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Updating Risk-Adjusted Ambulatory Care Sensitive Hospitalizations and Emergency Department Visits Quality Measures

A report by RTI International for the Medicare Payment Advisory Commission

The views expressed in this report are those of the authors. No endorsement by MedPAC is intended or should be inferred.

MEDPAC
Medicare Payment Advisory Commission

425 I Street, NW | Suite 701 | Washington, DC 20001 | (202) 220-3700 | www.medpac.gov

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Final Report

Prepared for

Ledia Tabor, MPH
Medicare Payment Advisory Commission
425 I Street, NW Suite 701
Washington, DC 20001

Prepared by

Micah Segelman, PhD
Benjamin Silver, PhD
Kelly Hughes, BA
Hannah Wright, MSPH
Chris Brostrup-Jensen, BA
Victor Coto, BA
Chris Beadles, MD, PhD
RTI International
3040 E. Cornwallis Road
Research Triangle Park, NC 27709

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Background

The Medicare Payment Advisory Commission (MedPAC) has established a set of principles for measuring quality of care provided under the auspices of the Medicare program. These principles hold that Medicare quality programs should use a small set of population-based outcome, patient experience, and value measures to assess the quality of care across different populations, such as beneficiaries enrolled in fee-for-service (FFS) in defined market areas.

The Commission has discussed including ambulatory care sensitive hospitalizations (ACSHs) and ambulatory care sensitive emergency department (ED) visits (ACSVs) in this small set of measures, given the adverse patient impact and high cost of these events. ACSHs and ACSVs may result from inadequate access to ambulatory care or inadequate coordination of ambulatory care received, and as such, may reflect the effectiveness of the ambulatory care system. Well-calibrated measures of ACSHs and ACSVs based on administrative data can provide a useful gauge of care access and quality within the ambulatory care system.

Medicare currently uses some potentially preventable hospital use measures for quality measurement. For example, CMS publicly reports the MA plan performance measure of hospitalizations for potentially preventable complications, which is based on the Agency for Healthcare Research and Quality's (AHRQ) Prevention Quality Indicators (PQIs) for ambulatory care sensitive conditions (ACSC). Additionally, starting in FY 2028, CMS will begin to use the Skilled Nursing Facility Within-Stay Potentially Preventable Readmission measure in the Skilled Nursing Facility Value Based Purchasing Program. These measures have differences in how they are calculated (e.g., ages included, and types of hospital stays), and are not adequately risk adjusted to be used for the entire Medicare population. Therefore, we developed a common measure of ACSHs that can be used across and within different Medicare populations. Although some research has been done to define ACSV quality measures, Medicare currently has not incorporated ACSVs into existing quality measurement programs. We compiled the existing research to create an ACSV measure that can be used to compare quality within and across Medicare payment models.

This report summarizes recent updates to the definition of ACSH and ACSV measures and updates to the risk-adjustment model for calculating expected rates of ACSHs and ACSVs, both nationally and at the market area level, using FFS (which includes ACOs) Medicare claims data. We calculated these rates across market areas as defined by Dartmouth hospital service areas (HSAs). To understand if the measure can be used to compare performance of ambulatory care systems treating FFS beneficiaries, we examined the extent of variation in risk-adjusted ACSH and ACSV rates across all market areas. Furthermore, we

analyzed differences in risk-adjusted ACSH and ACSV rates among population subgroups stratified by select beneficiary characteristics.

Methods

This report is an update to an earlier report describing the original development of these measures.[1] The primary focus of the present update was to update the diagnosis codes used to define ACSHs and ACSVs.

We used the Common Medicare Environment (CME) Custom Enrollment files, the Centers for Medicare & Medicaid Services' Hierarchical Condition Category (HCC) files, Inpatient National Claims History files, and outpatient files from calendar years 2021 and 2022 in this analysis. Beneficiaries who were enrolled in Medicare FFS Parts A and B for the full calendar year were eligible for sample selection in each year. We excluded beneficiaries who were enrolled in a MA plan at any point during the year, decedents, and those who lived outside of the 50 U.S. states. Beneficiaries who were missing information on market areas or on any covariate used for risk adjustment were also excluded.

We defined ACSHs using a combination of existing ACSH measures that are currently used in Medicare programs, including the Healthcare Effectiveness Data and Information Set (HEDIS) measures for Hospitalization for Potentially Preventable Complications and the AHRQ PQI measures. For ACSVs, we applied the same set of ACSCs used in defining ACSHs and incorporated additional specifications from a published study that convened a panel of experts to adapt the PQI measures to the ED setting. A physician reviewed both ACSH and ACSV definitions for clinical soundness.

The conditions considered for either an ACSH or an ACSV included diabetes, chronic obstructive pulmonary disease (COPD), asthma, hypertension, heart failure, bacterial pneumonia, urinary tract infection, cellulitis, and pressure ulcers. Three additional condition groups—upper respiratory infection/otitis/rhinitis, influenza (without pneumonia), and nonspecific back pain—were only included in the ACSV measure. ACSHs included both inpatient admissions and observation stays, whereas ACSVs consisted only of ED visits that did not result in an admission or observation stay. In our specifications, we included diagnosis and procedure codes from both HEDIS and PQI measures. We defined the outcome variable as the count of ACSHs or ACSVs per beneficiary in each year.

We used a zero-inflated negative binomial model to produce risk-adjusted counts of ACSHs or ACSVs. Risk factors (model covariates) included beneficiary age, sex, end-stage renal disease (ESRD), disability status, and 86 HCCs. We calculated market-level rates for HSAs.

[1] See Feng, Z., Silver, B., Segelman, M., Jones, M., Ingber, M., Beadles, C., & Pickett, R. (2019). *Developing Risk-Adjusted Avoidable Hospitalizations and Emergency Department Visits Quality Measures.* Produced for the Medicare Payment Advisory Commission. https://www.medpac.gov/wp-content/uploads/import_data/scrape_files/docs/default-source/contractor-reports/august2019_riskadjusted_ah_av_measures_contractor_sec.pdf

We identified all ACSHs and ACSVs, and aggregated both the observed and expected numbers of events of each type from the beneficiary level to the market area level in each year. Dividing the total number of observed ACSHs or ACSVs for each area by the total number of expected ACSHs or ACSVs yielded the observed to expected (O to E) ratios, which in turn were multiplied by the mean market-level observed rates to obtain risk-standardized rates.

Key Findings

In each year, about 2 of all beneficiaries in the study population experienced at least one ACSH, and 4 experienced at least one ACSV. In 2021, the observed rate of ACSHs was 31 events per 1,000 beneficiaries, while the observed rate of ACSVs was 49 visits per 1,000 beneficiaries. Nationally, both observed and expected rates of ACSHs and ACSVs were above average for disabled beneficiaries, African Americans, American Indians/Alaska Natives, and beneficiaries dually eligible for Medicare and Medicaid. Both observed and risk-adjusted ACSH and ACSV rates varied considerably across market areas.

Discussion

Our analysis reveals substantial variation in the risk-adjusted rates of ACSHs and ACSVs across HSAs, suggesting potential opportunities for improvement in ambulatory care. To the extent that risk-adjusted rates of ACSHs and ACSVs suggest problems in the access to and quality of ambulatory care for patients, the variation in these rates across market areas can be used to evaluate the relative performance of local ambulatory care delivery systems. This variation can also be used to identify and explore "hot spots"—areas with relatively high ACSH or ACSV rates—for better-targeted use of limited resources in quality improvement initiatives. The lower rate of ACSHs relative to ACSVs may have been driven in part by heightened Medicare policy efforts to reduce hospital readmissions; providers may not have been incentivized to reduce ACSVs as much as ACSHs. Going forward, MedPAC may continue testing the risk-adjusted ACSH and ACSV measures and apply these measures to other populations and entities, including enrollees in MA plans, ACOs, and groups of physicians or other providers participating in the Medicare program.

Conclusion

ACSHs and ACSVs constitute important quality measures because a substantial portion of hospitalizations and ED visits can be prevented with adequate access to high-quality ambulatory care. Risk-adjusted rates of ACSHs and ACSVs developed from this analysis can be used as performance indicators of the ambulatory care systems in a given market. The considerable variation in both ACSH and ACSV rates across market areas suggests opportunities to improve the quality of care and the potential to use these measures to compare quality across local health care markets.

1. Background

The Medicare Payment Advisory Commission (MedPAC) asserts that Medicare quality programs should include population-based measures of outcomes, patient experience, and value. In 2019, MedPAC contracted with RTI International to develop two population-based outcome measures: risk-adjusted rates of ACS hospitalizations and ED visits (at the time MedPAC referred to these measures as avoidable hospitalizations and ED visits) (Feng et al., 2019). The Commission sought to develop these two claims-based measures to compare quality of care within and across different populations (i.e., FFS Medicare in different local market areas), given the adverse impact on beneficiaries and high cost of these events. Conceptually, an ACS hospitalization or ED visit refers to hospital use that could have been prevented with timely, appropriate, high-quality care (Moy, Chang, & Barrett, 2013). For example, if a diabetic patient's primary care physician or specialist has an effective system to allow for urgent visits, the patient may be able to avoid a visit to the ED. If a diabetic patient's primary care physician and overall care team work effectively to control the patient's condition, an ED visit for a diabetic crisis could be avoidable.

RTI defined chronic and acute ACS conditions (outcomes) and developed a risk-adjustment model for calculating expected rates of ACS hospital use, both nationally and at the market area level, using FFS Medicare claims data. They calculated these rates for three years (2015-2017), across different groups of Medicare beneficiaries, and across two types of market areas: (1) MedPAC-defined market areas (MMAs) and (2) Dartmouth-defined hospital service areas (HSAs).

The RTI analysis revealed substantial variation in the risk-adjusted rates of ACS hospital use across market areas, suggesting potential opportunities for improvement in ambulatory care. They concluded that the extent that risk-adjusted rates of ACS hospital use suggest problems in the access to and quality of ambulatory care for patients, the variation in these rates across market areas can be used to evaluate the relative performance of local ambulatory care delivery systems.

MedPAC continues to use the specifications and programs that RTI developed to calculate ACS hospital use measures in various analyses, including its annual clinician payment update analysis, modeling of a Medicare Advantage value incentive program, reporting disparities in outcomes across different groups of Medicare beneficiaries, and studying the relationship between telehealth expansion and quality. MedPAC plans to use these measures in various future quality analysis.

Since it has been several years since the measures were developed, MedPAC contracted with RTI to incorporate updates to diagnosis codes associated with the ACS conditions, to consider using secondary diagnosis codes for COVID-19 as exclusions for the measures, and

to update much of RTI's previous analysis with more recent years of data to understand the variation in performance across market areas and different groups of Medicare beneficiaries.

Specifically, we address the following objectives in this report:

- Describe the methodology used to update the diagnosis codes for the risk-adjusted ACSH and ACSV measures, and describe how we considered using COVID-19 as an exclusion criteria for selected diagnoses.
- Describe the national trends in ACSH and ACSV rates from 2021 to 2022.
- Examine the extent of variation in risk-adjusted ACSH and ACSV rates across market areas using HSAs.
- Examine differences in risk-adjusted ACSH and ACSV rates among population subgroups stratified by select beneficiary characteristics (age, gender, race and ethnicity, original reason for Medicare eligibility, Medicare-Medicaid dual eligibility status, and low-income status) at the national level.
- Explore the degree of correlation between the risk-adjusted ACSH and ACSV rates cross-sectionally and the correlation across the years for each measure.

2. Methods

2.1 Study Design and Population

The population of interest for this study was Medicare beneficiaries enrolled in Medicare fee-for-service (FFS) Parts A and B for the full calendar year, annually, during our study period (2021 to 2022). For both years, we included all beneficiaries 18 years of age or older appearing in the Common Medicare Environment (CME) Custom Enrollment files who were enrolled in Parts A and B for all 12 months of the year, were not enrolled in a Medicare Advantage plan at any point in the year, and did not die during the year. This ensures that all included beneficiaries had the full year of claims data to calculate the rates of our outcomes of interest for each year. Our sample was further limited to beneficiaries living in the 50 United States and the District of Columbia who could be matched successfully to HSAs. Finally, we excluded beneficiaries who were missing information for one or more of the covariates described below to ensure complete data for our risk-adjustment models (see Table 3.1 for the full list of exclusions).

2.2 Data Sources

Our data were drawn from the 100 Medicare administrative claims data for calendar years 2021 - 2022. The sample of beneficiaries was identified using the CME Custom Enrollment files, which contains enrollment and demographic information for beneficiaries enrolled in the Medicare program at any point in the calendar year. The demographic characteristics used in the risk-adjustment models were also drawn from this file, and Hierarchical Condition Category (HCC) data used in the models were drawn from the Medicare HCC data file (see Section 2.4 for additional detail on the covariates selected for the model). Inpatient hospitalizations were drawn from the Medicare Inpatient National Claims History data files, and emergency department (ED) visits and observation stays were drawn from the Outpatient National Claims History files. All data were obtained under a Data Use Agreement between MedPAC and the Centers for Medicare & Medicaid Services.

2.3 Outcome Measures

In our risk-adjustment models, the unit of analysis was the Medicare beneficiary. The outcomes of interest were the number of avoidable hospitalizations (ACSHs) and the number of avoidable ED visits (ACSVs), based on a defined set of ambulatory care sensitive conditions (described below). We identified all inpatient admissions, observation stays, and ED visits that included beneficiaries made to short-stay acute or critical access hospitals defined in the Medicare Provider of Services file (Hospital Type Code 1 or 11). We summed the number of hospital visits of each type for each beneficiary included in our study population each year.

Inpatient admissions were identified from all inpatient claims. ED visits were flagged as claims containing at least one line with any of the following codes: Healthcare Common Procedure Coding System (HCPCS) codes 99281 to 99285, 99291, or G0380 to G0384, or Revenue Center Codes 0450 to 0459 and 0981. Observation stays were flagged as claims with at least one line satisfying all of the following criteria: (1) HCPCS code G0378 with at least eight revenue units, (2) a claim line for an ED visit (as previously defined) or HCPCS codes G0463 or G0379 elsewhere on the claim, and (3) no lines on the claim indicating a Revenue Center Status Code of T on the same date (indicating a significant procedure subject to multiple procedure discounting).

Because a single hospital visit can occasionally span multiple claims, claims for the same beneficiary in the same hospital with overlapping admission and discharge dates were consolidated into a single visit. In the case of transfers, defined as consecutive hospital stays (i.e., the second visit began within 1 day of discharge) for the same beneficiary in different hospitals, or SRC_adms = 4 or D, indicating transfer from a different hospital or from within the same hospital, the second hospital visit was not counted toward the total visits. Finally, outpatient claims that contained both ED and observation care were considered observation stays, and inpatient admissions that also included ED and/or observation care were counted as inpatient admissions.

We defined ACSHs using a combination of existing ACSH measures that are currently used in Medicare programs, including the Healthcare Effectiveness Data and Information Set (HEDIS) measures for Hospitalization for Potentially Preventable Complications published by the National Committee for Quality Assurance (NCQA, 2022), and the Prevention Quality Indicator (PQI) measures published by the Agency for Healthcare Research and Quality (AHRQ, 2022). Although there was considerable overlap in the codes listed in HEDIS and PQI, some codes appeared in only one measure. We therefore elected to include diagnosis and procedure codes from both measures in our specifications.

To update these measures from what developed in 2019, we first looked for updates to the original code set based on the 2022 PQI specifications. For each condition, we compared the original code set to the updated code set for the corresponding PQI measure using conditional formatting. If a code was unique to the original code set, we flagged it for potential removal. If a code was unique to the 2022 PQI measure, we flagged it for potential addition. We repeated this process using the 2022 HEDIS specifications for the Hospitalizations for Potentially Preventable Complications (HPC) measure. This step was performed for all conditions for which 2022 PQI or HEDIS specifications were available.

Second, we looked at updates based on the 2022 ICD10 crosswalk, which indicates mappings between existing codes and new codes. Using STATA, we checked for updates using the code set developed based on the 2019 original code set and the 2022 PQI and HEDIS potential additions. If the effective date of the change was prior to the measurement

period (pre-2020), we flagged the original codes for potential removal and the new codes for potential addition. Before flagging for potential removal, we confirmed the original codes were no longer effective in the latest version of ICD10. If the effective date was during the measurement period (2020-2022), we did not flag the original codes for potential removal. This step was performed for all diagnosis codes as an additional validation to the 2022 PQI and HEDIS updates.

Lastly, we discussed all potential additions and removals with a physician and finalized our updates. Clinical discussion centered on how each code was used clinically and whether the associated diagnosis was potentially preventable. Particular attention was paid to codes where data sources disagreed on whether to add and remove.

For ACSVs, we applied the same set of ambulatory care sensitive conditions as used in defining ACSHs, and incorporated additional specifications from a published study that convened a panel of experts to adapt the PQI measures to the ED setting (Davies et al., 2017). These measures and research identify ACSHs and ACSVs as hospital stays with certain diagnosis codes indicating one of several ambulatory care sensitive conditions. These conditions are listed in Table 2.1.

Table 2.1. Ambulatory Care Sensitive Conditions

Condition	Type	ACSH	ACSV
Diabetes, short term	Chronic	X	X
Diabetes, long term	Chronic	X	X
Chronic obstructive pulmonary disease (COPD)	Chronic	X	X
Asthma	Chronic	X	X
Hypertension	Chronic	X	X
Heart failure	Chronic	X	X
Bacterial pneumonia	Acute	X	X
Urinary tract infection	Acute	X	X
Cellulitis	Acute	X	X
Pressure ulcers	Acute	X	X
Upper respiratory infection/otitis/rhinitis	Acute		X
Influenza	Acute		X
Nonspecific back pain	Acute		X

ACSH = avoidable hospitalization; ACSV = avoidable emergency department (ED) visit.

Most of the included conditions could be considered either an ACSH or an ACSV. In other words, the visits are considered ambulatory care sensitive regardless of whether the patients are admitted or treated entirely as outpatients. These include chronic conditions,

such as diabetes (short or long term), chronic obstructive pulmonary disease (COPD), asthma, hypertension, and heart failure, and acute conditions, such as bacterial pneumonia, urinary tract infections, cellulitis, and pressure ulcers. Three additional condition groups—upper respiratory infection/otitis/rhinitis, influenza (without pneumonia), and nonspecific back pain—were determined to be ambulatory care sensitive only when appearing in the ED (Corwin, Parker, & Brown, 2016; Davies et al., 2017). In other words, if ultimately admitted (or treated under observation), the conditions were considered serious enough that they were no longer ambulatory care sensitive. These three types of conditions were only included in the ACSV measure.

Our definition of ACSHs included both inpatient admissions and observation stays, whereas ACSVs consisted only of ED visits. There are advantages and disadvantages to this approach. One could argue that inpatient admissions should be distinct because they indicate an increased level of clinical severity when compared with ED visits and observation stays (which are both considered outpatient for billing purposes). Additionally, hospitals vary considerably in where they draw the line between ED and observation care, and observation stays often begin in the ED. However, there is a growing body of literature showing an increasing prevalence of observation stays and a shift of patients toward observation who would previously have been admitted to an inpatient stay (Feng et al., 2012; Silver et al., 2018; Wright, Jung, Feng, & Mor, 2014). A more complete measure of hospitalizations could also count observation stays because, from the beneficiary's perspective, observation stays may be indistinguishable from an inpatient admission. Following suggestions by MedPAC, we included both inpatient admissions and observation stays in the ACSH definition, effectively combining all cases that required care beyond the ED.

2.4 Covariates

We controlled for demographic characteristics, such as age and gender, and clinical characteristics, primarily based on HCCs. HCCs are groups of clinically related diagnoses with similar implications for health care utilization and cost. Age was divided into 5-year groupings separately for male and female patients. We adjusted for a total of 86 HCC categories (based on HCC Version 24) from the Medicare HCC data file. The HCCs were derived from ICD-10 codes from the claims for each beneficiary in the prior year. In addition, we included end-stage renal disease (ESRD) status and disability status. Several variables, including the Medicare status code, current reason for Medicare entitlement, and an indicator for ESRD status, were used to determine ESRD status. Individuals over age 65 and originally eligible for Medicare because of disability were identified using age, original reason for Medicare entitlement, and an additional disability indicator from the HCC file.

2.5 Multivariate Model

We used a zero-inflated negative binomial (ZINB) model[2]. The ZINB model is used to model data with a high proportion of zeros and is a two-part model. The first part predicts whether or not the individual has any events using a logistic model, and the second part uses a negative binomial model to predict the count of events. The final predicted count is the product of the probability of a nonzero count with the predicted count from the negative binomial model. In our case, we included the same predictors in both parts of the model, although in other contexts, the predictors in the two parts can be different. Because our ultimate goal is to calculate observed and expected rates at the market level, we did not account for clustering, and thus did not use fixed or random effects in these models.

2.6 Calculating Risk-Standardized Rates

We calculated market-level rates for HSAs. We summed the number of observed events (ACSHs or ACSVs) for each individual in the market area to obtain the total observed number of events. We summed the number of events that were predicted by the model for each individual in the market area to obtain the expected number of events. Dividing the market area total number of observed by the total number of expected events yielded an O to E ratio for each market area. Multiplying the O to E ratio by the national observed rate of events resulted in the risk-standardized rate.

2.7 Considering a secondary diagnosis of COVID-19 as an exclusion for selected ACS conditions

We tested a version of these measures which applied an exclusion when there was a secondary diagnosis of COVID-19 for selected conditions. The rationale was that it is possible that where the beneficiary also had COVID-19, the hospitalization or ED visit was less likely to be ambulatory care sensitive. We selected conditions for the COVID-19 exclusion through discussion with a physician. Conditions related to pulmonary conditions and heart failure were considered to overlap clinically with COVID-19 and thus not be ambulatory care sensitive when co-occurring with COVID-19. Therefore, we tested the exclusion with the following ACS conditions: COPD, Asthma, Heart Failure, Bacteria Pneumonia, Upper respiratory infection/otitis/rhinitis and Influenza (without pneumonia).

We defined COVID-19 as an active diagnosis of COVID-19, as indicated by the diagnosis code U07.1. Events with the selected ACS conditions and a secondary diagnosis of COVID-19 were not considered to not be an ACSH and ACSV.

[2] In our previous report, we discuss our model selection process. See Feng, Z., Silver, B., Segelman, M., Jones, M., Ingber, M., Beadles, C., & Pickett, R. (2019). *Developing Risk-Adjusted Avoidable Hospitalizations and Emergency Department Visits Quality Measures.* Produced for the Medicare Payment Advisory Commission. https://www.medpac.gov/wp-content/uploads/import_data/scrape_files/docs/default-source/contractor-reports/august2019_riskadjusted_ah_av_measures_contractor_sec.pdf

As explained below, we did not ultimately include results from the version of the measure with the COVID-19 exclusions in this report, but we do include results on the prevalence of COVID-19 as a secondary diagnosis.

3. Results

3.1 Final Sample After Exclusions

The sample exclusions and the count of beneficiaries in the final sample are shown in ***Table 3.1***. The table shows exclusions hierarchically, so each row shows the number of beneficiaries dropped after applying all the exclusion criteria listed above. As shown in the table, the number of Medicare beneficiaries increased from more than 63 million in 2021 to more than 64 million in 2022. The number of beneficiaries excluded from our sample also increased, largely due to an increase in Medicare Advantage enrollment. The number of beneficiaries included in our final sample decreased from just under 28 million in 2021 to just under 27 million in 2022.

Table 3.1. Hierarchical Sample Exclusions and Final Beneficiary Sample, 2021 to 2022

Characteristic	2021		2022	
	N dropped	**Total Remaining**	***N dropped***	**Total Remaining**
Initial Beneficiaries	0	63,505,438	0	64,655,025
< 18 Years Old	1,461	63,503,977	1,432	64,653,593
Did Not Have a Complete Year of Medicare Fee for Service Parts A & B Coverage	34,007,448	29,496,529	36,334,168	28,319,425
Died During Year	1,408,907	28,087,622	1,292,679	27,026,746
>110 Years old	17,937	28,069,685	18,118	27,008,628
Missing Age, Gender, or Geography	1,327	28,068,358	1,312	27,007,316
Outside 50 States + DC	108,070	27,960,288	103,513	26,903,803
Missing HSA	8,767	27,951,521	7,403	26,896,400
Missing HCCs	296	27,951,225	15,515	26,880,885
Missing ESRD or Disabled	2	27,951,223	2	26,880,883
Final Beneficiary Sample	35,554,215	27,951,223	37,774,142	26,880,883

3.2 Observed ACSH and ACSV Prevalence and Rates

The observed avoidable hospitalization (ACSH) and avoidable emergency department (ED) visits (ACSV) prevalence, measured in the number and percentage of beneficiaries who experienced at least one ACSH or ACSV, is shown in ***Table 3.2*** for 2021 and ***Table 3.3*** for 2022. The observed ACSH and ACSV rates, measured in the number of ACSHs or ACSVs per 1,000 beneficiaries in each year, are presented in ***Table 3.4*** for 2021 and ***Table 3.5*** for 2022.

Table 3.2. Observed ACS Hospitalizations and ACS ED Visit Prevalence, 2021

	2021	
	Number of Beneficiaries with Each Type of Event	**Percentage of Final Sample Beneficiaries (N = 27,951,223)**
Inpatient/Observation Stays and ACS Inpatient/Observation		
Any Inpatient or Observation Stay	4,078,651	14.59
Any Inpatient Stay	3,544,691	12.68
Any Observation Stay	892,089	3.19
Any ACS Hospitalization	676,725	2.42
Any Acute ACS Hospitalization	278,197	1.00
Any Acute Inpatient ACS Hospitalization	244,491	0.87
Any Acute Observation ACS Hospitalization	39,930	0.14
Any Chronic ACS Hospitalization	425,400	1.52
Any Chronic Inpatient ACS Hospitalization	387,008	1.38
Any Chronic Observation ACS Hospitalization	54,212	0.19
ED Visits and ACS ED Visits		
Any ED Visit	5,726,577	20.49
Any ACS ED visits	1,117,549	4.00
Any Acute ACS ED visits	791,335	2.83
Any Chronic ACS ED visits	367,432	1.31

ED = emergency department; ACS = ambulatory care sensitive. Text indenting shown on the rows indicates subcategories, which may not sum to the category above them because of possible overlaps (some beneficiaries may have multiple types of events in a given year).

Table 3.3. Observed ACS Hospitalizations and ACS ED Visit Prevalence, 2022

	2022	
	Number of Beneficiaries with Each Type of Event	**Percentage of Final Sample Beneficiaries (N = 26,880,883)**
Inpatient/Observation Stays and ACS Inpatient/Observation		
Any Inpatient or Observation Stay	3,941,870	14.66
Any Inpatient Stay	3,431,058	12.76
Any Observation Stay	856,074	3.18
Any ACS Hospitalization	661,648	2.46
Any Acute ACS Hospitalization	284,943	1.06
Any Acute Inpatient ACS Hospitalization	251,360	0.94
Any Acute Observation ACS Hospitalization	40,035	0.15
Any Chronic ACS Hospitalization	404,325	1.50
Any Chronic Inpatient ACS Hospitalization	368,337	1.37
Any Chronic Observation ACS Hospitalization	50,031	0.19
ED Visits and ACS ED Visits		
Any ED Visit	5,797,690	21.57
Any ACS ED visits	1,180,670	4.39
Any Acute ACS ED visits	865,023	3.22
Any Chronic ACS ED visits	358,318	1.33

ED = emergency department; ACS = ambulatory care sensitive. Text indenting shown on the rows indicates subcategories, which may not sum to the category above them because of possible overlaps (some beneficiaries may have multiple types of events in a given year).

Table 3.4. Observed ACS Hospitalizations and ACS ED Visit Rates, 2021

	2021	
	Number of Events	**Rate per 1,000 Final Sample Beneficiaries**
Inpatient/Observation Stays and ACS Hospitalizations		
Inpatient/Observation Stays	6,213,263	222.29
Inpatient Stays	5,208,097	186.33
Observation Stays	1,005,166	35.96
ACS Hospitalization	862,773	30.87
Acute ACS Hospitalizations	306,622	10.97
Acute Inpatient ACS Hospitalizations	265,837	9.51
Acute Observation ACS Hospitalizations	40,785	1.46
Chronic ACS Hospitalizations	556,151	19.90
Chronic Inpatient ACS Hospitalizations	498,121	17.82
Chronic Observation ACS Hospitalizations	58,030	2.08
ED Visits and ACS ED Visits		
ED Visits	9,375,070	335.41
ACS ED visits	1,362,267	48.74
Acute ACS ED visits	916,815	32.80
Chronic ACS ED visits	445,452	15.94

ED = emergency department; ACS = ambulatory care sensitive. Text indenting shown on the rows indicates subcategories, which sum to the category above them (the types of events reported in this table are mutually exclusive).

Table 3.5. Observed ACS Hospitalizations and ACS ED Visit Rates, 2022

	2022	
	Number of Events	**Rate per 1,000 Final Sample Beneficiaries**
Inpatient/Observation Stays and ACS Hospitalizations		
Inpatient/Observation Stays	6,025,362	224.15
Inpatient Stays	5,065,222	188.43
Observation Stays	960,140	35.72
ACS Hospitalization	836,239	31.11
Acute ACS Hospitalizations	314,444	11.70
Acute Inpatient ACS Hospitalizations	273,474	10.17
Acute Observation ACS Hospitalizations	40,970	1.52
Chronic ACS Hospitalizations	521,795	19.41
Chronic Inpatient ACS Hospitalizations	468,393	17.42
Chronic Observation ACS Hospitalizations	53,402	1.99
ED Visits and ACS ED Visits		
ED Visits	9,466,047	352.15
ACS ED visits	1,428,244	53.13
Acute ACS ED visits	1,001,117	37.24
Chronic ACS ED visits	427,127	15.89

ED = emergency department; ACS = ambulatory care sensitive. Text indenting shown on the rows indicates subcategories, which sum to the category above them (the types of events reported in this table are mutually exclusive).

In each year, about 15% of the population experienced an inpatient or observation stay, while roughly 20-22% experienced an ED visit (***Tables 3.2 and 3.3***). Because of beneficiaries with multiple stays and/or visits, the rate of inpatient or observation stays ranged from 222 to 224 per 1,000 beneficiaries, and the rate of ED visits ranged from 335 to 352 per 1,000 beneficiaries (***Tables 3.4 and 3.5***). Because ACSHs and ACSVs make up a relatively modest proportion of all inpatient/observation stays and all ED visits, respectively, the percentage of all beneficiaries who experienced an ACSH or an ACSV, and the corresponding rates, were considerably lower. In each year, about 2% of all beneficiaries experienced an ACSH, while roughly 4% experienced an ACSV (***Tables 3.2 and 3.3***). The rate of ACSHs was 31 stays per 1,000 beneficiaries in both years, while the rate of ACSV ranged from 49 to 53 visits per 1,000 beneficiaries (***Tables 3.4 and 3.5***).

Full descriptive results on model covariates are presented in **Appendix A**. Detailed results on the frequency of having multiple events in a given year are shown in **Appendix B**. Detailed results on the frequency of ACSHs and ACSVs, by condition and year, are shown in

Appendix C. In **Tables C-3 and C-4** we show the prevalence of COVID-19 as a secondary diagnosis for each of the conditions. Because COVID-19 as a secondary diagnosis was relatively infrequent and employing it as an exclusion criteria in the definition of ACSH and ACSV had little impact on the results; we did not use COVID-19 as an exclusion criteria for the ACSH and ACSV measures for the purposes of the results shown in this report.

As explained above, we used a zero-inflated negative binomial model for risk adjustment. Full results using this model to predict ACSH or ACSV counts are shown in **Appendix D**.

3.3 Results by Beneficiary Characteristics

We next compared results nationally across categories of age, gender, race/ethnicity, dual eligibility status, and low-income subsidy. We aggregated the observed counts and the expected counts of ACSHs and ACSVs across all individuals in each category. This enabled us to calculate an observed to expected (O to E) ratio and hence a risk-standardized rate for each category.

As shown in ***Table 3.6*** (for ACSHs) and ***Table 3.7*** (for ACSVs) for the results based on the 2021 data, both the observed and expected ACSH and ACSV rates were above the national average for beneficiaries aged 65 years or older who were originally eligible for Medicare because of disability, African Americans, American Indians or Alaska Natives, dually eligible beneficiaries and low income beneficiaries; rates were lower than average for Asians or Pacific Islanders. Thus, for example, dually eligible beneficiaries both experienced more ACSH and ACSV events and tended to be clinically at higher risk for ACSHs and ACSVs. Note that for dually eligible beneficiaries, the observed rate more than doubles the rate for non-duals, but the risk-standardized rate is about 30% higher. This demonstrates the success of the model in "leveling the playing field" through risk adjustment. However, even after risk adjustment, differences remain between duals and non-duals in ACSH and ACSV rates. This may indicate opportunities for improved ambulatory care delivery to reduce ACSH and ACSV rates for duals. Similar patterns can be observed for 2022 data in ***Tables 3.8 and 3.9*** for ACSH and ACSV, respectively, with slightly smaller differences between duals and non-duals in their risk-standardized rates.

Table 3.6. ACS Hospitalizations Outcomes by Select Beneficiary Characteristics – 2021

Characteristic	Beneficiaries		Percentage of Beneficiaries with at Least One ACS Hospitalizations Observed	Rate of ACS Hospitalizations per 1,000 Beneficiaries		O to E Ratio	Risk-Standardized Rate of ACS Hospitalizations per 1,000 Beneficiaries
	Number	Percentage		Observed	Expected		
All Beneficiaries	27,951,223	100.00	2.42	30.87	30.86	1.000	30.87
Age/Eligibility Group							
18–64	3,607,637	12.91	2.91	41.87	41.82	1.001	30.91
65+ and not originally disabled	22,152,534	79.25	2.12	26.05	26.07	0.999	30.85
65+ and originally disabled	2,191,052	7.84	4.63	61.42	61.28	1.002	30.94
Gender							
Male	12,632,303	45.19	2.36	30.24	30.33	0.997	30.78
Female	15,318,920	54.81	2.47	31.38	31.31	1.002	30.94
Race/Ethnicity							
Non-Hispanic White	22,540,405	80.64	2.38	29.83	30.12	0.990	30.56
Black (or African American)	2,135,795	7.64	3.45	48.99	41.94	1.168	36.06
Hispanic	1,451,304	5.19	2.58	34.01	34.58	0.983	30.35
American Indian or Alaska Native	143,952	0.52	3.77	49.39	42.08	1.174	36.23
Asian or Pacific Islander	806,909	2.89	1.48	18.26	25.83	0.707	21.83
Other	232,586	0.83	1.87	23.32	27.71	0.842	25.98
Unknown	640,272	2.29	1.11	14.43	16.49	0.875	27.00
Dual Status							
Dual	4,582,822	16.40	4.36	60.58	50.50	1.200	37.03
Nondual	23,368,401	83.60	2.04	25.04	27.01	0.927	28.61

(continued)

Table 3.6. ACS Hospitalizations Outcomes by Select Beneficiary Characteristics – 2021 (continued)

Characteristic	Beneficiaries		Percentage of Beneficiaries with at Least One ACS Hospitalizations Observed	Rate of ACS Hospitalizations per 1,000 Beneficiaries		O to E Ratio	Risk-Standardized Rate of ACS Hospitalizations per 1,000 Beneficiaries
	Number	Percentage		Observed	Expected		
Low-Income Status							
Low-Income	5,080,795	18.18	4.29	59.32	49.93	1.188	36.67
Non-Low-Income	22,870,428	81.82	2.01	24.55	26.63	0.922	28.46
Geography							
Urban	22,047,582	78.88	2.39	30.55	30.85	0.990	30.57
Rural	5,903,641	21.12	2.53	32.05	30.91	1.037	32.00

O to E = observed to expected; ACS = ambulatory care sensitive.

Table 3.7. ACS ED Visits Outcomes by Select Beneficiary Characteristics – 2021

Characteristic	Beneficiaries		Percentage of Beneficiaries with at Least One ACS Hospitalizations Observed	Rate of ACS Hospitalizations per 1,000 Beneficiaries		O to E Ratio	Risk-Standardized Rate of ACS Hospitalizations per 1,000 Beneficiaries
	Number	Percentage		Observed	Expected		
All Beneficiaries	27,951,223	100.00	4.00	48.74	48.73	1.000	48.75
Age/Eligibility Group							
18–64	3,607,637	12.91	6.69	91.29	90.92	1.004	48.93
65+ and Not Originally Disabled	22,152,534	79.25	3.33	38.79	38.87	0.998	48.64
65+ and Originally Disabled	2,191,052	7.84	6.30	79.29	78.96	1.004	48.94
Gender							
Male	12,632,303	45.19	3.46	42.14	42.15	1.000	48.73
Female	15,318,920	54.81	4.45	54.18	54.15	1.000	48.76
Race/Ethnicity							
Non-Hispanic White	22,540,405	80.64	3.87	46.60	47.75	0.976	47.57
Black (or African American)	2,135,795	7.64	5.76	75.56	61.76	1.224	59.63
Hispanic	1,451,304	5.19	4.89	60.78	54.20	1.121	54.65
American Indian or Alaska Native	143,952	0.52	7.68	106.04	64.57	1.642	80.03
Asian or Pacific Islander	806,909	2.89	2.16	25.24	42.40	0.595	29.01
Other	232,586	0.83	3.02	36.23	44.45	0.815	39.72
Unknown	640,272	2.29	2.37	28.40	33.27	0.854	41.60
Dual Status							
Dual	4,582,822	16.40	7.30	98.46	79.43	1.240	60.41
Nondual	23,368,401	83.60	3.35	38.99	42.71	0.913	44.49
Low-Income Status							
Low-Income	5,080,795	18.18	7.15	95.94	78.46	1.223	59.59
Non-Low-Income	22,870,428	81.82	3.30	38.25	42.12	0.908	44.26

(continued)

Table 3.7. ACS ED Visits Outcomes by Select Beneficiary Characteristics – 2021 (continued)

Characteristic	Beneficiaries		Percentage of Beneficiaries with at Least One ACS Hospitalizations Observed	Rate of ACS Hospitalizations per 1,000 Beneficiaries		O to E Ratio	Risk-Standardized Rate of ACS Hospitalizations per 1,000 Beneficiaries
	Number	Percentage		Observed	Expected		
Geography							
Urban	22,047,582	78.88	3.64	43.93	48.47	0.906	44.17
Rural	5,903,641	21.12	5.32	66.70	49.69	1.342	65.43

O to E = observed to expected; ACS = ambulatory care sensitive.

Table 3.8. ACS Hospitalizations Outcomes by Select Beneficiary Characteristics – 2022

Characteristic	Beneficiaries		Percentage of Beneficiaries with at Least One ACS Hospitalizations Observed	Rate of ACS Hospitalizations per 1,000 Beneficiaries		O to E Ratio	Risk-Standardized Rate of ACS Hospitalizations per 1,000 Beneficiaries
	Number	Percentage		Observed	Expected		
All Beneficiaries	26,880,883	100.00	2.46	31.11	31.12	1.000	31.10
Age/Eligibility Group							
18–64	3,156,663	11.74	2.80	39.91	39.78	1.003	31.21
65+ and not originally disabled	21,659,750	80.58	2.20	26.87	26.90	0.999	31.07
65+ and originally disabled	2,064,470	7.68	4.73	62.16	62.10	1.001	31.14
Gender							
Male	12,141,650	45.17	2.38	30.21	30.29	0.997	31.03
Female	14,739,233	54.83	2.53	31.85	31.80	1.002	31.16
Race/Ethnicity							
Non-Hispanic White	21,767,481	80.98	2.44	30.34	30.56	0.993	30.88
Black (or African American)	1,923,520	7.16	3.41	47.49	41.58	1.142	35.53
Hispanic	1,375,234	5.12	2.64	34.59	34.36	1.007	31.32
American Indian or Alaska Native	130,127	0.48	3.81	49.45	42.19	1.172	36.47
Asian or Pacific Islander	796,057	2.96	1.55	18.92	26.26	0.721	22.42
Other	225,154	0.84	1.93	23.75	28.41	0.836	26.01
Unknown	663,310	2.47	1.18	15.23	16.88	0.902	28.07
Dual Status							
Dual	4,216,564	15.69	4.33	59.29	50.27	1.180	36.69
Nondual	22,664,319	84.31	2.11	25.87	27.55	0.939	29.20
Low-Income Status							
Low-Income	4,608,799	17.15	4.29	58.49	49.89	1.173	36.48
Non-Low-Income	22,272,084	82.85	2.08	25.44	27.23	0.934	29.06

(continued)

Table 3.8. ACS Hospitalizations Outcomes by Select Beneficiary Characteristics – 2022 (continued)

Characteristic	Beneficiaries		Percentage of Beneficiaries with at Least One ACS Hospitalizations Observed	Rate of ACS Hospitalizations per 1,000 Beneficiaries		O to E Ratio	Risk-Standardized Rate of ACS Hospitalizations per 1,000 Beneficiaries
	Number	Percentage		Observed	Expected		
Geography							
Urban	21,300,376	79.24	2.44	30.84	31.17	0.990	30.78
Rural	5,580,507	20.76	2.55	32.12	30.91	1.039	32.33

O to E = observed to expected; ACS = ambulatory care sensitive.

Table 3.9. ACS ED Visits Outcomes by Select Beneficiary Characteristics – 2022

Characteristic	Beneficiaries		Percentage of Beneficiaries with at Least One ACS Hospitalizations Observed	Rate of ACS Hospitalizations per 1,000 Beneficiaries		O to E Ratio	Risk-Standardized Rate of ACS Hospitalizations per 1,000 Beneficiaries
	Number	Percentage		Observed	Expected		
All Beneficiaries	26,880,883	100.00	4.39	53.13	53.14	1.000	53.12
Age/Eligibility Group							
18–64	3,156,663	11.74	6.99	94.31	94.09	1.002	53.25
65+ and Not Originally Disabled	21,659,750	80.58	3.77	43.92	43.99	0.998	53.05
65+ and Originally Disabled	2,064,470	7.68	6.92	86.79	86.54	1.003	53.28
Gender							
Male	12,141,650	45.17	3.79	45.76	45.76	1.000	53.13
Female	14,739,233	54.83	4.89	59.21	59.22	1.000	53.12
Race/Ethnicity							
Non-Hispanic White	21,767,481	80.98	4.27	51.06	52.36	0.975	51.81
Black (or African American)	1,923,520	7.16	6.15	79.27	65.62	1.208	64.18
Hispanic	1,375,234	5.12	5.52	68.46	58.19	1.177	62.51
American Indian or Alaska Native	130,127	0.48	8.59	117.62	69.14	1.701	90.39
Asian or Pacific Islander	796,057	2.96	2.58	29.84	47.08	0.634	33.68
Other	225,154	0.84	3.50	41.67	49.23	0.847	44.98
Unknown	663,310	2.47	2.76	32.89	37.58	0.875	46.50
Dual Status							
Dual	4,216,564	15.69	7.69	102.44	83.60	1.225	65.11
Nondual	22,664,319	84.31	3.78	43.96	47.47	0.926	49.20
Low-Income Status							
Low-Income	4,608,799	17.15	7.58	100.53	82.89	1.213	64.44
Non-Low-Income	22,272,084	82.85	3.73	43.32	46.99	0.922	48.99

(continued)

Table 3.9. ACS ED Visits Outcomes by Select Beneficiary Characteristics – 2022 (continued)

Characteristic	Beneficiaries		Percentage of Beneficiaries with at Least One ACS Hospitalizations Observed	Rate of ACS Hospitalizations per 1,000 Beneficiaries		O to E Ratio	Risk-Standardized Rate of ACS Hospitalizations per 1,000 Beneficiaries
	Number	Percentage		Observed	Expected		
Geography							
Urban	21,300,376	79.24	4.03	48.26	52.98	0.911	48.39
Rural	5,580,507	20.76	5.77	71.75	53.75	1.335	70.92

O to E = observed to expected; ACS = ambulatory care sensitive.

3.4 Market-Level Results

Descriptive statistics of the market-level results for hospital service areas (HSAs) for 2021 and 2022 are shown in ***Tables 3.10*** and ***3.11***, respectively.

Using the 2021 HSA results (***Table 3.10***) as an illustration, the percentage of beneficiaries with an ACSH ranged from 0 to 10.66 across all 3,436 HSAs. Among the HSAs, the mean and median percentages of beneficiaries with an ACSH were 2.64 and 2.57, respectively. The observed ACSH rate per 1,000 beneficiaries ranged from 0 to 149.86, and the mean and median were 33.74 and 32.36, respectively. On average, the risk-standardized rates were similar to the observed rates, with a mean and median of risk-standardized ACSH rates per 1,000 beneficiaries of 33.17 and 31.63, respectively.

In general, the percentage of beneficiaries with an ACSV and the rate of ACSVs were substantially higher than the corresponding ACSH percentage and rate. Furthermore, there was a large degree of variation across market areas for both ACSHs and ACSVs. For example, the interquartile ranges for the O to E ratios for ACSHs and ACSVs across HSAs in 2021 were 0.86 to 1.22 and 0.92 to 1.54, respectively (***Table 3.10***). Given that an O to E ratio of 1 indicates average quality, the interquartile range includes market areas with moderately better than expected and substantially worse than expected quality.

Table 3.10. HSA Market-Level Distributions of ACS Hospitalizations and ACS ED Visits Measures – 2021 (N = 3,436)

		Mean	SD	Min	10th	25th	50th	75th	90th	Max
ACS Hospitalizations	Number of Beneficiaries in the Market Area	8,135	13,856	56	776	1,559	3,565	9,016	19,352	197,542
	Percentage of FFS Medicare Beneficiaries with an ACS Hospitalization	2.64%	0.87%	0.00%	1.64%	2.07%	2.57%	3.07%	3.66%	10.66%
	Observed Rate of ACS Hospitalizations per 1,000 Beneficiaries	33.74	12.58	0.00	19.91	25.46	32.36	39.60	48.68	149.86
	O to E Ratio for ACS Hospitalizations	1.075	0.339	0.000	0.722	0.862	1.025	1.216	1.478	3.770
	Risk-Standardized Rate of ACS Hospitalizations per 1,000 Beneficiaries	33.17	10.46	0.00	22.30	26.60	31.63	37.54	45.62	116.36
	Percentage of FFS Medicare Beneficiaries with an Acute ACS Hospitalizations	1.18%	0.55%	0.00%	0.62%	0.83%	1.09%	1.41%	1.86%	6.05%
	Observed Rate of Acute ACS Hospitalizations per 1,000 Beneficiaries	13.29	6.66	0.00	6.62	9.00	11.94	15.87	21.37	74.93
	Percentage of FFS Medicare Beneficiaries with a Chronic ACS Hospitalization	1.57%	0.54%	0.00%	0.95%	1.22%	1.53%	1.87%	2.20%	6.36%
	Observed Rate of Chronic ACS Hospitalizations per 1,000 Beneficiaries	20.45	8.11	0.00	11.50	15.17	19.63	24.66	29.71	93.44

(continued)

Table 3.10. HSA Market-Level Distributions of ACS Hospitalizations and ACS ED Visits Measures – 2021 (N = 3,436) (continued)

		Mean	SD	Min	10th	25th	50th	75th	90th	Max
ACS ED Visits	Percentage of FFS Medicare Beneficiaries with an ACS ED Visit	5.04%	1.78%	0.53%	2.92%	3.78%	4.84%	6.11%	7.36%	21.60%
	Observed Rate of ACS ED Visit Rates per 1,000 Beneficiaries	62.91	26.56	5.34	33.89	44.90	59.40	76.76	95.53	559.17
	O to E Ratio for ACS ED Visits	1.270	0.510	0.097	0.719	0.916	1.204	1.540	1.896	11.125
	Risk-Standardized Rate of ACS ED Visit Rates per 1,000 Beneficiaries	61.90	24.85	4.73	35.04	44.63	58.67	75.07	92.41	542.21
	Percentage of FFS Medicare Beneficiaries with an Acute ACS ED Visit	3.55%	1.32%	0.00%	2.02%	2.63%	3.40%	4.29%	5.21%	15.09%
	Observed Rate of Acute ACS ED Visit Rates per 1,000 Beneficiaries	41.56	17.30	0.00	22.75	29.87	39.29	50.40	62.05	263.31
	Percentage of FFS Medicare Beneficiaries with a Chronic ACS ED Visit	1.72%	0.74%	0.00%	0.89%	1.18%	1.61%	2.16%	2.70%	10.06%
	Observed Rate of Chronic ACS ED Visit Rates per 1,000 Beneficiaries	21.35	11.45	0.00	10.16	13.80	19.32	26.80	34.65	295.86

FFS = fee-for-service; ACS = ambulatory care sensitive; HSA = hospital service area; O to E = observed to expected; SD = standard deviation.

Table 3.11. HSA Market-Level Distributions of ACS Hospitalizations and ACS ED Visits Measures - 2022 (N = 3,436)

		Mean	SD	Min	10th	25th	50th	75th	90th	Max
ACS Hospitalizations	Number of Beneficiaries in the Market Area	7,823	13,405	48	729	1,474	3,372	8,561	18,643	193,257
	Percentage of FFS Medicare Beneficiaries with an ACS Hospitalization	2.68%	0.88%	0.00%	1.68%	2.11%	2.59%	3.11%	3.75%	10.13%
	Observed Rate of ACS Hospitalizations per 1,000 Beneficiaries	34.07	12.63	0.00	20.47	25.80	32.47	39.74	49.41	140.52
	O to E Ratio for ACS Hospitalizations	1.078	0.345	0.000	0.723	0.866	1.021	1.218	1.467	4.179
	Risk-Standardized Rate of ACS Hospitalizations per 1,000 Beneficiaries	33.52	10.72	0.00	22.50	26.93	31.76	37.89	45.63	130.00
	Percentage of FFS Medicare Beneficiaries with an Acute ACS Hospitalizations	1.25%	0.57%	0.00%	0.68%	0.88%	1.15%	1.49%	1.94%	5.42%
	Observed Rate of Acute ACS Hospitalizations per 1,000 Beneficiaries	14.12	6.94	0.00	7.24	9.61	12.79	16.54	22.63	63.54
	Percentage of FFS Medicare Beneficiaries with a Chronic ACS Hospitalization	1.55%	0.54%	0.00%	0.92%	1.21%	1.51%	1.84%	2.20%	6.68%
	Observed Rate of Chronic ACS Hospitalizations per 1,000 Beneficiaries	19.94	7.94	0.00	11.20	14.80	19.17	23.93	29.09	99.71

(continued)

Table 3.11. HSA Market-Level Distributions of ACS Hospitalizations and ACS ED Visits Measures - 2022 (N = 3,436) (continued)

		Mean	SD	Min	10th	25th	50th	75th	90th	Max
ACS ED Visits	Percentage of FFS Medicare Beneficiaries with an ACS ED Visit	5.49%	1.92%	0.77%	3.27%	4.15%	5.29%	6.60%	7.91%	24.93%
	Observed Rate of ACS ED Visit Rates per 1,000 Beneficiaries	67.97	27.65	7.71	38.31	48.90	64.26	81.82	101.35	472.14
	O to E Ratio for ACS ED Visits	1.262	0.499	0.140	0.720	0.927	1.200	1.517	1.866	8.643
	Risk-Standardized Rate of ACS ED Visit Rates per 1,000 Beneficiaries	67.06	26.52	7.43	38.24	49.23	63.78	80.59	99.17	459.22
	Percentage of FFS Medicare Beneficiaries with an Acute ACS ED Visit	3.99%	1.47%	0.39%	2.33%	2.98%	3.82%	4.74%	5.79%	17.89%
	Observed Rate of Acute ACS ED Visit Rates per 1,000 Beneficiaries	46.70	19.04	3.85	26.12	33.91	44.23	56.18	68.97	257.91
	Percentage of FFS Medicare Beneficiaries with a Chronic ACS ED Visit	1.75%	0.75%	0.00%	0.92%	1.21%	1.63%	2.16%	2.71%	10.26%
	Observed Rate of Chronic ACS ED Visit Rates per 1,000 Beneficiaries	21.28	11.01	0.00	10.36	13.99	19.29	26.45	34.13	217.01

FFS = fee-for-service; ACS = ambulatory care sensitive; HSA = hospital service area; O to E = observed to expected; SD = standard deviation.

3.5 Correlations Between Measures

To explore the stability of these measures across years, we calculated correlations for O to E ratios for both ACSH and ACSV measures. We found strong correlations between the O to E ratios for 2021 and 2022 for both ACSHs and ACSVs (see ***Table 3.12***). Correlations across years were stronger for ACSVs than for ACSHs.

Table 3.12. Market-Level Correlations Across Years for ACS Hospitalizations and ACS ED Visits

	Years		HSA	
			Correlation Coefficient	*P* Value
O to E Ratio for ACS Hospitalizations	2021	2022	0.716	<0.001
O to E Ratio for ACS ED Visits	2021	2022	0.880	<0.001

HSA = hospital service area; O to E = observed to expected.

The correlations between O to E ratios for the ACSHs and ACSVs for the same years were positive but relatively weak (see ***Table 3.13***). These correlations suggest that some of the same factors, including the quality of and access to primary care, which affect one measure, may also affect the other. However, it is not surprising that the relationship is not strong, because ACSHs and ACSVs can substitute for each other.

Table 3.13. Market-Level Correlations Between ACS Hospitalizations and ACS ED Visits Measures, 2021

O to E Ratio for ACS Hospitalizations vs. O to E Ratio for ACS ED Visits	HSA	
	Correlation Coefficient	*P* Value
2021	0.291	<0.001
2022	0.281	<0.001

4. Discussion

We updated a previously developed risk-adjustment model that accounts for a rich set of individual-level risk factors for avoidable hospitalizations (ACSHs) and avoidable emergency department (ED) visits (ACSVs) in the population of fee-for-service (FFS) Medicare beneficiaries in 2021-2022.[3] These factors included beneficiary demographics (age and gender) and measures of comorbidities and disease severity based on the Centers for Medicare & Medicaid Services Hierarchical Condition Categories (HCCs). Using this model, we calculated risk-adjusted rates of ACSHs and ACSVs at the local market level and examined the variation in these rates across 3,436 Dartmouth-defined hospital service areas (HSAs).

The risk adjustment is intended to minimize any "unwarranted variations" in the rates of ACSHs and ACSVs that could be attributable to differences in the health status and disease severity of the underlying population in an area. However, our analysis reveals substantial variation in the risk-adjusted rates of ACSHs and ACSVs across local market areas. This variation signals opportunities for improvement not only in the quality of care provided to patient, but also in the effectiveness and efficiency of the ambulatory care delivery systems in relatively poor-performing market areas where the observed ACSH or ACSV rates exceed their expected rates by a significant margin, relative to the national average. Indeed, research has suggested evidence that higher rates of preventive care are associated with lower rates of preventable hospitalizations and lower spending (*Health*Landscape, 2016), and the sharp decrease in recent years in primary care office visits was accompanied by an increase in ED visits (Chou, Venkatesh, Trueger, & Pitts, 2019). On the premise that the risk-adjusted rates of ACSHs and ACSVs are indicative of problems in the access to and quality of ambulatory care for patients, the variation in these rates across market areas can be employed for monitoring and evaluation of the relative performance of local ambulatory care delivery systems. Such variation can also be used to identify and explore "hot spots"—areas with relatively high ACSH or ACSV rates—for better targeted use of limited resources in health reform and quality improvement initiatives.

The strong correlation across the two years of analysis on the risk-adjusted ACSH rate and risk-adjusted ACSV rate, respectively, lends support to the consistency in both measures and their potential utility for quality monitoring and improvement purposes. In each year cross-sectionally, there is a positive but relatively weak correlation between the ACSH rate and ACSV rate, suggesting that areas with higher rates of ACSHs also tend to have higher rates of ACSVs. The lack of strong correlation between the two measures is not totally

[3] See Feng, Z., Silver, B., Segelman, M., Jones, M., Ingber, M., Beadles, C., & Pickett, R. (2019). *Developing Risk-Adjusted Avoidable Hospitalizations and Emergency Department Visits Quality Measures*. Produced for the Medicare Payment Advisory Commission. https://www.medpac.gov/wp-content/uploads/import_data/scrape_files/docs/default-source/contractor-reports/august2019_riskadjusted_ah_av_measures_contractor_sec.pdf

surprising, as they capture different aspects of quality, and in some market areas, ACSHs and ACSVs may substitute for each other.

In addition, our analysis suggests the importance of social risk factors that are not currently included in our risk-adjustment model but may have contributed to differences in ACSH and ACSV rates among population subgroups. For instance, the risk-adjusted rates of both ACSHs and ACSVs are significantly higher for beneficiaries who are dually eligible for Medicare and Medicaid (who are low-income with relatively high needs and high costs as a group) than for Medicare-only beneficiaries. Whether to include the dual eligible status and other socioeconomic variables in a risk-adjustment model remains controversial (Joynt Maddox et al., 2019). MedPAC currently does not support the inclusion of such variables for risk adjustment and argues that doing so would mask disparities in clinical performance; instead, it recommends that for payment purposes, Medicare should account for social risk factors by directly adjusting payment using peer grouping (MedPAC, 2018).

One potential limitation of this analysis is that our risk-adjustment model did not control for market area–level characteristics that may also affect ACSH and ACSV rates, in addition to beneficiary-level risk factors already included in the model. Such characteristics could include area–level poverty rates (which may influence access to and quality of ambulatory care); health care supply-side factors, such as the number of hospital beds per capita (which may induce demand for and use of hospital care); and the number of primary care physicians per capita (which can affect the use of preventive care). The extent of Medicare managed care penetration in a market area may also be relevant because of its potential spillover effects on FFS Medicare delivery system. These factors may be considered in future work. However, similar to the question of whether individual-level social risk factors should be included in risk-adjustment models, the inclusion of market area–level characteristics can also be controversial, particularly if the risk-adjusted measures are intended to capture the quality of care at the market level.

Going forward, MedPAC may continue testing the risk-adjusted ACSH and ACSV measures and apply these measures to other populations and entities. These may include Medicare enrollees in Medicare Advantage (MA) plans, accountable care organizations, and groups of physicians or other providers participating in the Medicare program.

5. Conclusion

Ambulatory care sensitive hospitalizations (ACSHs) and ambulatory care sensitive emergency department (ED) visits (ACSVs) constitute important quality measures because a substantial portion of hospitalizations and ED visits can be prevented with adequate and better-quality ambulatory care. The market area–level, risk-adjusted rates of ACSHs and ACSVs developed from this analysis can be used as performance indicators of the ambulatory care systems in a given market. The considerable variation in both ACSH and ACSV rates across market areas suggests opportunities to improve the quality of care and the potential to use these measures to compare quality across local health care markets. These measures may be refined further by accommodating advances in risk-adjustment methods.

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Appendix A: Descriptive Statistics for Model Covariates

Table A.1. Descriptive Statistics for Model Covariates, 2021–2022

Covariate	Beneficiaries			
	2021		2022	
	Number	Percentage	Number	Percentage
Total Beneficiaries (N)	27,951,223		26,880,883	
Male Less Than 65 Years of Age	1,907,546	6.82	1,685,498	6.27
Male Aged 65–69	3,387,881	12.12	3,207,285	11.93
Male Aged 70–74	3,121,223	11.17	3,032,542	11.28
Male Aged 75–79	2,019,167	7.22	2,060,012	7.66
Male Aged 80–84	1,240,864	4.44	1,225,877	4.56
Male Aged 85–89	646,270	2.31	631,341	2.35
Male Aged 90–94	252,602	0.90	243,822	0.91
Male Aged 95+	56,750	0.20	55,273	0.21
Female Less Than 65 Years of Age	1,700,091	6.08	1,471,165	5.47
Female Aged 65–69	3,940,504	14.10	3,739,253	13.91
Female Aged 70–74	3,666,545	13.12	3,581,972	13.33
Female Aged 75–79	2,512,926	8.99	2,546,931	9.47
Female Aged 80–84	1,709,821	6.12	1,684,604	6.27
Female Aged 85–89	1,054,952	3.77	1,017,589	3.79
Female Aged 90–94	546,374	1.95	517,672	1.93
Female Aged 95+	187,707	0.67	180,047	0.67
End Stage Renal Disease Status	260,988	0.93	231,606	0.86
Aged and Originally Eligible Due To Disability	2,208,174	7.90	2,079,938	7.74
HIV/AIDs	77,180	0.28	72,994	0.27
Septicemia, Sepsis, Systemic Inflammatory Response Syndrome/Shock	547,778	1.96	523,556	1.95
Opportunistic Infections	79,339	0.28	79,814	0.30
Metastatic Cancer and Acute Leukemia	283,352	1.01	290,174	1.08
Lung and Other Severe Cancers	290,956	1.04	293,405	1.09

(continued)

Table A.1. Descriptive Statistics for Model Covariates, 2021–2022 (continued)

Covariate	Beneficiaries			
	2021		2022	
	Number	Percentage	Number	Percentage
Lymphoma and Other Cancers	393,168	1.41	403,901	1.50
Colorectal, Bladder, and Other Cancers	507,652	1.82	510,164	1.90
Breast, Prostate, and Other Cancers and Tumors	1,678,272	6.00	1,733,110	6.45
Diabetes With Acute Complications	97,741	0.35	96,305	0.36
Diabetes With Chronic Complications	4,001,273	14.32	4,021,941	14.96
Diabetes Without Complication	2,166,380	7.75	2,055,476	7.65
Protein-Calorie Malnutrition	345,201	1.24	367,614	1.37
Morbid Obesity	1,643,003	5.88	1,788,891	6.65
Other Significant Endocrine and Metabolic Disorders	981,543	3.51	1,017,603	3.79
End-Stage Liver Disease	89,436	0.32	92,731	0.34
Cirrhosis of Liver	137,886	0.49	141,443	0.53
Chronic Hepatitis	112,473	0.40	105,801	0.39
Intestinal Obstruction/Perforation	292,186	1.05	305,767	1.14
Chronic Pancreatitis	55,661	0.20	54,280	0.20
Inflammatory Bowel Disease	273,435	0.98	281,908	1.05
Bone/Joint/Muscle Infections/ Necrosis	215,533	0.77	215,403	0.80
Rheumatoid Arthritis and Inflammatory Connective Tissue Disease	1,761,761	6.30	1,829,567	6.81
Severe Hematological Disorders	97,573	0.35	95,341	0.35
Disorders of Immunity	462,300	1.65	530,198	1.97
Coagulation Defects & Other Specified Hematological Disorders	1,308,520	4.68	1,442,114	5.36
Dementia with Complications	338,622	1.21	340,601	1.27
Dementia without Complications	918,179	3.28	901,063	3.35
Substance Use with Psychotic Complications	32,063	0.11	30,646	0.11

(continued)

Table A.1. Descriptive Statistics for Model Covariates, 2021–2022 (continued)

Covariate	Beneficiaries			
	2021		2022	
	Number	Percentage	Number	Percentage
Substance Use Disorder, Moderate/Severe or Substance Use with Complications	650,909	2.33	636,522	2.37
Substance Use Disorder, Mild, Except Alcohol and Cannabis	48,360	0.17	46,389	0.17
Schizophrenia	384,509	1.38	355,929	1.32
Reactive and Unspecified Psychosis	71,568	0.26	67,467	0.25
Major Depressive, Bipolar, and Paranoid Disorders	2,483,416	8.88	2,563,895	9.54
Personality Disorders	15,369	0.05	14,677	0.05
Quadriplegia	50,323	0.18	50,399	0.19
Paraplegia	49,114	0.18	48,699	0.18
Spinal Cord Disorders/Injuries	167,998	0.60	186,892	0.70
Amyotrophic Lateral Sclerosis & Other Motor Neuron Disease	10,621	0.04	10,831	0.04
Cerebral Palsy	86,149	0.31	86,142	0.32
Myasthenia Gravis/Myoneural Disorders, Inflammatory & Toxic Neuropathy	251,351	0.90	268,364	1.00
Muscular Dystrophy	14,001	0.05	14,000	0.05
Multiple Sclerosis	142,355	0.51	141,452	0.53
Parkinson’s and Huntington’s Diseases	352,142	1.26	353,338	1.31
Seizure Disorders and Convulsions	696,785	2.49	655,969	2.44
Coma, Brain Compression/Anoxic Damage	70,139	0.25	60,057	0.22
Respirator Dependence/Tracheostomy Status	61,801	0.22	59,806	0.22
Respiratory Arrest	3,272	0.01	2,760	0.01
Cardio-Respiratory Failure and Shock	795,708	2.85	833,835	3.10
Congestive Heart Failure	2,770,438	9.91	2,781,936	10.35
Acute Myocardial Infarction	417,873	1.50	395,100	1.47

(continued)

Table A.1. Descriptive Statistics for Model Covariates, 2021–2022 (continued)

Covariate	Beneficiaries			
	2021		2022	
	Number	Percentage	Number	Percentage
Unstable Angina & Other Acute Ischemic Heart Disease	292,571	1.05	285,333	1.06
Angina Pectoris	766,095	2.74	774,384	2.88
Specified Heart Arrhythmias	3,673,493	13.14	3,663,910	13.63
Intracranial Hemorrhage	109,290	0.39	110,419	0.41
Ischemic or Unspecified Stroke	679,991	2.43	665,656	2.48
Hemiplegia/Hemiparesis	315,200	1.13	307,006	1.14
Monoplegia, Other Paralytic Syndromes	39,240	0.14	40,886	0.15
Atherosclerosis of Extremities W/Ulceration or Gangrene	119,564	0.43	111,721	0.42
Vascular Disease With Complications	479,693	1.72	492,342	1.83
Vascular Disease	3,460,870	12.38	3,507,454	13.05
Cystic Fibrosis	3,968	0.01	4,180	0.02
Chronic Obstructive Pulmonary Disease	2,664,925	9.53	2,512,567	9.35
Fibrosis of Lung and Other Chronic Lung Disorders	266,378	0.95	278,521	1.04
Aspiration and Specified Bacterial Pneumonias	154,104	0.55	146,711	0.55
Pneumococcal Pneumonia, Empyema, Lung Abscess	136,647	0.49	67,573	0.25
Proliferative Diabetic Retinopathy & Vitreous Hemorrhage	193,684	0.69	200,168	0.74
Exudative Macular Degenera-tion	459,029	1.64	467,462	1.74
Dialysis Status	213,454	0.76	199,869	0.74
Acute Renal Failure	973,006	3.48	984,254	3.66
Chronic Kidney Disease, Stage 5	65,158	0.23	61,244	0.23
Chronic Kidney Disease, Severe (Stage 4)	210,177	0.75	213,261	0.79
Chronic Kidney Disease, Moderate (Stage 3)	1,815,232	6.49	1,895,296	7.05

(continued)

Table A.1. Descriptive Statistics for Model Covariates, 2021–2022 (continued)

Covariate	Beneficiaries			
	2021		2022	
	Number	Percentage	Number	Percentage
Press Ulcer of Skin W/Necrosis Through To Muscle, Tendon, Bone	33,431	0.12	34,201	0.13
Pressure Ulcer of Skin With Full Thickness Skin Loss	89,819	0.32	90,672	0.34
Pressure Ulcer of Skin With Partial Thickness Skin Loss	82,461	0.30	77,976	0.29
Chronic Ulcer of Skin, Except Pressure	440,478	1.58	440,468	1.64
Severe Skin Burn or Condition	3,677	0.01	3,726	0.01
Severe Head Injury	1,580	0.01	1,473	0.01
Major Head Injury	151,833	0.54	157,769	0.59
Vertebral Fractures Without Spinal Cord Injury	245,582	0.88	262,207	0.98
Hip Fracture/Dislocation	218,701	0.78	219,747	0.82
Traumatic Amputations and Complications	46,387	0.17	48,026	0.18
Complications of Specified Implanted Device or Graft	438,807	1.57	439,918	1.64
Major Organ Transplant or Replacement Status	89,451	0.32	92,255	0.34
Artificial Openings for Feeding or Elimination	212,241	0.76	216,412	0.81
Amputation Status, Lower Limb/Amputation Complications	104,940	0.38	106,132	0.39

Appendix B:
Number and Percentage of Beneficiaries by ACSH and ACSV Count, 2021–2022

Table B-1. Number and Percentage of Beneficiaries by ACS Hospitalizations Count, 2021

	Beneficiaries	
Count of ACS Hospitalizations	Number	Percentage
0	27,274,498	97.58
1	552,832	1.98
2	88,256	0.32
3	22,341	0.08
4	7,560	0.03
5	2,936	0.01
6	1,250	0.00
7	606	0.00
8	330	0.00
9	195	0.00
10+	419	0.00

Table B-2. Number and Percentage of Beneficiaries by ACS Hospitalizations Count, 2022

	Beneficiaries	
Count of ACS Hospitalizations	Number	Percentage
0	26,219,235	97.54
1	543,236	2.02
2	85,175	0.32
3	21,489	0.08
4	6,766	0.03
5	2,577	0.01
6	1,079	0.00
7	554	0.00
8	264	0.00
9	168	0.00
10+	340	0.00

Table B-3. Number and Percentage of Beneficiaries by ACS ED Visits Count, 2021

	Beneficiaries	
Count of ACS ED Visits	**Number**	**Percentage**
0	26,833,674	96.00
1	954,506	3.41
2	121,507	0.43
3	26,091	0.09
4	8,090	0.03
5	3,239	0.01
6	1,450	0.01
7	826	0.00
8	499	0.00
9	355	0.00
10+	986	0.00

Table B-4. Number and Percentage of Beneficiaries by ACS ED Visits Count, 2022

	Beneficiaries	
Count of ACS ED Visits	**Number**	**Percentage**
0	25,700,213	95.61
1	1,010,656	3.76
2	128,272	0.48
3	26,930	0.10
4	7,919	0.03
5	3,103	0.01
6	1,525	0.01
7	774	0.00
8	450	0.00
9	266	0.00
10+	775	0.00

Appendix C:
Frequency of ACSHs and ACSVs, and Prevalence of COVID-19 as a Secondary Diagnosis, by Condition and Year

Table C-1. Frequency of ACS Hospitalizations and ACS ED Visits, by Condition, 2021

Condition	ACS Hospitalizations Counts	Percentage of Total	ACS ED Visits Counts	Percentage of Total
Diabetes Short-Term	54,335	6.30	70,289	5.16
Diabetes Long-Term	67,747	7.85	21,607	1.59
COPD	94,026	10.90	110,406	8.10
Asthma	10,744	1.25	31,281	2.30
Hypertension[1]	5,749	0.67	144,181	10.58
Heart Failure[1]	323,550	37.50	67,688	4.97
Bacterial Pneumonia	95,319	11.05	82,701	6.07
UTI	129,268	14.98	336,227	24.68
Cellulitis	77,208	8.95	138,578	10.17
Pressure Ulcers	4,827	0.56	1,487	0.11
URI/Otitis/ Rhinitis			135,830	9.97
Influenza			4,934	0.36
Non-Specific Back Pain			217,058	15.93
Chronic	556,151	64.46	445,452	32.70
Acute	306,622	35.54	916,815	67.30
Total	862,773	100.00	1,362,267	100.00

Table C-2. Frequency of ACS Hospitalizations and ACS ED Visits, by Condition, 2022

Condition	ACS Hospitalizations Counts	Percentage of Total	ACS ED Visits Counts	Percentage of Total
Diabetes Short-Term	48,811	5.84	63,091	4.42
Diabetes Long-Term	62,595	7.49	19,367	1.36
COPD	89,605	10.72	106,542	7.46
Asthma	11,207	1.34	31,160	2.18
Hypertension[1]	5,259	0.63	143,596	10.05
Heart Failure[1]	304,318	36.39	63,371	4.44
Bacterial Pneumonia	107,034	12.80	91,705	6.42
UTI	129,674	15.51	344,684	24.13
Cellulitis	72,900	8.72	134,994	9.45
Pressure Ulcers	4,836	0.58	1,369	0.10
URI/Otitis/ Rhinitis			167,530	11.73
Influenza			49,899	3.49
Non-Specific Back Pain			210,936	14.77
Chronic	521,795	62.40	427,127	29.91
Acute	314,444	37.60	1,001,117	70.09
Total	836,239	100.00	1,428,244	100.00

Table C-3. Prevalence of COVID-19 as a Secondary Diagnosis for ACS Hospitalizations, by Condition and Year, 2021 - 2022

Condition	2021			2022		
	ACS Hospitalizations Stay Counts	COVID as Secondary Diagnosis Counts	Percentage of Total	ACS Hospitalizations Stay Counts	COVID as Secondary Diagnosis Counts	Percentage of Total
Diabetes Short-Term	54,335	1,684	3.10	48,811	2,902	5.95
Diabetes Long-Term	67,747	1,072	1.58	62,595	2,110	3.37
COPD	94,026	489	0.52	89,605	1,341	1.50
Asthma	10,744	47	0.44	11,207	181	1.62
Hypertension	5,749	43	0.75	5,259	92	1.75
Heart Failure	323,550	2,886	0.89	304,318	7,627	2.51
Bacterial Pneumonia	95,319	487	0.51	107,034	1,304	1.22
UTI	129,268	2,230	1.73	129,674	5,519	4.26
Cellulitis	77,208	873	1.13	72,900	2,102	2.88
Pressure Ulcers	4,827	91	1.89	4,836	240	4.96
Chronic	556,151	6,221	1.12	521,795	14,253	2.73
Acute	306,622	3,681	1.20	314,444	9,165	2.91
Total	862,773	9,902	1.15	836,239	23,418	2.80

Table C-4. Prevalence of COVID-19 as a Secondary Diagnosis for ACS ED Visits, by Condition and Year, 2021-2022

Condition	2021			2022		
	ACS ED Visit Counts	COVID as Secondary Diagnosis Counts	Percentage of Total	ACS ED Visit Counts	COVID as Secondary Diagnosis Counts	Percentage of Total
Diabetes Short-Term	70,289	468	0.67	63,091	637	1.01
Diabetes Long-Term	21,607	108	0.50	19,367	145	0.75
COPD	110,406	428	0.39	106,542	1,042	0.98
Asthma	31,281	108	0.35	31,160	256	0.82
Hypertension[1]	144,181	287	0.20	143,596	565	0.39
Heart Failure[1]	67,688	297	0.44	63,371	511	0.81
Bacterial Pneumonia	82,701	377	0.46	91,705	492	0.54
UTI	336,227	1,030	0.31	344,684	2,039	0.59
Cellulitis	138,578	178	0.13	134,994	391	0.29
Pressure Ulcers	1,487	6	0.40	1,369	17	1.24
URI/Otitis/ Rhinitis	135,830	494	0.36	167,530	1,187	0.71
Influenza	4,934	29	0.59	49,899	315	0.63
Non-Specific Back Pain	217,058	238	0.11	210,936	421	0.20
Chronic	445,452	1,696	0.38	427,127	3,156	0.74
Acute	916,815	2,352	0.26	1,001,117	4,862	0.49
Total	1,362,267	4,048	0.30	1,428,244	8,018	0.56

Appendix D:
ACSH and ACSV Risk Adjustment Model Results, 2021–2022

Table D-1. ZINB Model Results Predicting the Count of ACS Hospitalizations, 2021–2022

N Beneficiaries	2021				2022			
	First Stage		Second Stage		First Stage		Second Stage	
Covariate	β	p	β	p	β	p	β	p
Male Less Than 65 Years of Age	-0.534	<0.001	0.201	<0.001	-0.477	<0.001	0.181	<0.001
Male Aged 65–69	-0.245	<0.001	-0.148	<0.001	-0.193	<0.001	-0.142	<0.001
Male Aged 70–74	-0.315	<0.001	-0.236	<0.001	-0.399	<0.001	-0.229	<0.001
Male Aged 75–79	-0.680	<0.001	-0.246	<0.001	-0.746	<0.001	-0.229	<0.001
Male Aged 80–84	-1.179	<0.001	-0.247	<0.001	-1.273	<0.001	-0.200	<0.001
Male Aged 85–89	-1.770	<0.001	-0.233	<0.001	-1.856	<0.001	-0.164	<0.001
Male Aged 90–94	-2.505	<0.001	-0.203	<0.001	-2.650	<0.001	-0.131	<0.001
Male Aged 95+	-3.061	<0.001	-0.198	<0.001	-3.190	<0.001	-0.076	0.002
Female Less Than 65 Years of Age	-0.460	<0.001	0.302	<0.001	-0.402	<0.001	0.290	<0.001
Female Aged 70–74	-0.227	<0.001	-0.050	<0.001	-0.282	<0.001	-0.038	<0.001
Female Aged 75–79	-0.645	<0.001	-0.054	<0.001	-0.726	<0.001	-0.031	0.003
Female Aged 80–84	-1.211	<0.001	-0.072	<0.001	-1.303	<0.001	-0.017	0.127
Female Aged 85–89	-1.883	<0.001	-0.087	<0.001	-2.016	<0.001	-0.014	0.231
Female Aged 90–94	-2.675	<0.001	-0.112	<0.001	-2.795	<0.001	0.008	0.496
Female Aged 95+	-3.394	<0.001	-0.193	<0.001	-3.656	<0.001	-0.080	<0.001
End Stage Renal Disease Status	-2.381	<0.001	0.647	<0.001	-1.856	<0.001	0.583	<0.001
Aged and Originally Eligible Due to Disability	-0.669	<0.001	0.111	<0.001	-0.743	<0.001	0.106	<0.001
HIV/Aids	-0.139	0.012	-0.034	0.244	-0.055	0.351	0.022	0.456
Septicemia, Sepsis, Systemic Inflammatory Response Syndrome/Shock	-0.612	<0.001	-0.019	0.003	-0.578	<0.001	-0.006	0.307
Opportunistic Infections	-0.410	<0.001	0.012	0.496	-0.476	<0.001	-0.021	0.252

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Table D-1. ZINB Model Results Predicting the Count of ACS Hospitalizations, 2021–2022 (continued)

N Beneficiaries	2021				2022			
	First Stage		Second Stage		First Stage		Second Stage	
Covariate	β	p	β	p	β	p	β	p
Metastatic Cancer and Acute Leukemia	-0.781	<0.001	-0.146	<0.001	-0.833	<0.001	-0.116	<0.001
Lung and Other Severe Cancers	-0.450	<0.001	0.010	0.407	-0.523	<0.001	0.033	0.004
Lymphoma and Other Cancers	-0.224	<0.001	-0.045	0.001	-0.363	<0.001	-0.046	<0.001
Colorectal, Bladder, and Other Cancers	-0.116	<0.001	-0.035	0.002	-0.149	<0.001	-0.050	<0.001
Breast, Prostate, and Other Cancers and Tumors	0.162	<0.001	-0.047	<0.001	0.136	<0.001	-0.046	<0.001
Diabetes With Acute Complications	-1.098	<0.001	0.788	<0.001	-1.326	<0.001	0.759	<0.001
Diabetes With Chronic Complications	-0.747	<0.001	0.250	<0.001	-0.799	<0.001	0.247	<0.001
Diabetes Without Complication	-0.431	<0.001	0.044	<0.001	-0.523	<0.001	0.038	<0.001
Protein-Calorie Malnutrition	-0.593	<0.001	-0.026	0.001	-0.539	<0.001	-0.023	0.002
Morbid Obesity	-0.360	<0.001	0.087	<0.001	-0.381	<0.001	0.071	<0.001
Other Significant Endocrine and Metabolic Disorders	-0.006	0.699	0.045	<0.001	0.028	0.081	0.053	<0.001
End-Stage Liver Disease	-0.602	<0.001	-0.019	0.276	-0.709	<0.001	-0.007	0.703
Cirrhosis of Liver	-0.320	<0.001	0.109	<0.001	-0.409	<0.001	0.121	<0.001
Chronic Hepatitis	-0.001	0.987	0.066	0.002	-0.052	0.277	0.080	<0.001
Intestinal Obstruction/Perforation	-0.098	0.001	-0.097	<0.001	-0.081	0.010	-0.079	<0.001
Chronic Pancreatitis	-0.002	0.973	0.203	<0.001	-0.149	0.016	0.183	<0.001
Inflammatory Bowel Disease	0.059	0.061	-0.008	0.629	0.061	0.061	-0.002	0.890
Bone/Joint/Muscle Infections/Necrosis	-0.206	<0.001	0.195	<0.001	-0.242	<0.001	0.219	<0.001
Rheumatoid Arthritis and Inflammatory Connective Tissue Disease	-0.119	<0.001	-0.008	0.211	-0.186	<0.001	-0.022	<0.001
Severe Hematological Disorders	-0.441	<0.001	0.060	0.001	-0.382	<0.001	0.077	<0.001

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Table D-1. ZINB Model Results Predicting the Count of ACS Hospitalizations, 2021–2022 (continued)

N Beneficiaries	2021				2022			
	First Stage		Second Stage		First Stage		Second Stage	
Covariate	β	p	β	p	β	p	β	p
Disorders of Immunity	-0.119	<0.001	-0.082	<0.001	-0.056	0.026	-0.086	<0.001
Coagulation Defects & Other Specified Hematological Disorders	-0.030	0.034	-0.019	0.002	-0.030	0.042	-0.037	<0.001
Dementia with Complications	-1.559	<0.001	-0.280	<0.001	-1.719	<0.001	-0.225	<0.001
Dementia without Complications	-1.065	<0.001	-0.140	<0.001	-1.169	<0.001	-0.106	<0.001
Substance Use with Psychotic Complications	-0.363	<0.001	0.082	0.004	-0.382	<0.001	0.072	0.014
Substance Use Disorder, Moderate/Severe or Substance Use with Complications	-0.169	<0.001	0.209	<0.001	-0.217	<0.001	0.193	<0.001
Substance Use Disorder, Mild, Except Alcohol and Cannabis	-0.283	<0.001	0.413	<0.001	-0.458	<0.001	0.423	<0.001
Schizophrenia	-0.225	<0.001	0.053	<0.001	-0.322	<0.001	0.051	<0.001
Reactive and Unspecified Psychosis	-0.364	<0.001	0.024	0.232	-0.534	<0.001	0.078	<0.001
Major Depressive, Bipolar, and Paranoid Disorders	-0.110	<0.001	0.018	0.001	-0.150	<0.001	0.034	<0.001
Personality Disorders	0.393	<0.001	0.345	<0.001	0.272	0.016	0.362	<0.001
Quadriplegia	-1.144	<0.001	-0.013	0.507	-1.265	<0.001	0.087	<0.001
Paraplegia	-0.940	<0.001	0.143	<0.001	-0.902	<0.001	0.229	<0.001
Spinal Cord Disorders/Injuries	-0.182	<0.001	-0.008	0.655	-0.214	<0.001	0.004	0.786
Amyotrophic Lateral Sclerosis & Other Motor Neuron Disease	-0.470	0.006	-0.148	0.039	-0.648	<0.001	-0.212	0.002
Cerebral Palsy	-0.368	<0.001	-0.139	<0.001	-0.493	<0.001	-0.095	0.001
Myasthenia Gravis/Myoneural Disorders, Inflammatory & Toxic Neuropathy	-0.159	<0.001	-0.042	0.002	-0.203	<0.001	-0.040	0.002
Muscular Dystrophy	-0.431	0.002	-0.170	0.011	-0.634	<0.001	-0.289	<0.001
Multiple Sclerosis	-0.385	<0.001	-0.013	0.559	-0.532	<0.001	-0.013	0.545
Parkinson's and Huntington's Diseases	-0.680	<0.001	0.017	0.121	-0.783	<0.001	0.026	0.015

(continued)

Table D-1. ZINB Model Results Predicting the Count of ACS Hospitalizations, 2021–2022 (continued)

N Beneficiaries	2021				2022			
	First Stage		Second Stage		First Stage		Second Stage	
Covariate	β	p	β	p	β	p	β	p
Seizure Disorders and Convulsions	-0.185	<0.001	0.015	0.060	-0.218	<0.001	0.030	<0.001
Coma, Brain Compression/Anoxic Damage	-0.083	0.205	-0.180	<0.001	-0.058	0.429	-0.161	<0.001
Respirator Dependence/Tracheostomy Status	-0.095	0.128	0.095	<0.001	-0.119	0.087	0.096	<0.001
Respiratory Arrest	-0.763	0.003	0.281	<0.001	-0.358	0.215	0.351	<0.001
Cardio-Respiratory Failure and Shock	-0.903	<0.001	0.333	<0.001	-0.809	<0.001	0.380	<0.001
Congestive Heart Failure	-0.726	<0.001	0.448	<0.001	-0.751	<0.001	0.446	<0.001
Acute Myocardial Infarction	-0.011	0.611	0.203	<0.001	-0.080	0.001	0.189	<0.001
Unstable Angina & Other Acute Ischemic Heart Disease	0.053	0.035	0.180	<0.001	0.115	<0.001	0.199	<0.001
Angina Pectoris	0.062	<0.001	0.062	<0.001	0.027	0.146	0.042	<0.001
Specified Heart Arrhythmias	-0.435	<0.001	0.197	<0.001	-0.478	<0.001	0.205	<0.001
Intracranial Hemorrhage	-0.109	0.038	-0.074	<0.001	-0.201	<0.001	-0.095	<0.001
Ischemic or Unspecified Stroke	-0.287	<0.001	0.014	0.080	-0.353	<0.001	0.017	0.027
Hemiplegia/Hemiparesis	-0.515	<0.001	-0.018	0.068	-0.494	<0.001	-0.008	0.419
Monoplegia, Other Paralytic Syndromes	-0.264	0.001	0.018	0.531	-0.461	<0.001	-0.042	0.130
Atherosclerosis of Extremities W/Ulceration or Gangrene	-2.121	<0.001	0.378	<0.001	-2.243	<0.001	0.411	<0.001
Vascular Disease With Complications	-0.261	<0.001	0.104	<0.001	-0.305	<0.001	0.096	<0.001
Vascular Disease	-0.298	<0.001	0.037	<0.001	-0.315	<0.001	0.041	<0.001
Cystic Fibrosis	-0.030	0.894	0.103	0.386	0.397	0.055	0.430	<0.001
Chronic Obstructive Pulmonary Disease	-1.208	<0.001	0.270	<0.001	-1.454	<0.001	0.285	<0.001
Fibrosis of Lung and Other Chronic Lung Disorders	-0.498	<0.001	-0.041	0.008	-0.602	<0.001	-0.037	0.011
Aspiration and Specified Bacterial Pneumonias	-0.642	<0.001	0.031	0.001	-0.700	<0.001	0.017	0.087

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Table D-1. ZINB Model Results Predicting the Count of ACS Hospitalizations, 2021–2022 (continued)

N Beneficiaries	2021				2022			
	First Stage		Second Stage		First Stage		Second Stage	
Covariate	β	p	β	p	β	p	β	p
Pneumococcal Pneumonia, Empyema, Lung Abscess	-0.547	<0.001	0.143	<0.001	-0.515	<0.001	0.169	<0.001
Proliferative Diabetic Retinopathy & Vitreous Hemorrhage	-0.627	<0.001	0.159	<0.001	-0.731	<0.001	0.172	<0.001
Exudative Macular Degeneration	-0.079	0.001	0.049	<0.001	-0.054	0.033	0.060	<0.001
Dialysis Status	0.071	0.163	-0.394	<0.001	-0.388	<0.001	-0.235	<0.001
Acute Renal Failure	-0.689	<0.001	0.256	<0.001	-0.647	<0.001	0.281	<0.001
Chronic Kidney Disease, Stage 5	-0.593	<0.001	-0.089	<0.001	-0.584	<0.001	0.039	0.083
Chronic Kidney Disease, Severe (Stage 4)	-0.841	<0.001	0.219	<0.001	-0.877	<0.001	0.229	<0.001
Chronic Kidney Disease, Moderate (Stage 3)	-0.237	<0.001	0.040	<0.001	-0.199	<0.001	0.044	<0.001
Press Ulcer of Skin W/Necrosis Through To Muscle, Tendon, Bone	-2.900	<0.001	0.096	<0.001	-18.246	0.981	0.122	<0.001
Pressure Ulcer of Skin With Full Thickness Skin Loss	-2.007	<0.001	0.104	<0.001	-2.321	<0.001	0.111	<0.001
Pressure Ulcer of Skin With Partial Thickness Skin Loss	-1.538	<0.001	0.122	<0.001	-1.733	<0.001	0.136	<0.001
Chronic Ulcer of Skin, Except Pressure	-1.274	<0.001	0.230	<0.001	-1.433	<0.001	0.253	<0.001
Severe Skin Burn or Condition	-0.296	0.198	-0.011	0.893	-0.199	0.421	-0.037	0.651
Severe Head Injury	0.969	0.013	0.055	0.733	0.303	0.545	-0.358	0.035
Major Head Injury	-0.018	0.673	-0.010	0.544	-0.062	0.160	-0.004	0.829
Vertebral Fractures Without Spinal Cord Injury	-0.364	<0.001	0.124	<0.001	-0.395	<0.001	0.111	<0.001
Hip Fracture/Dislocation	-0.381	<0.001	-0.116	<0.001	-0.448	<0.001	-0.115	<0.001
Traumatic Amputations and Complications	-0.450	<0.001	-0.037	0.037	-0.510	<0.001	-0.019	0.263
Complications of Specified Implanted Device or Graft	-0.245	<0.001	-0.013	0.112	-0.306	<0.001	-0.011	0.154
Major Organ Transplant or Replacement Status	-0.051	0.374	-0.311	<0.001	-0.044	0.462	-0.276	<0.001

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Table D-1. ZINB Model Results Predicting the Count of ACS Hospitalizations, 2021–2022 (continued)

N Beneficiaries	2021				2022			
	First Stage		Second Stage		First Stage		Second Stage	
Covariate	**β**	**p**	**β**	**p**	**β**	**p**	**β**	**p**
Artificial Openings for Feeding or Elimination	-0.760	<0.001	-0.154	<0.001	-0.724	<0.001	-0.128	<0.001
Amputation Status, Lower Limb/Amputation Complications	-0.991	<0.001	0.205	<0.001	-1.094	<0.001	0.225	<0.001
Constant	2.857	<0.001	-2.550	<0.001	2.896	<0.001	-2.671	<0.001
Ln(α)	0.858	<0.001			0.878	<0.001		
Dispersion Parameter (α)	2.358				2.406			

Table D-2. ZINB Model Results Predicting the Count of ACS ED Visits, 2021–2022

N Beneficiaries	2021				2022			
	First Stage		Second Stage		First Stage		Second Stage	
Covariate	β	p	β	p	β	p	β	p
Male Less Than 65 Years of Age	-0.355	<0.001	0.444	<0.001	-0.278	<0.001	0.411	<0.001
Male Aged 65–69	0.079	<0.001	-0.208	<0.001	0.091	<0.001	-0.226	<0.001
Male Aged 70–74	0.049	0.003	-0.267	<0.001	-0.042	0.012	-0.276	<0.001
Male Aged 75–79	-0.202	<0.001	-0.219	<0.001	-0.284	<0.001	-0.220	<0.001
Male Aged 80–84	-0.506	<0.001	-0.165	<0.001	-0.581	<0.001	-0.137	<0.001
Male Aged 85–89	-0.817	<0.001	-0.113	<0.001	-0.907	<0.001	-0.077	<0.001
Male Aged 90–94	-1.141	<0.001	-0.088	<0.001	-1.349	<0.001	-0.074	<0.001
Male Aged 95+	-1.438	<0.001	-0.111	<0.001	-1.556	<0.001	-0.057	0.027
Female Less Than 65 Years of Age	-0.884	<0.001	0.612	<0.001	-0.778	<0.001	0.604	<0.001
Female Aged 70–74	-0.081	<0.001	0.000	0.998	-0.183	<0.001	-0.017	0.018
Female Aged 75–79	-0.403	<0.001	0.054	<0.001	-0.455	<0.001	0.064	<0.001
Female Aged 80–84	-0.832	<0.001	0.096	<0.001	-0.906	<0.001	0.113	<0.001
Female Aged 85–89	-1.354	<0.001	0.100	<0.001	-1.392	<0.001	0.140	<0.001
Female Aged 90–94	-2.151	<0.001	0.040	<0.001	-1.946	<0.001	0.116	<0.001
Female Aged 95+	-3.172	<0.001	-0.072	<0.001	-3.043	<0.001	-0.039	0.009
End Stage Renal Disease Status	-1.179	<0.001	0.013	0.397	-0.457	<0.001	-0.026	0.119
Aged and Originally Eligible Due to Disability	-0.553	<0.001	0.269	<0.001	-0.588	<0.001	0.268	<0.001
HIV/Aids	-0.505	<0.001	0.035	0.085	-0.714	<0.001	-0.038	0.065
Septicemia, Sepsis, Systemic Inflammatory Response Syndrome/Shock	-2.673	<0.001	0.088	<0.001	-2.428	<0.001	0.119	<0.001
Opportunistic Infections	-0.453	<0.001	0.063	<0.001	-0.915	<0.001	0.034	0.028
Metastatic Cancer and Acute Leukemia	-0.647	<0.001	-0.099	<0.001	-0.671	<0.001	-0.080	<0.001
Lung and Other Severe Cancers	-0.380	<0.001	-0.035	0.002	-0.378	<0.001	-0.013	0.211
Lymphoma and Other Cancers	-0.168	<0.001	-0.052	<0.001	-0.326	<0.001	-0.040	<0.001

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Table D-2. ZINB Model Results Predicting the Count of ACS ED Visits, 2021–2022 (continued)

N Beneficiaries	2021				2022			
	First Stage		Second Stage		First Stage		Second Stage	
Covariate	β	p	β	p	β	p	β	p
Colorectal, Bladder, and Other Cancers	-0.259	<0.001	-0.018	0.062	-0.281	<0.001	-0.004	0.622
Breast, Prostate, and Other Cancers and Tumors	-0.022	0.205	-0.065	<0.001	-0.090	<0.001	-0.062	<0.001
Diabetes With Acute Complications	-0.372	<0.001	0.677	<0.001	-0.334	<0.001	0.599	<0.001
Diabetes With Chronic Complications	-0.595	<0.001	0.228	<0.001	-0.676	<0.001	0.203	<0.001
Diabetes Without Complication	-0.462	<0.001	0.065	<0.001	-0.534	<0.001	0.061	<0.001
Protein-Calorie Malnutrition	-0.754	<0.001	-0.048	<0.001	-0.684	<0.001	-0.058	<0.001
Morbid Obesity	-0.456	<0.001	0.068	<0.001	-0.518	<0.001	0.050	<0.001
Other Significant Endocrine and Metabolic Disorders	-0.143	<0.001	0.005	0.375	-0.208	<0.001	0.001	0.903
End-Stage Liver Disease	-0.720	<0.001	0.019	0.233	-0.755	<0.001	0.037	0.011
Cirrhosis of Liver	-0.373	<0.001	0.080	<0.001	-0.282	<0.001	0.106	<0.001
Chronic Hepatitis	-0.256	<0.001	0.112	<0.001	-0.170	0.005	0.117	<0.001
Intestinal Obstruction/Perforation	-0.751	<0.001	0.046	<0.001	-0.711	<0.001	0.053	<0.001
Chronic Pancreatitis	-0.393	<0.001	0.231	<0.001	-0.455	<0.001	0.227	<0.001
Inflammatory Bowel Disease	-0.063	0.104	0.025	0.036	-0.146	<0.001	0.009	0.415
Bone/Joint/Muscle Infections/Necrosis	-0.288	<0.001	0.038	<0.001	-0.362	<0.001	0.038	<0.001
Rheumatoid Arthritis and Inflammatory Connective Tissue Disease	-0.395	<0.001	0.071	<0.001	-0.464	<0.001	0.086	<0.001
Severe Hematological Disorders	-0.567	<0.001	-0.022	0.204	-0.657	<0.001	-0.004	0.790
Disorders of Immunity	-0.223	<0.001	-0.038	<0.001	-0.266	<0.001	-0.028	<0.001
Coagulation Defects & Other Specified Hematological Disorders	-0.304	<0.001	-0.055	<0.001	-0.372	<0.001	-0.053	<0.001
Dementia with Complications	-1.575	<0.001	-0.160	<0.001	-1.740	<0.001	-0.132	<0.001
Dementia without Complications	-1.067	<0.001	0.007	0.228	-1.113	<0.001	0.011	0.042
Substance Use with Psychotic Complications	-1.475	<0.001	0.277	<0.001	-1.702	<0.001	0.256	<0.001

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Table D-2. ZINB Model Results Predicting the Count of ACS ED Visits, 2021–2022 (continued)

N Beneficiaries	2021				2022			
	First Stage		Second Stage		First Stage		Second Stage	
Covariate	β	p	β	p	β	p	β	p
Substance Use Disorder, Moderate/Severe or Substance Use with Complications	-0.381	<0.001	0.322	<0.001	-0.457	<0.001	0.277	<0.001
Substance Use Disorder, Mild, Except Alcohol and Cannabis	-0.881	<0.001	0.568	<0.001	-0.864	<0.001	0.578	<0.001
Schizophrenia	0.089	<0.001	0.358	<0.001	-0.006	0.829	0.324	<0.001
Reactive and Unspecified Psychosis	-0.414	<0.001	0.117	<0.001	-0.429	<0.001	0.156	<0.001
Major Depressive, Bipolar, and Paranoid Disorders	-0.346	<0.001	0.101	<0.001	-0.407	<0.001	0.093	<0.001
Personality Disorders	0.213	0.048	0.452	<0.001	0.083	0.487	0.358	<0.001
Quadriplegia	-1.013	<0.001	0.118	<0.001	-1.351	<0.001	0.134	<0.001
Paraplegia	-0.678	<0.001	0.331	<0.001	-1.058	<0.001	0.299	<0.001
Spinal Cord Disorders/Injuries	-0.365	<0.001	0.110	<0.001	-0.362	<0.001	0.103	<0.001
Amyotrophic Lateral Sclerosis & Other Motor Neuron Disease	0.287	0.127	-0.012	0.842	-0.123	0.560	-0.104	0.054
Cerebral Palsy	0.155	0.007	0.003	0.888	0.103	0.066	0.052	0.006
Myasthenia Gravis/Myoneural Disorders, Inflammatory & Toxic Neuropathy	-0.444	<0.001	-0.079	<0.001	-0.387	<0.001	-0.037	<0.001
Muscular Dystrophy	0.120	0.443	-0.005	0.917	-0.339	0.069	-0.105	0.029
Multiple Sclerosis	0.006	0.913	-0.029	0.088	-0.178	0.001	-0.026	0.102
Parkinson's and Huntington's Diseases	-0.674	<0.001	0.090	<0.001	-0.562	<0.001	0.121	<0.001
Seizure Disorders and Convulsions	-0.146	<0.001	0.089	<0.001	-0.225	<0.001	0.097	<0.001
Coma, Brain Compression/Anoxic Damage	-0.528	<0.001	-0.105	<0.001	-0.583	<0.001	-0.090	<0.001
Respirator Dependence/Tracheostomy Status	-0.517	0.002	-0.103	<0.001	-0.753	<0.001	-0.084	<0.001
Respiratory Arrest	-1.467	0.168	0.223	<0.001	-0.058	0.917	0.133	0.044
Cardio-Respiratory Failure and Shock	-1.184	<0.001	0.177	<0.001	-1.069	<0.001	0.175	<0.001
Congestive Heart Failure	-0.376	<0.001	0.175	<0.001	-0.430	<0.001	0.166	<0.001

(continued)

Table D-2. ZINB Model Results Predicting the Count of ACS ED Visits, 2021–2022 (continued)

N Beneficiaries	2021				2022			
	First Stage		Second Stage		First Stage		Second Stage	
Covariate	β	p	β	p	β	p	β	p
Acute Myocardial Infarction	-0.529	<0.001	0.123	<0.001	-0.623	<0.001	0.099	<0.001
Unstable Angina & Other Acute Ischemic Heart Disease	-0.539	<0.001	0.116	<0.001	-0.670	<0.001	0.070	<0.001
Angina Pectoris	-0.377	<0.001	0.070	<0.001	-0.457	<0.001	0.055	<0.001
Specified Heart Arrhythmias	-0.452	<0.001	0.055	<0.001	-0.512	<0.001	0.063	<0.001
Intracranial Hemorrhage	-0.313	0.001	-0.084	<0.001	-0.556	<0.001	-0.104	<0.001
Ischemic or Unspecified Stroke	-0.557	<0.001	0.023	0.001	-0.602	<0.001	0.027	<0.001
Hemiplegia/Hemiparesis	-0.388	<0.001	0.010	0.298	-0.298	<0.001	0.031	<0.001
Monoplegia, Other Paralytic Syndromes	-0.535	<0.001	0.043	0.087	-0.590	<0.001	0.038	0.106
Atherosclerosis of Extremities W/Ulceration or Gangrene	-1.140	<0.001	0.046	<0.001	-1.147	<0.001	0.053	<0.001
Vascular Disease With Complications	-0.696	<0.001	0.029	<0.001	-0.735	<0.001	0.043	<0.001
Vascular Disease	-0.488	<0.001	-0.038	<0.001	-0.521	<0.001	-0.025	<0.001
Cystic Fibrosis	0.264	0.356	0.158	0.063	0.344	0.179	0.172	0.028
Chronic Obstructive Pulmonary Disease	-0.948	<0.001	0.419	<0.001	-1.150	<0.001	0.417	<0.001
Fibrosis of Lung and Other Chronic Lung Disorders	-0.639	<0.001	0.011	0.372	-0.810	<0.001	0.039	<0.001
Aspiration and Specified Bacterial Pneumonias	-2.082	<0.001	0.020	0.034	-3.990	0.067	0.024	0.009
Pneumococcal Pneumonia, Empyema, Lung Abscess	-1.055	<0.001	0.245	<0.001	-1.038	<0.001	0.272	<0.001
Proliferative Diabetic Retinopathy & Vitreous Hemorrhage	-0.188	<0.001	0.136	<0.001	-0.223	<0.001	0.135	<0.001
Exudative Macular Degeneration	-0.078	0.026	0.041	<0.001	-0.079	0.023	0.051	<0.001
Dialysis Status	0.539	<0.001	-0.157	<0.001	-0.292	0.003	-0.128	<0.001
Acute Renal Failure	-1.248	<0.001	0.108	<0.001	-1.248	<0.001	0.107	<0.001
Chronic Kidney Disease, Stage 5	-0.259	0.032	-0.099	<0.001	-0.128	0.214	-0.005	0.841
Chronic Kidney Disease, Severe (Stage 4)	-0.417	<0.001	0.077	<0.001	-0.499	<0.001	0.059	<0.001

(continued)

Table D-2. ZINB Model Results Predicting the Count of ACS ED Visits, 2021–2022 (continued)

N Beneficiaries	2021				2022			
	First Stage		Second Stage		First Stage		Second Stage	
Covariate	β	p	β	p	β	p	β	p
Chronic Kidney Disease, Moderate (Stage 3)	-0.202	<0.001	0.003	0.608	-0.202	<0.001	0.006	0.226
Press Ulcer of Skin W/Necrosis Through To Muscle, Tendon, Bone	-4.021	0.458	-0.087	<0.001	-15.474	0.989	-0.100	<0.001
Pressure Ulcer of Skin With Full Thickness Skin Loss	-2.208	<0.001	-0.053	<0.001	-1.769	<0.001	-0.029	0.020
Pressure Ulcer of Skin With Partial Thickness Skin Loss	-1.429	<0.001	0.035	0.013	-1.623	<0.001	0.031	0.021
Chronic Ulcer of Skin, Except Pressure	-0.628	<0.001	0.144	<0.001	-0.733	<0.001	0.142	<0.001
Severe Skin Burn or Condition	-0.740	0.084	0.091	0.197	-0.159	0.616	0.187	0.005
Severe Head Injury	-0.122	0.860	-0.082	0.528	0.305	0.533	0.015	0.898
Major Head Injury	-0.172	0.003	0.075	<0.001	-0.134	0.021	0.071	<0.001
Vertebral Fractures Without Spinal Cord Injury	-0.447	<0.001	0.243	<0.001	-0.584	<0.001	0.220	<0.001
Hip Fracture/Dislocation	-0.366	<0.001	-0.075	<0.001	-0.395	<0.001	-0.074	<0.001
Traumatic Amputations and Complications	-0.609	<0.001	-0.036	0.055	-0.768	<0.001	-0.040	0.026
Complications of Specified Implanted Device or Graft	-0.288	<0.001	0.291	<0.001	-0.384	<0.001	0.267	<0.001
Major Organ Transplant or Replacement Status	-0.439	<0.001	-0.362	<0.001	-0.577	<0.001	-0.312	<0.001
Artificial Openings for Feeding or Elimination	-1.102	<0.001	0.098	<0.001	-0.855	<0.001	0.108	<0.001
Amputation Status, Lower Limb/Amputation Complications	-0.352	<0.001	0.187	<0.001	-0.429	<0.001	0.163	<0.001
Constant	0.751	<0.001	-2.813	<0.001	0.756	<0.001	-2.750	<0.001
Ln(α)	1.234	<0.001			1.148	<0.001		
Dispersion Parameter (α)	3.436				3.153			