians and hospitals play no role in their patients' outcomes.

**Case mix:** The particular illness severity, age, and, for some measures, gender characteristics of patients with index admissions at a given hospital.

**Clinical Classification Software (CCS):** Software maintained by the AHRQ that groups thousands of individual procedure and diagnosis codes into clinically coherent, mutually exclusive procedure and diagnosis categories. AHRQ CCS categories are used to determine if a readmission is planned. AHRQ CCS procedure categories are used to define planned and potentially planned procedures. AHRQ CCS diagnosis categories are used to define acute diagnoses and complications of care that are considered unplanned, as well as a few specific types of care that are always considered planned (for example, maintenance chemotherapy). Mappings which show the assignment of ICD-10 codes to the AHRQ CCS diagnosis and procedure categories are available [here](#) on the AHRQ website.

**Cohort:** The index admissions used to calculate the measure after inclusion and exclusion criteria have been applied.

**Comorbidities:** Medical conditions the patient had in addition to their primary reason for admission to the hospital.

**Complications:** Medical conditions that may have occurred as a consequence of care rendered during hospitalization.

**Condition Categories (CCs):** Groupings of ICD-9-CM/ICD-10-CM diagnosis codes into clinically relevant categories, from the HCC system.<sup>10,11</sup> CMS uses modified groupings, but not the hierarchical logic of the system, to create risk factor variables. Mappings which show the assignment of ICD-9 and ICD-10 codes to the CCs are available [here](#) on *QualityNet*.

**Credible interval (CI):** Analogous to a confidence interval, under a Bayesian framework. Like a confidence interval, a CI is a range of values that describes the uncertainty surrounding an estimate. However, unlike a confidence interval, the 95% CI is selected from the posterior probability distribution, which takes into account the prior distribution and new evidence learned.

**Deviance  $R^2$ :** A statistical tool used to evaluate the goodness-of-fit of logistic models.

**Expected days:** The average number of risk-adjusted days in acute care that a hospital's patients would have been expected to spend if discharged from an average performing hospital with the same case mix.

**Index admission:** Any admission included in the measure calculation as the initial admission for an episode of AMI, HF, or pneumonia care and evaluated for the outcome.

**Log-likelihood:** The logarithm of a likelihood function, which is defined as a function of the parameters of a statistical model given data.

**Medicare Fee-For-Service (FFS):** Original Medicare plan in which providers receive a fee or payment directly from Medicare for each individual service provided. Only beneficiaries in Medicare FFS, rather than managed care (Medicare Advantage), are included in the measures.

**Outcome:** The result of a broad set of healthcare activities that affect patients' well-being. For the EDAC measures, the outcome is the number of days the patient spends in acute care in the 30 days after discharge.

**Planned readmissions:** A readmission within 30 days of discharge from a short-term acute care hospital that is a scheduled part of the patient's plan of care. Planned readmissions are not captured in the outcomes of these measures.

**Posterior predictive checking (PPC):** To evaluate whether the model fits the data well, observations from the fitted model are simulated, followed by a comparison of the distribution of the simulation data to the observed data (that is, the real data). The aim is to investigate whether there is any discrepancy between the real data and the model-based simulated data.

**Predicted days:** The average number of risk-adjusted days a hospital's patients spent in acute care.

**Risk-adjustment variables:** Patient demographics and comorbidities used to standardize rates for differences in case mix across hospitals.

**Truncated Poisson model (or Truncated Poisson distribution):** Similar to the usual Poisson distribution, the zero-truncated Poisson (ZTP) distribution is a discrete probability distribution that only takes positive integers.

**Unplanned readmissions:** Acute clinical events a patient experienced that require urgent rehospitalization. Unplanned readmissions are captured in the outcomes of these measures.

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## 7. APPENDICES

### Appendix A. Statistical Approach to EDAC for AMI, HF and Pneumonia Measures

We estimate the hospital-specific EDAC using a random effects hurdle model. This model consists of the two-part logit/truncated Poisson model specifications for days in acute care and includes two random effects for hospitals – one for the logit part and one for the truncated Poisson part – with a non-zero covariance between the two random effects. This strategy accounts for within-hospital correlation of the observed outcome and accommodates the assumption that underlying differences in quality across hospitals lead to systematic differences in outcomes.

#### Hospital Performance Reporting

Explicitly, let  $Y_{ij}$  denote the number of days in acute care experienced by the  $i$ -th patient discharged from the  $j$ -th hospital, and  $\omega_{ij}$  is the patient's exposure time (the number of days alive up to 30). At the first stage, whether a patient has non-zero days in acute care (that is, a binary outcome of  $Y_{ij} > 0$  vs.  $Y_{ij} = 0$ ) is modeled via a logistic regression model. At the second stage, if a patient utilizes acute care within 30 days after discharge ( $Y_{ij} > 0$ ),  $Y_{ij}$  is made a variable of counts and is assumed to follow a ZTP distribution. Thus, we have the following "hurdle" model:

$$\begin{cases} \text{logit}(\pi_{ij}) = \log(\omega_{ij}) + X_{ij}C + v_j \text{ where } \pi_{ij} = \Pr\{Y_{ij} > 0\} \\ \log(\mu_{ij}) = \log(\omega_{ij}) + X_{ij}B + u_j \text{ where } Y_{ij} | Y_{ij} > 0 \sim \text{Truncated Poisson}(\mu_{ij}) \end{cases} \quad (1)$$

Note that  $E(Y_{ij} | Y_{ij} > 0) = \mu_{ij} / (1 - \exp(-\mu_{ij}))$  and  $E(Y_{ij}) = \pi_{ij} \mu_{ij} / (1 - \exp(-\mu_{ij}))$ .  $(v_j, u_j) \sim MVN(M, \Sigma)$ , where  $v_j$  and  $u_j$  are random effects across hospitals with means  $M = [C_0, B_0]$  and variance-covariance matrix  $\Sigma$ . The  $X_{ij}$  is a vector of patient risk factors, and  $B$  and  $C$  are vectors of covariate coefficients.

We estimated the model and used the coefficient vectors  $B$  and  $C$  and the random effects  $v_j$  and  $u_j$  to calculate the predicted ( $P_{ij}$ ) and expected ( $E_{ij}$ ) days in acute care for each index admission, respectively. Specifically, we calculate:

$$\text{Predicted} \quad P_{ij} = \text{logit}^{-1}(\log(\omega_{ij}) + X_{ij}C + v_j) * \frac{\exp(\log(\omega_{ij}) + X_{ij}B + u_j)}{1 - \exp(-\exp(\log(\omega_{ij}) + X_{ij}B + u_j))} \quad (2)$$

$$\text{Expected} \quad E_{ij} = \text{logit}^{-1}(\log(\omega_{ij}) + X_{ij}C + C_0) * \frac{\exp(\log(\omega_{ij}) + X_{ij}B + B_0)}{1 - \exp(-\exp(\log(\omega_{ij}) + X_{ij}B + B_0))} \quad (3)$$

where  $C_0$  and  $B_0$  are means of the random effects  $v_j$  and  $u_j$ .

We then calculated the EDAC for the hospital  $j$  as:

$$EDAC_j = 100 * \sum(P_{ij} - E_{ij})/m_j \quad (4)$$

where the sum is over all patients at hospital  $j$ , and  $m_j$  is the number of index admissions at hospital  $j$ . To be consistent with the reporting of the CMS 30-day AMI, HF, and pneumonia readmission measures, we have multiplied the final measure by 100 so that EDAC represents EDAC per 100 discharges.

### Creating Credible Intervals (CIs)

We use Markov Chain Monte Carlo (MCMC) estimation approach to derive a CI.<sup>12</sup> MCMC estimation allows us to generate a large number of simulated values of  $P_{ij}$ ,  $E_{ij}$ ,  $v_j$  and  $u_j$ , from their posterior distribution (determined by both prior assumption for those quantities and the actual data), to base inferences; using these simulated values of  $P_{ij}$ ,  $E_{ij}$ ,  $v_j$  and  $u_j$ , we can also obtain the posterior distribution of  $EDAC_j$  for each hospital (since  $EDAC_j$  is a function of those values). The median value of the posterior distribution of  $EDAC_j$  is taken as the hospital point estimate, with the 2.5<sup>th</sup> and 97.5<sup>th</sup> percentile order statistics taken as the endpoints of a 95% CI.

## **Appendix B. Data QA**

This production year required updates to all SAS packs to account for updates in ICD-10 codes and associated mappings of clinical groupers. To assure the quality of measure output, we utilized a multi-phase approach to QA of the EDAC measures.

This section represents QA for the subset of the work CORE conducted to maintain and report these EDAC measures. It does not describe the QA for processing data and creating the input files, nor does it include the QA for the final processing of production data for public reporting, because another contractor conducts that work.

### **Phase I**

The first step in this year's QA process was to review changes in the cohort and outcomes definitions as determined by the measure-specific code set files that were updated to account for changes in ICD-10 coding. This included updates to the AHRQ CCS software and the HCC clinical category maps.

In general, we used both manual scan and descriptive analyses to conduct data validity checks, including cross-checking EDAC information, distributions of ICD-10 codes, and frequencies of key variables.

### **Phase II**

We updated the existing SAS packs to accommodate the new codes and updates to the measures. To assure accuracy in SAS pack coding, two analysts independently write SAS code for any major changes made in calculating the EDAC measures: data preparation, sample selection, hierarchical modeling, and calculation of EDAC. This process highlights any programming errors in syntax or logic. Once the parallel programming process is complete, the analysts cross-check their codes by analyzing datasets in parallel, checking for consistency of output, and reconciling any discrepancies.

### **Phase III**

A third analyst reviews the finalized SAS code and recommends changes to the coding and readability of the SAS packs, where appropriate. The primary analyst receives the suggested changes for possible re-coding or program documentation when needed.

During this phase, we also compare prior years' risk-adjustment coefficients and variable frequencies to enable us to check for potential inconsistencies in the data and the impact of any changes to the SAS packs. Anything that seems outside of normal coding fluctuation is further reviewed in more detail.



## Appendix C. Annual Updates

Prior annual updates for the measures can be found in the annual updates and specifications reports available [here](#) on *QualityNet*. For convenience, we have listed all updates under the reporting year and corresponding report. In 2013, CMS began assigning version numbers to its measures. The measure specifications in the original methodology reports are considered Version 1.0 for each measure. The measure specifications in the updated AMI and HF EDAC methodology reports are considered Version 1.1. The measures receive a new version number for each subsequent year of public reporting.

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### 2020

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#### 2020 Measures Updates and Specifications Report (Version 5.0 – AMI and HF) (Version 4.0 – Pneumonia)

1. Updated the ICD-10 code-based specifications used in the measures. Specifically:
  - Incorporated the code changes that occurred in the FY 2019 version of the ICD-10-CM/PCS (effective with October 1, 2018+ discharges) into the cohort definitions and risk models;
  - Applied version 2019.1 (beta version) of the AHRQ CCS for ICD-10-CM/PCS to the planned readmission algorithm;
  - Applied a modified version of the FY 2019 V22 CMS-HCC crosswalk that is maintained by RTI International to the risk models; and,
  - Made additional code specification changes prompted by the activities described in [Section 3](#).
    - Rationale: Revisions to the measure specifications were warranted to accommodate updated versions of the ICD-10-CM/PCS, AHRQ CCS, and CMS-HCC crosswalk as well as the workgroup review activities.
2. Added admission data from VA hospitals to the measures.
  - Rationale: Creates a more inclusive perspective of the relative quality of U.S. hospitals.
3. Added the revenue center codes 0138 (Semi\_private 3 and 4 beds-rehabilitation) and 0158 (Room&Board ward (medical or general)-rehabilitation) to the revenue center code list used to identify transfers to rehabilitation units, to ensure these transfers are not captured as readmissions for any hospital (Refer to the [2018 updates](#) below).
  - Rationale: Revenue center codes 0138 and 0158 are appropriate codes for identifying rehabilitation stays in non-VA hospital claims.

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### 2019

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#### 2019 Measures Updates and Specifications Report (Version 4.0 – AMI and HF) (Version 3.0 – Pneumonia)

1. Updated the ICD-10 code-based specifications used in the measures. Specifically:
  - Incorporated the code changes that occurred in the FY 2018 version of the ICD-10-CM/PCS (effective with October 1, 2017+ discharges) into the cohort definitions, planned readmission algorithm, and risk models;
  - Applied version 2018.1 of the AHRQ CCS for ICD-10-CM/PCS to the planned readmission algorithm;
  - Applied a modified version of the FY 2018 V22 CMS-HCC crosswalk that is maintained by RTI International to the risk models; and,
  - Made additional code specification changes prompted by other workgroup activities, including code frequency monitoring, review of select pre-existing ICD-10 code specifications, and neighboring code searches. For example, ICD-10-CM code I21.9, Acute myocardial infarction, unspecified, was identified through a “neighboring code search”

(found near existing code I21.4, Non-ST elevation (N-STEMI) myocardial infarction) and determined through clinical review to be a code which meets measure intent. As a result, it was added to the AMI cohort inclusion list.

- Rationale: Revisions to the measure specifications were warranted to accommodate updated versions of the ICD-10-CM/PCS, AHRQ CCS, and CMS-HCC crosswalk as well as the workgroup review activities.
2. Revised the methodology used to count the number of observation stay days in the EDAC outcome. The use of both physician and facility claims (and use of the claim with the longer duration when both claims are present) was changed to use of physician claims only in cases when a facility claim is not available.
    - Rationale: Done in response to stakeholder feedback. This change has minimal impact on the measure results.

## 2018

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### 2018 Measures Updates and Specifications Report (Version 3.0 – AMI and HF) (Version 2.0 – Pneumonia)

1. Updated the ICD-10 code-based specifications used in the measures. Specifically:
  - Incorporated the code changes that occurred in the FY 2017 version of the ICD-10-CM/PCS into the planned readmission algorithm and risk models;
  - Applied the 2017.1 and 2017.2 versions of the AHRQ CCS to the planned readmission algorithm for diagnoses and procedures, respectively;
  - Applied the FY 2017 version of the V22 CMS-HCC crosswalk maintained by RTI International to the risk models; and,
  - Monitored code frequencies to identify any code specification changes warranted due to possible changes in coding practices and patterns. Additionally, our clinical and measure experts reviewed the pre-existing ICD-10 code-based specifications to confirm the appropriateness of the specifications unaffected by the updates.
    - Rationale: Updated versions of the ICD-10-CM/PCS, AHRQ CCS, and CMS-HCC crosswalk were released. Revisions to the measure specifications were warranted to accommodate these updates.
2. Updated the methodology used in analytic input file production to identify transfers to rehabilitation units, to further ensure these transfers are not captured as readmissions for any hospital. In addition to the previous methods described in the [2017 update](#) below, use of revenue center codes has been implemented, to help identify these cases in both ICD-9 and ICD-10 code-based claims. Specifically:
  - 0024: Inpatient Rehabilitation Facility services paid under PPS submitted as Type of Bill 11X
  - 0118: Private medical or general-rehabilitation
  - 0128: Semi-private 2 bed (medical or general)-rehabilitation
  - 0148: Private (deluxe)-rehabilitation
    - Rationale: The inability to use principal discharge diagnosis codes to identify rehabilitation stays (due to ICD-10 coding guidance) has led to an under-counting of these transfers primarily for Maryland hospitals and critical access hospitals, hospitals that are not part of the IPPS. Utilization of revenue center codes augments our ability to identify and exclude admissions to rehabilitation beds in these hospitals that are not identified through discharge disposition codes alone. Of note, rehabilitation units are most often identified by CMS certification number (CCN).
3. Removed the obstetric AHRQ CCS procedure and diagnosis categories from the planned readmission algorithm. Specifically, AHRQ CCS procedure categories 134 and 135 and AHRQ CCS

diagnosis categories 194 and 196 were deleted from the always planned procedure and diagnosis lists, respectively. They remain in the SAS packs, but are commented out.

- Rationale: The obstetric codes were incorporated into the initial planned readmission algorithm specifications during development. They were provided for all-payer settings, but are not applicable to the CMS EDAC measures that include only those patients aged 65 or over.
- 4. Re-specified the pneumonia risk model, updating the CC-based risk variables previously defined using the HCC version 12 map (in the pneumonia measure methodology report posted [here](#) on *QualityNet*) to the HCC version 22 map.
  - Rationale: The measurement period for 2018 public reporting required data from claims that include ICD-10 codes in addition to data from claims that include ICD-9 codes. Thus, updating the CC-based risk variables to the ICD-10-compatible HCC system version 22 was warranted.

## 2017

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### 2017 Measures Updates and Specifications Report (Version 2.0 – AMI and HF)

1. Revised the measure specifications to accommodate the implementation of ICD-10 coding:
  - Identified the ICD-10 codes used to define each of the measure cohorts for discharges on or after October 1, 2015;
  - Updated the planned readmission algorithm, by using the most recent (2016) version of the ICD-10-based AHRQ CCS and ICD-10 codes for certain “potentially planned procedures” and “acute diagnoses” to the algorithm specifications, for discharges on or after October 1, 2015; and,
  - Re-specified the risk models, updating the CC-based risk variables to the ICD-10-compatible HCC system version 22 and applying ICD-10 codes for certain risk variables (for example, ‘History of percutaneous transluminal coronary angioplasty (PTCA)’ to the models.
    - Rationale: The ICD-9 code sets used to report medical diagnoses and inpatient procedures were replaced by ICD-10 code sets on October 1, 2015. The U.S. Department of Health and Human Services (HHS) mandated that ICD-10 codes be used for medical coding, effective with October 1, 2015 discharges. The measurement period for 2017 public reporting required data from claims that include ICD-10 codes in addition to data from claims that include ICD-9 codes. Thus, re-specification was warranted to accommodate ICD-10 coding.
2. Psychiatric and rehabilitation units within short-term acute care hospitals in Maryland have the same type of provider ID number (or CCN) as the acute care hospital in which they are housed. Transfers to these units can therefore look like readmissions. To accurately assess readmissions in Maryland and allow for public reporting of Maryland readmission rates, methodologies to identify these cases were needed, to ensure these transfers are not captured as readmissions for any hospital:
  - Identification of psychiatric admissions before and after October 1, 2015:
    - (1) the admission being evaluated as a potential readmission has a psychiatric principal discharge diagnosis code (ICD-9-CM codes beginning with ‘29’, ‘30’ or ‘31’, for discharges prior to October 1, 2015, or ICD-10-CM codes beginning with ‘F’, for discharges on or after October 1, 2015);
    - (2) the index admission has a discharge disposition code to a psychiatric hospital or psychiatric unit from the index admission; and,
    - (3) the admission being evaluated as a potential readmission occurred during the same day as or the day following the index discharge.

- Identification of rehabilitation admissions prior to October 1, 2015:
  - (1) The admission being evaluated as a potential readmission has an ICD-9-CM principal discharge diagnosis code beginning with 'V57'.
- Identification of rehabilitation admissions on or after October 1, 2015:
  - (1) the index admission has a discharge disposition code to a rehabilitation hospital or rehabilitation unit from the index admission; and,
  - (2) the admission being evaluated as a potential readmission occurred on the same day as or the day following the index discharge.
- Psychiatric/rehabilitation admissions identified as described above are not captured as readmissions. Note that we do not expect to see rehabilitation claims in hospital data from states other than Maryland.
  - Rationale: With the implementation of ICD-10 coding effective with discharges on or after October 1, 2015, the criteria for Maryland hospitals had to be specified for both ICD-10 and ICD-9 code-based claims. For psychiatric admissions, defining "psychiatric diagnosis" with ICD-10-CM codes for discharges on or after October 1, 2015 was a simple solution, as mental health diagnosis codes all reside under the Category 'F' (Mental, Behavioral and Neurodevelopmental disorders). However, for rehabilitation admissions, rehabilitation diagnosis codes are no longer coded consistently. Thus, defining the V57.0 ICD-9-CM code criterion with ICD-10-CM codes was not a viable option, and a different strategy was warranted.

## Appendix D. Measure Specifications

### Appendix D.1 Hospital-Level 30-Day EDAC following AMI (NQF #2881)

#### Cohort

##### Inclusion Criteria for AMI Measure

- 1. Principal discharge diagnosis of AMI**  
Rationale: AMI is the condition targeted for measurement.
- 2. Enrolled in Medicare FFS Part A and Part B for the 12 months prior to the date of admission and Part A during the index admission, or those who are VA beneficiaries**  
Rationale: Claims data are consistently available only for Medicare FFS and VA beneficiaries. For patients who are not VA beneficiaries, the 12-month prior enrollment criterion ensures that patients were Medicare FFS beneficiaries and that their comorbidities are captured from claims for risk adjustment. Medicare Part A is required at the time of admission to non-VA hospitals to ensure that no Medicare Advantage patients are included in the measure.
- 3. Aged 65 or over**  
Rationale: Patients younger than 65 are not included in the measure because they are considered to be too clinically distinct from patients 65 or over.
- 4. Discharged alive from a non-federal short-term acute care hospital or VA hospital**  
Rationale: It is only possible for patients to be eligible for an ED visit, observation stay, or readmission if they are discharged alive.
- 5. Not transferred to another acute care facility**  
Rationale: Hospitalizations that result in a transfer to another acute care facility are not included in the measure because the measure's focus is on admissions that result in discharge to a non-acute care setting (for example, to home or a skilled nursing facility).

##### Exclusion Criteria for AMI Measure

- 1. Without at least 30 days of post-discharge enrollment in Medicare FFS (in the case of patients who are not VA beneficiaries)**  
Rationale: The 30-day outcome cannot be assessed in this group since claims data are used to determine whether a patient visited the ED, was placed under observation, or was readmitted.
- 2. Discharged against medical advice**  
Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge.
- 3. Same-day discharges**  
Rationale: Patients admitted and then discharged on the same day are not included as an index admission because it is unlikely that these admissions are for clinically significant AMIs.
- 4. AMI admissions within 30 days of discharge from a prior AMI index admission**  
Rationale: Additional AMI admissions within 30 days are excluded as index admissions because they are part of the outcome. A single admission is not considered both an index admission and a readmission for another index admission.

The ICD-10-CM codes used to define the AMI cohort are outlined in the 2020 AMI EDAC Measure Code Specifications supplemental file posted [here](#) on *QualityNet*.

## **Outcome**

### **Outcome Criteria for AMI Measure**

#### **All-cause days in acute care within 30 days from the date of discharge from an index admission**

Rationale: Days in acute care are defined as days spent in an ED, admitted to observation status, or admitted as an unplanned readmission for any cause within 30 days from the date of discharge from the index AMI hospitalization. From a patient's perspective, days in acute care from any cause is an adverse event. Multiple events are counted in order to capture the full patient experience in the post-discharge period. Outcomes occurring within 30 days of discharge can be influenced by hospital care. The 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities to reduce days in acute care.

## Appendix D.2 Hospital-Level 30-Day EDAC following HF (NQF #2880)

### Cohort

#### Inclusion Criteria for HF Measure

- 1. Principal discharge diagnosis of HF**  
Rationale: HF is the condition targeted for measurement.
- 2. Enrolled in Medicare FFS Part A and Part B for the 12 months prior to the date of admission and Part A during the index admission, or those who are VA beneficiaries**  
Rationale: Claims data are consistently available only for Medicare FFS and VA beneficiaries. For patients who are not VA beneficiaries, the 12-month prior enrollment criterion ensures that patients were Medicare FFS beneficiaries and that their comorbidities are captured from claims for risk adjustment. Medicare Part A is required at the time of admission to non-VA hospitals to ensure that no Medicare Advantage patients are included in the measure.
- 3. Aged 65 or over**  
Rationale: Patients younger than 65 are not included in the measure because they are considered to be too clinically distinct from patients 65 or over.
- 4. Discharged alive from a non-federal short-term acute care hospital or VA hospital**  
Rationale: It is only possible for patients to be eligible for an ED visit, observation stay, or readmission if they are discharged alive.
- 5. Not transferred to another acute care facility**  
Rationale: Hospitalizations that result in a transfer to another acute care facility are not included in the measure because the measure's focus is on admissions that result in discharge to a non-acute care setting (for example, to home or a skilled nursing facility).

#### Exclusion Criteria for HF Measure

- 1. Without at least 30 days of post-discharge enrollment in Medicare FFS (in the case of patients who are not VA beneficiaries)**  
Rationale: The 30-day outcome cannot be assessed in this group since claims data are used to determine whether a patient visited the ED, was placed under observation, or was readmitted.
- 2. Discharged against medical advice**  
Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge.
- 3. HF admissions within 30 days of discharge from a prior HF index admission**  
Rationale: Additional HF admissions within 30 days are excluded as index admissions because they are part of the outcome. A single admission is not considered both an index admission and a readmission for another index admission.
- 4. With a procedure code for LVAD implantation or heart transplantation either during the index admission or in the 12 months prior to the index admission**  
Rationale: These patients represent a clinically distinct group.

The ICD-10 codes used to define HF cohort inclusions and exclusions for discharges on or after October 1, 2015 are outlined in the 2020 HF EDAC Measure Code Specifications supplemental file posted [here](#) on *QualityNet*.

ICD-9 code lists used to identify HF cohort exclusions (LVAD and heart transplant procedures) in claims for discharges prior to October 1, 2015 can be found in the HF updated measure methodology report posted [here](#) on *QualityNet*.

## **Outcome**

### **Outcome Criteria for HF Measure**

#### **All-cause days in acute care within 30 days from the date of discharge from an index admission**

Rationale: Days in acute care are defined as days spent in an ED, admitted to observation status, or admitted as an unplanned readmission for any cause within 30 days from the date of discharge from the index HF hospitalization. From a patient's perspective, days in acute care from any cause is an adverse event. Multiple events are counted in order to capture the full patient experience in the post-discharge period. Outcomes occurring within 30 days of discharge can be influenced by hospital care. The 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities to reduce days in acute care.



## Appendix D.3 Hospital-Level 30-Day EDAC following Pneumonia (NQF #2882)

### Cohort

#### Inclusion Criteria for Pneumonia Measure

**1. Principal discharge diagnosis of:**

- **Pneumonia; or,**
- **Sepsis (not including severe sepsis) with a secondary diagnosis of pneumonia coded as POA and no secondary diagnosis of severe sepsis coded as POA**

Rationale: Pneumonia is the condition targeted for measurement. Sepsis admissions with a secondary diagnosis of pneumonia, as described above, are also included in order for the measure to more fully reflect the population of Medicare FFS and VA beneficiaries being treated for pneumonia.

**2. Enrolled in Medicare FFS Part A and Part B for the 12 months prior to the date of admission and Part A during the index admission, or those who are VA beneficiaries**

Rationale: Claims data are consistently available only for Medicare FFS and VA beneficiaries. For patients who are not VA beneficiaries, the 12-month prior enrollment criterion ensures that patients were Medicare FFS beneficiaries and that their comorbidities are captured from claims for risk adjustment. Medicare Part A is required at the time of admission to non-VA hospitals to ensure that no Medicare Advantage patients are included in the measure.

**3. Aged 65 or over**

Rationale: Patients younger than 65 are not included in the measure because they are considered to be too clinically distinct from patients 65 or over.

**4. Discharged alive from a non-federal short-term acute care hospital or VA hospital**

Rationale: It is only possible for patients to be eligible for an ED visit, observation stay, or readmission if they are discharged alive.

**5. Not transferred to another acute care facility**

Rationale: Hospitalizations that result in a transfer to another acute care facility are not included in the measure because the measure's focus is on admissions that result in discharge to a non-acute care setting (for example, to home or a skilled nursing facility).

#### Exclusion Criteria for Pneumonia Measure

**1. Without at least 30 days of post-discharge enrollment in Medicare FFS (in the case of patients who are not VA beneficiaries)**

Rationale: The 30-day outcome cannot be assessed in this group since claims data are used to determine whether a patient visited the ED, was placed under observation, or was readmitted.

**2. Discharged against medical advice**

Rationale: Providers did not have the opportunity to deliver full care and prepare the patient for discharge.

**3. Pneumonia admissions within 30 days of discharge from a prior pneumonia index admission**

Rationale: Additional pneumonia admissions within 30 days are excluded as index admissions because they are part of the outcome. A single admission is not considered both an index admission and a readmission for another index admission.

The ICD-10-CM codes used to define the pneumonia cohort are outlined in the 2020 Pneumonia EDAC Measure Code Specifications supplemental file posted [here](#) on *QualityNet*.

## **Outcome**

### **Outcome Criteria for Pneumonia Measure**

#### **All-cause days in acute care within 30 days from the date of discharge from an index admission**

Rationale: Days in acute care are defined as days spent in an ED, admitted to observation status, or admitted as an unplanned readmission for any cause within 30 days from the date of discharge from the index pneumonia hospitalization. From a patient's perspective, days in acute care from any cause is an adverse event. Multiple events are counted in order to capture the full patient experience in the post-discharge period. Outcomes occurring within 30 days of discharge can be influenced by hospital care. The 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities to reduce days in acute care.

## Appendix D.4 Definition of ED Visits and Observation Stays

**Table D.4.1 – Codes Used to Define ED Visits and Observation Stays**

Code (Code Type)	Description
<b>ED Definition</b>	
0450 (Revenue Center Code)	Emergency room-general classification
0451 (Revenue Center Code)	Emergency room-emtala emergency medical screening services
0452 (Revenue Center Code)	Emergency room-ER beyond emtala screening
0459 (Revenue Center Code)	Emergency room-other
0981 (Revenue Center Code)	Professional fees-emergency room
<b>Observation Stay Definition</b>	
0762 (Revenue Center Code)	Treatment or observation room-observation room
G0378 (Healthcare Common Procedure Coding System [HCPCS] Code)	Hospital observation service, per hour
99217 (Current Procedural Terminology [CPT] Code)	Observation care discharge day management
99218 (CPT Code)	Initial observation care, per day, for the evaluation and management of a patient which requires these 3 key components: A detailed or comprehensive history; A detailed or comprehensive examination; and Medical decision making that is straightforward or of low complexity. Counseling and/or coordination of care with other physicians, other qualified health care professionals, or agencies are provided consistent with the nature of the problem(s) and the patient's and/or family's needs. Usually, the problem(s) requiring admission to outpatient hospital "observation status" are of low severity. Typically, 30 minutes are spent at the bedside and on the patient's hospital floor or unit.
99219 (CPT Code)	Initial observation care, per day, for the evaluation and management of a patient, which requires these 3 key components: A comprehensive history; A comprehensive examination; and Medical decision making of moderate complexity. Counseling and/or coordination of care with other physicians, other qualified health care professionals, or agencies are provided consistent with the nature of the problem(s) and the patient's and/or family's needs. Usually, the problem(s) requiring admission to outpatient hospital "observation status" are of moderate severity. Typically, 50 minutes are spent at the bedside and on the patient's hospital floor or unit.
99220 (CPT Code)	Initial observation care, per day, for the evaluation and management of a patient, which requires these 3 key components: A comprehensive history; A comprehensive examination; and Medical decision making of high complexity. Counseling and/or coordination of care with other physicians, other qualified health care professionals, or agencies are provided consistent with the nature of the problem(s) and the patient's and/or family's needs. Usually, the problem(s) requiring admission to outpatient hospital "observation status" are of high severity. Typically, 70 minutes are spent at the bedside and on the patient's hospital floor or unit.
99234 (CPT Code)	Observation or inpatient hospital care, for the evaluation and management of a patient including admission and discharge on the same date, which requires these 3 key components: A detailed or comprehensive history; A detailed or

Code (Code Type)	Description
	comprehensive examination; and Medical decision making that is straightforward or of low complexity. Counseling and/or coordination of care with other physicians, other qualified health care professionals, or agencies are provided consistent with the nature of the problem(s) and the patient's and/or family's needs. Usually the presenting problem(s) requiring admission are of low severity. Typically, 40 minutes are spent at the bedside and on the patient's hospital floor or unit.
99235 (CPT Code)	Observation or inpatient hospital care, for the evaluation and management of a patient including admission and discharge on the same date, which requires these 3 key components: A comprehensive history; A comprehensive examination; and Medical decision making of moderate complexity. Counseling and/or coordination of care with other physicians, other qualified health care professionals, or agencies are provided consistent with the nature of the problem(s) and the patient's and/or family's needs. Usually the presenting problem(s) requiring admission are of moderate severity. Typically, 50 minutes are spent at the bedside and on the patient's hospital floor or unit.
99236 (CPT Code)	Observation or inpatient hospital care, for the evaluation and management of a patient including admission and discharge on the same date, which requires these 3 key components: A comprehensive history; A comprehensive examination; and Medical decision making of high complexity. Counseling and/or coordination of care with other physicians, other qualified health care professionals, or agencies are provided consistent with the nature of the problem(s) and the patient's and/or family's needs. Usually the presenting problem(s) requiring admission are of high severity. Typically, 55 minutes are spent at the bedside and on the patient's hospital floor or unit.

## Appendix E. Planned Readmission Algorithm

Figure PR.1 – Planned Readmission Algorithm Version 4.0 2020 Flowchart

