CENTERS FOR MEDICARE & MEDICAID SERVICES
OFFICE OF MINORITY HEALTH

Impact of Hospital Readmissions Reduction Initiatives on Vulnerable Populations

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EXECUTIVE SUMMARY

Issue

Decreasing hospital readmissions – defined as inpatient stays that occur within 30 days of discharge from an initial inpatient hospitalization – is a high priority for the Centers for Medicare & Medicaid Services (CMS). Hospital readmissions are a known key quality of care indicator, and account for billions of dollars in annual Medicare spending. In addition, populations made vulnerable through public policies, social inequity, and social bias are known to be at heightened risk for hospital readmissions, and this increased likelihood is known as a *readmissions disparity*. Understanding the drivers of readmissions disparities can help to improve health outcomes for Medicare beneficiaries, particularly for those who are vulnerable, and in containing readmissions-related costs.

Report Objective

This study analyzed the roles that key demographic, clinical, and geographic characteristics, as well as hospital quality and type factors, play in hospital readmissions among Medicare beneficiaries, noting that beneficiaries of certain demographic, clinical, and geographic backgrounds may have higher risks by social risk factors, and the adverse health consequences associated with those factors, than by their counterparts of other backgrounds.

Social risk factors include social and structural conditions that facilitate poor health outcomes. On average, individuals who are racial and/or ethnic minorities, individuals with disabilities, and individuals residing in rural and underserved communities may be disproportionately impacted by social risk factors and may as a result have unique health needs and concerns. This study explored whether and to what extent readmissions were associated with demographic and clinical characteristics, including race and ethnicity, potentially disabling condition status, dual eligibility status, as well as geographic characteristics of residence, including rurality.

The overarching purpose of the analysis was to identify disparities in readmissions across levels of the above indicators of interest (e.g. race and ethnicity groups), stratified by (1) discharge settings (e.g. home/self-care, skilled nursing facility, home health care, inpatient rehabilitation facility), (2) levels of hospital quality, (3) a select set of high-frequency diagnoses, and (4) Census divisions. A more nuanced understanding of such associations supports the CMS Office of Minority Health's goal to achieve health equity across all Medicare beneficiaries.

Key Findings

Race and ethnicity, dual eligibility, and potentially disabling condition status were associated with Medicare fee-for-services beneficiaries' 30-day readmissions. The readmission rate by race and ethnicity ranged from 13.8% among non-Hispanic White beneficiaries to 19.4% among non-Hispanic Black beneficiaries. Readmission rates were 16.8% among Hispanic beneficiaries, 15.9% among American Indian/Alaska Native beneficiaries, and 14.3% among beneficiaries who were of Asian descent. Almost one-fifth (19.4%) of beneficiaries with dual eligibility had a readmission compared with 12.3% of those without dual eligibility. Readmission rate differences were observed among beneficiaries with and without potentially disabling conditions such that the readmission rate among beneficiaries with potentially disabling conditions was 18.3% compared with 11.9% for beneficiaries without a potentially disabling condition. Rate differences were also observed among beneficiaries with substance use disorder (SUD); 23.3% of beneficiaries with SUD had a readmission compared to 12.9% of those without SUD. The overall unadjusted 30-day hospital readmission rate among all beneficiaries was 14.7%.

At the organization level, 30-day readmissions differed across the quality of the treatment facility (i.e., the hospital where initial admission occurred) as well as post-acute care setting at discharge. Beneficiaries whose index hospital quality rating was 5 stars (highest rating) had the lowest readmission rate (11.5%) compared to beneficiaries whose index hospital quality rating was 1 star (17.8%) (lowest rating). Discharges to inpatient psychiatric hospitals had the highest readmission rates (33.1%), followed by other post-acute care settings[1] (32.1%), and critical access hospitals (30.0%), while the settings with the lowest hospital readmission rates were hospice (6.5%), inpatient rehabilitation facility (12.5%), and home/self-care (13.9%).

We identified two groups that may benefit from targeted quality improvement (QI) interventions:

Beneficiaries with potentially disabling conditions:
Compared to beneficiaries without potentially disabling conditions, beneficiaries with potentially disabling conditions have:

- Higher odds of readmission across all levels of hospital quality.
- Higher odds of readmission across a number of discharge settings, and particularly when discharged to home or self-care.

Black/African American beneficiaries:
Compared to non-Hispanic White beneficiaries, Black/African American beneficiaries have:

- Higher readmission rates across levels of hospital quality.
- Greater likelihood of being treated at hospitals with lower quality ratings.
- Higher odds of being readmitted regardless of discharge setting (except for those discharged to long-term care hospitals).

Conclusion

The study's results suggest that a framework designed to incentivize improved matching of discharge setting intensity with beneficiary needs may yield reductions in readmissions and disparities in readmissions across demographic and clinical characteristic groups. For example, individuals with potentially disabling conditions may experience unique barriers to adequately engage in follow-up care after discharge to home/self-care and may benefit from close follow-up monitoring to ensure that the resources necessary for their care are available to them at home. Some individuals with potentially disabling conditions may benefit from discharge to a higher-intensity setting; however, patients' preferences should be considered.

The results also suggest that targeted improvements to reduce disparities in 30-day hospital readmissions may have potential for meaningful impact if they are designed to drive health care organizations to focus on improving care for beneficiaries who are Black/African American, along with beneficiaries who have potentially disabling conditions, beneficiaries who are dually eligible for Medicare and Medicaid, and beneficiaries with substance use disorder (SUD). Interventions may involve improvements in discharge planning and post-acute coordination of care for beneficiaries in these groups. Quality improvement initiatives targeting lower-quality (1–3 stars) hospitals may reduce race and ethnicity disparities and improve readmission rates for

[1] Other post-acute care settings included discharges to court/law enforcement, federal hospitals, and other types of health care institutions not specified elsewhere.

Black/African American beneficiaries, as index hospital stays for Black/African American beneficiaries tend to occur in lower-quality facilities.

INTRODUCTION

In 2013 alone, the cost of Medicare hospital readmissions was $29.6 billion (Strom et al., 2017). The Centers for Medicare & Medicaid Services (CMS) has advanced multiple initiatives to reduce the incidence of preventable hospital readmissions, in part, to reduce Medicare spending. The rising prevalence of multiple chronic conditions in adults older than 65 slows these efforts. While 37.2% of U.S. adults 65 and older had two or more chronic conditions in 2000, by 2010 the prevalence had risen to 45.3% (Freid et al., 2012). Additionally, the prevalence of behavioral health conditions, such as substance use disorder, is estimated to have risen substantially among older adults over the last decade (Gossop & Moos, 2008; Han et al., 2009). The growth in the number of medically complex older adults has made finding effective solutions to reduce hospital readmission rates a more urgent concern for Medicare beneficiaries (Centers for Disease Control and Prevention (CDC), 2018).

The Hospital Readmissions Reduction Program (HRRP) was implemented by CMS in 2012 with the aim of reducing payments to hospitals with high readmission rates for certain health conditions. The Office of the Assistant Secretary for Planning and Evaluation (ASPE) published a report in 2016 (the "Study A Report") entitled *Social Risk Factors and Medicare's Value-based Purchasing Programs* which highlighted the importance of understanding and addressing associations between social risk factors with key health outcomes. HHRP evaluation data in particular demonstrate a link between social risk factors and hospital readmission risk, specifically, that readmission risk is positively associated with a variety of social risk factors, including poverty, housing instability, and residence in a disadvantaged neighborhood (Joynt Maddox et al., 2019).

CMS defines hospital readmissions as inpatient stays that occur within 30 days of discharge from the index admission (i.e. initial inpatient hospitalization) (CMS, 2018). Hospital readmissions are considered a core health care quality indicator due to the fact that they can be the direct result of substandard care during index hospitalization, poor discharge planning, and/or poor coordination of post-acute care services (Feigenbaum et al., 2012). While overall readmission rates have decreased over time, data from 2006–2015 suggest that there are consistent racial and ethnic- and geographic-related disparities in hospital readmissions (Desai et al., 2016; Martsolf et al., 2016). Additional research concerning hospital readmissions suggests that factors such as hospital size and type affect readmissions (Gerhardt et al., 2013; Martsolf et al., 2016). Moreover, lower-quality hospitals tend to have higher rates of readmission than do higher-quality hospitals (Krumholz et al., 2017).

Study Objectives and Research Questions

This study sought to analyze whether demographic, clinical, and geographic characteristics were associated with 30-day hospital inpatient readmissions in Medicare fee-for-service (FFS) beneficiaries; specifically, whether key demographic, clinical, and geographic groups known to be disproportionately impacted by social risk factors had higher rates of 30-day hospital inpatient readmission. This report details the relationships identified between readmissions and race and ethnicity, potentially disabling condition status, Medicare-Medicaid dual eligibility status, and rurality, stratified by level of index hospital quality rating, primary diagnoses at index

hospitalization, post-acute discharge setting type, and Census division. Additional relevant factors including substance use disorder are also examined.

The analysis examined a four interrelated research questions (RQ1-RQ4), as follows: Among Medicare FFS beneficiaries, is there consistency in the association between race and ethnicity, potentially disabling condition status, Medicare-Medicaid dual eligibility status, and rurality and 30-day hospital inpatient readmissions, stratified by each of the following?

RQ1: Level of hospital quality

RQ2: Primary diagnosis at index hospitalization

RQ3: Setting of discharge from index hospitalization

RQ4: Census division

METHODS

Associations between demographic, clinical, and geographic factors with 30-day hospital inpatient readmissions, stratified by hospital quality, discharge setting, diagnosis at index hospitalization, and Census division, were analyzed. The stratification approach allowed for the identification of potential interacting effects and, as a result, prospective targets for quality improvement efforts.

Data Sources

***Administrative data from the CMS Chronic Conditions Data Warehouse (CCW*)**: The CMS CCW is a data warehouse that includes institutional and non-institutional Medicare FFS program administrative claims, enrollment status, and eligibility information for all Medicare beneficiaries for calendar year 2016. This report used hospitalization data from the Medicare Provider and Analysis Review (MedPAR) file, supplemented with beneficiary demographic and clinical characteristics from the Master Beneficiary Summary File (MBSF) and geographic characteristics and the Geographic Variation Database (GVDB). The CCW also houses data specific to hospitals (e.g. level of medical school affiliation, number of beds) from the Provider of Service (POS) file.

Quality data from Hospital Compare: Hospital Compare, part of CMS's Hospital Quality Initiative, is a dataset of quality measures that allows for comparisons of the quality of care delivered at more than 4,000 Medicare-certified hospitals. Data are reported annually and are in the public domain (CMS, 2019). Data from the 2016 release of Hospital Compare were linked to beneficiary data by unique provider ID.

Facility-level data from Medicare Cost Reports: The Healthcare Cost Report Information System (HCRIS), hosted by CMS, contains provider-level information, including facility characteristics, utilization data, cost, and other financial data. Data are provided annually. To support categorization of a provider's disproportionate share status, data from the 2016 Medicare Cost Reports dataset were linked to beneficiary data by unique provider ID.

Study Sample

This study included all Medicare FFS beneficiaries eligible for Medicare Part A during 2016 who had an index hospital admission with a discharge date between January 1 and December 1, 2016. The end date for index hospitalization allowed a full 30-day observation window during which readmission could occur. Readmissions between January 2 and December 31, 2016 were assessed among surviving beneficiaries.

Outcome Variable

***Hospital readmissions*:** This study defined a hospital readmission as an unplanned all-cause inpatient admission within 30 days of the index admission discharge date. Exclusion criteria developed by CMS's Hospital-wide Readmission measure (YNHHSC/CORE, 2017) was applied to determine which records qualified for study inclusion. Briefly, readmission type—planned or unplanned—is determined using the algorithm published in the 2018 All-Cause Hospital Wide Measure Updates and Specifications Report that groups readmissions by the Agency for Healthcare Research and Quality's Clinical Classifications Software (AHRQ CCS) using primary procedures and primary diagnoses (YNHHSC/CORE, 2017).

Primary Exposures: Demographic and Clinical Factors

***Race and ethnicity*:** Race and ethnicity were obtained from the MBSF and defined using the Research Triangle Institute race and ethnicity variable, comprised of seven possible categories: American Indian and Alaska Native, Asian and Pacific Islander, non-Hispanic Black/African American, Hispanic/Latino, non-Hispanic White, other, and unknown. Beneficiaries who were non-Hispanic White represented the referent group.

***Rurality*:** A two-category designation of beneficiary residence was defined based on the Core Based Statistical Area (CBSA) variable and ascertained using administrative information on state and county. Categories included rural (including micropolitan and non-CBSA) and urban (metropolitan). This variable was termed "rurality" to represent beneficiaries' rural status and beneficiaries with an urban residence represented the referent group.

***Potentially disabling conditions*:** The presence of a potentially disabling condition was defined using flags for chronic conditions in the CCW, indicating the presence of any condition among four possible groups of potentially disabling conditions: mobility, cognitive, hearing, and vision. The mobility difficulty group included flags for cerebral palsy, cystic fibrosis, mobility impairments, multiple sclerosis and transverse myelitis, muscular dystrophy, spina bifida and other congenital anomalies of the nervous system, and spinal cord injury. The cognitive difficulty group included flags for learning disabilities, intellectual disabilities and related conditions, autism spectrum, Alzheimer's disease, related disorders or senile dementia, traumatic brain injury and nonpsychotic mental disorders due to brain damage, and other developmental delays. The hearing and visual difficulties groups each were identified by a single condition flag. Chronic condition flags in the CCW are defined by CMS using an algorithm which includes diagnosis and procedure codes derived from health care claims (CCW, 2019). Potentially disabling condition was defined by the presence of any one or more specified conditions. Beneficiaries with one or more of the above specified conditions were placed in the "potentially disabling condition" group, and beneficiaries without any of the above specified conditions were

placed in the "no potentially disabling conditions" group. Beneficiaries with no potentially disabling conditions represented the referent group.

***Dual-eligibility for Medicare and Medicaid*:** Dual-eligibility was defined as concurrent enrollment in both Medicare and Medicaid benefits any time during the reporting calendar year. Beneficiaries who were not dually eligible represented the referent group.

Because beneficiary age is fundamental to determining Medicare eligibility, and disability and dual-eligibility are intrinsically linked for Medicare beneficiaries younger than 65 years, analyses for disability status and dual-eligibility were examined separately for populations younger than 65 years and for those 65 and older. This stratification enabled us to determine whether associations between each risk factor – potentially disabling condition and dual-eligibility – and 30-day hospital inpatient readmissions differed by age group due to underlying eligibility requirements.

Stratification Variables

To aid in better targeting spaces in need of quality improvement activities and resources, associations were examined between demographic, clinical and geographic factors of interest and 30-day hospital inpatient readmissions by stratifying by level of the characteristics described below.

Hospital quality: Hospital quality for the index hospitalization was determined using CMS's Hospital Overall Quality Star Ratings, and ranged from 1 star, indicating the lowest quality, to 5 stars, indicating the highest quality. Hospitals missing star ratings included behavioral health hospitals and hospitals that did not submit a minimum threshold of measures needed to calculate an overall star rating. There were 436,654 (5.6%) index stays from hospitals for which a quality rating could not be assigned. These claims were excluded from all models that involved stratifying by hospital quality (but were included in all other models).

Primary diagnosis at index hospitalization leading to the highest frequency of readmissions: Primary diagnosis at index hospitalization was defined using the AHRQ CCS that groups International Classification of Diseases, 10th Revision (ICD-10) coded diagnoses into one of 285 clinically coherent diagnosis categories (referred to as "single-level CCS diagnosis categories"). The five diagnosis categories leading to the highest frequency of readmission in 2016 were (1) septicemia, (2) congestive heart failure (CHF), (3) chronic obstructive pulmonary disease/bronchiectasis (COPD), (4) complication of device, and (5) pneumonia. Analyses were conducted among each of these five conditions.

***Discharge setting*:** Options for setting of discharge from the index hospitalization included the following 10 categories: (1) home/self-care, (2) skilled nursing facility (SNF), (3) home health care, (4) inpatient rehabilitation facility, (5) intermediate care facility, (6) long-term care hospital, (7) inpatient psychiatric hospital, (8) hospice, (9) critical access hospital, and (10) other. Other settings included discharges to court/law enforcement, federal hospitals, and other types of health care institutions not specified elsewhere.

***Census division*:** Census division, which included the District of Columbia but not the U.S. territories, was based on beneficiary residential address and spanned the following nine categories: (1) New England (CT, MA, ME, NH, RI, VT), (2) Middle Atlantic (NJ, NY, PA), (3) East North Central (IL, IN, MI, OH, WI), (4) West North Central (IA, KS, MN, MO, ND, NE, SD), (5) South Atlantic (DC, DE, FL, GA, MD, NC, SC, VA, WV), (6) East South Central (AL, KY, MS, TN), (7) West South Central (AR, LA, OK, TX), (8) Mountain (AZ, CO, ID, MT, NM, NV, UT, WY), and (9) Pacific (AK, CA, HI, OR, WA).

Additional Covariates

Additional beneficiary demographic characteristics included **age at index admission** (18–44 years, 45–65 years, 65–84 years, and 85 years and older) and **sex** (male and female).

The following clinical variables theoretically associated with 30-day hospital inpatient readmissions were included as covariates: **substance use disorder** (including alcohol and drug use disorders) (yes or no); **primary diagnosis at index hospitalization** (AHRQ CCS software classifies ICD-10 coded diagnoses into 18 broad categories [referred to as "multi-level CCS diagnosis categories"]. Note that this covariate was not included in analysis stratified by the top five primary diagnoses at index hospitalization); **length of index hospitalization** (categories, split into quartiles, included quartile 1: <2 days; quartile 2: 2–3 days; quartile 3: 3–6 days; quartile 4: >6 days); and **hierarchical condition categories (HCC) risk score during month of index hospitalization discharge** (categories, split into quartiles, included quartile 1: <0.817; quartile 2: 0.817–1.487; quartile 3: 1.488–2.929; quartile 4: >2.929).

Finally, the following facility variables, which are theoretically associated with 30-day inpatient hospital readmissions, were also included: **Medicare Disproportionate Share Hospital (DSH) status of index stay hospital** (categories, split into quartiles, ranged from lowest quartile of DSH share percentage among claims from hospitals with DSH identified to highest quartile of DSH share percentage and included quartile 1: <0.089; quartile 2: 0.089–0.135; quartile 3: 0.136–0.203; quartile 4: >0.203); **index stay hospital medical school affiliation** (categories included major, limited, graduate, and no affiliation); and **number of beds in index stay hospital** (categories included <100, 100-199, and 200+).

Statistical Analysis

The study focused on exploring the association between race and ethnicity, potentially disabling condition status, dual-eligibility status, and rurality and 30-day hospital inpatient readmissions. These analyses were stratified by hospital quality, select primary diagnoses at index hospitalization, discharge setting, and beneficiary Census division. These characteristics were selected based on their potential to provide guidance for targeted quality improvement interventions.

Unadjusted[2] logistic regression models were first constructed to determine whether race and ethnicity, potentially disabling condition status, dual-eligibility status, and rurality were associated with 30-day hospital inpatient readmission. Separate models were constructed

[2]Unadjusted models do not include covariates.

stratified by hospital quality, primary diagnosis at index hospitalization, discharge setting, and Census division levels. Multivariable logistic regression was then used to examine association of race and ethnicity, potentially disabling condition status, dual-eligibility status, and rurality with 30-day hospital inpatient readmission, adjusting for additional demographic, clinical, and facility characteristics. All covariates were included in the adjusted models, regardless of statistical significance, in keeping with the theoretical importance of selected covariates.

Odds ratios (OR) and accompanying 95% confidence intervals (CIs) were reported for both unadjusted and adjusted models, and the level of significance was set at $p < 0.05$. All analyses were performed using SAS 9.4.

RESULTS

In the overall sample population, there were 7,756,376 index hospital stays and a 30-day readmission rate of 14.7%. The majority of index admissions were among beneficiaries 65 years and older (78.0%). Contingency tables are displayed in Appendix A, Table 1. Below is a description of admission and readmission rates by demographic, clinical, and geographic factors, as well as by stratification characteristics.

Admission and Readmission Rates by Demographic, Clinical, and Geographic Factors

Race and ethnicity: The majority (78.0%) of index hospital stays were to beneficiaries who were non-Hispanic White. Beneficiaries who were Black/African American, Hispanic, Asian/Pacific Islander, and American Indian/Alaska Native represented 12.5%, 5.8%, 1.6%, and 0.8% of index hospital stays, respectively. However, the readmission rate was highest in Black/African American beneficiaries (19.4%), followed by Hispanic (16.8%), American Indian/Alaska Native (15.9%), Asian (14.3%), and non-Hispanic White (13.8%) beneficiaries.

Rurality: Approximately one-fifth (20.8%) of index stays were represented by beneficiaries living in rural areas. Rural-residing beneficiaries had a 13.5% rate of 30-day inpatient readmission versus a 15.0% rate for beneficiaries living in urban areas.

Potentially disabling conditions: Forty-four percent of the beneficiary population was identified as having one or more potentially disabling conditions, and this group had a 18.3% rate of readmission. By contrast, beneficiaries without potentially disabling conditions had a rate of readmission of 11.9%. In addition, the proportion of beneficiaries with one or more potentially disabling conditions varied by age group. Among beneficiaries aged 18–64, 36.1% had one or more potentially disabling conditions, compared with 46.3% among those aged 65 and older. In both age groups, the readmission rate was approximately 7 percentage points higher among beneficiaries with one or more potentially disabling conditions than for those who did not have potentially disabling conditions (i.e. beneficiaries 18–64 years with and without potentially disabling conditions: 24.0% readmission versus 17.2% readmission; beneficiaries 65 years and older with and without potentially disabling conditions: 17.0% readmission versus 10.1% readmission).

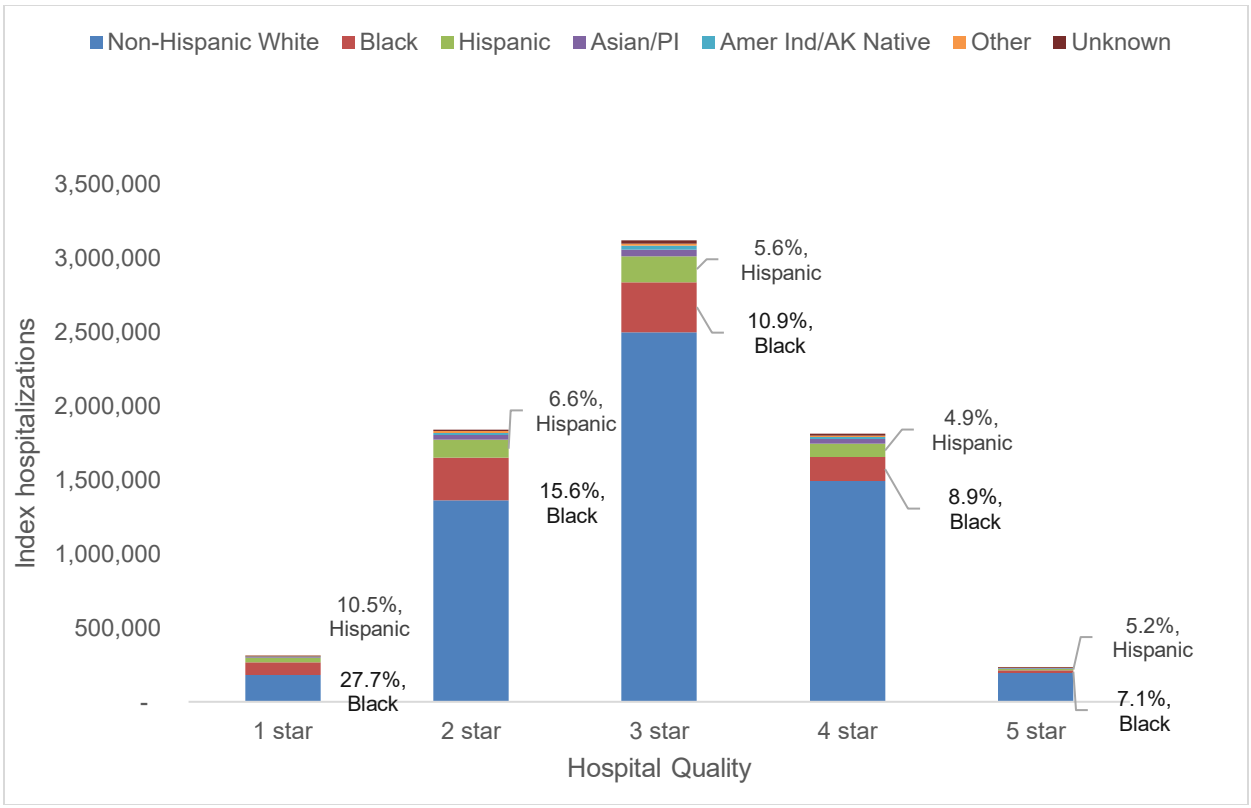
Dual-eligibility: While one-third (33.2%) of the overall population was composed of individuals dually eligible for Medicare and Medicaid, this proportion differed by age group. A majority (69.3%) of beneficiaries 18–64 years of age qualified as dually eligible, compared to 23.0% of those 65 years of age and older. Overall, those who qualified as dually eligible had a readmission rate of 19.4% versus 12.3% for beneficiaries who did not. The readmission rate was higher among dually eligible beneficiaries 18–64 years than for those in this age group without dual-eligibility (21.5% versus 15.3%, respectively). Among beneficiaries 65 and older, the readmission rate for dually eligible individuals was 17.6% versus 12.0% for those who were not dually eligible.

Admission and Readmission Rates by Stratification Characteristics

Hospital quality: Four percent of index stays were to 1-star (lowest rating) hospitals, 23.7% were to 2-star hospitals, 40.2% were to 3-star hospitals, 23.4% were to 4-star hospitals, and 3.0% were to 5-star hospitals. Readmission rates decreased as star levels increased; rates ranged from 17.8% in 1-star hospitals to 11.5% in 5-star hospitals. However, caution is warranted when interpreting this finding, due to the fact that hospital quality measures include indicators assessing readmission as components of the overall quality score.

For context, hospital quality and distribution of index stays by race and ethnicity were also explored (Figure 1). Notably, beneficiaries who were Black/African American accounted for 27.7% of discharges from 1-star hospitals, but only 10.9% of discharges from 3-star hospitals and 7.1% of discharges from 5-star hospitals. Similarly, of nearly 450,000 index hospitalizations for Hispanic beneficiaries, only 5.2% occurred from 5-star hospitals.

Figure 1. Frequency of index hospitalizations and percentage of Black/African American and Hispanic beneficiaries for each hospital quality star rating.



Primary diagnosis: Among the five diagnoses leading to the highest frequency of readmissions, pneumonia accounted for 3.0% of all index stays, complication of device accounted for 3.6%, COPD accounted for 3.3%, CHF accounted for 4.4%, and septicemia accounted for 7.0%. The 30-day readmission rate for each condition ranged from 16.3% for complication of device to 22.6% for CHF.

Discharge setting: Four index stay discharge settings accounted for nearly all (95.8%) of discharge locations: home/self-care (52.5%), SNF (21.6%), home health care (19.3%), and inpatient rehabilitation facility (2.4%). Readmission rates varied slightly by setting and were 13.9% for home/self-care, 15.6% for SNF, 15.1% for home health care, and 12.5% for inpatient rehabilitation facility.

Census division: The South Atlantic Census Division had the highest representation in the study sample (21.9%); the Mountain Division represented the smallest geographic subgroup (5.3%). Medicare beneficiaries residing in the New England Census Division had the highest rate of 30-day readmission (15.5%), and those from the Mountain Division had the lowest (12.3%).

Admission and Readmission Rates by Additional Covariates

Substance use disorder was identified in 16.8% of the population. This group had a 23.3% rate of readmission versus a 12.9% rate of readmission for those without substance use disorder. Across all quartiles of increasing DSH percentages, there was a stepwise increase in 30-day readmissions, with rates of 13.7%, 14.6%, 14.8%, and 16.4%, respectively. Furthermore, there were slight differences in readmission rates by hospital groupings based on bed count: 11.5% of index admissions were to hospitals with fewer than 100 beds, and these beneficiaries had a

readmission rate that was slightly lower than their counterparts at hospitals with 100–199 beds or ≥200 beds (13.6% versus 14.9% and 14.8%, respectively).

Relationship Between Demographic, Clinical, and Geographic Factors and Readmission Rates Stratified by Key Characteristics

Each set of tables in Appendix A covers all four risk factors: race and ethnicity, potentially disabling condition status, dual-eligibility status, and rurality:

- Tables 2–5 summarize readmission rates and results of the bivariate (i.e. unadjusted) and multivariable (i.e. adjusted) logistic regression analyses, for all demographic, clinical, and geographic factors.
- Tables 2a–2dii address Research Question 1 by examining the unadjusted and adjusted associations between demographic, clinical, and geographic factors with readmission across *levels of hospital quality*.
- Tables 3a–3dii address Research Question 2 by examining the unadjusted and adjusted associations between demographic, clinical, and geographic factors with readmission across *select high-frequency primary diagnoses at the index admission*.
- Tables 4a–4dii address Research Question 3 by examining the unadjusted and adjusted associations between demographic, clinical, and geographic factors with readmission across *discharge setting from the index admission*.
- Tables 5a–5dii address Research Question 4 by examining the unadjusted and adjusted associations between demographic, clinical, and geographic factors with readmission across *Census division*s.

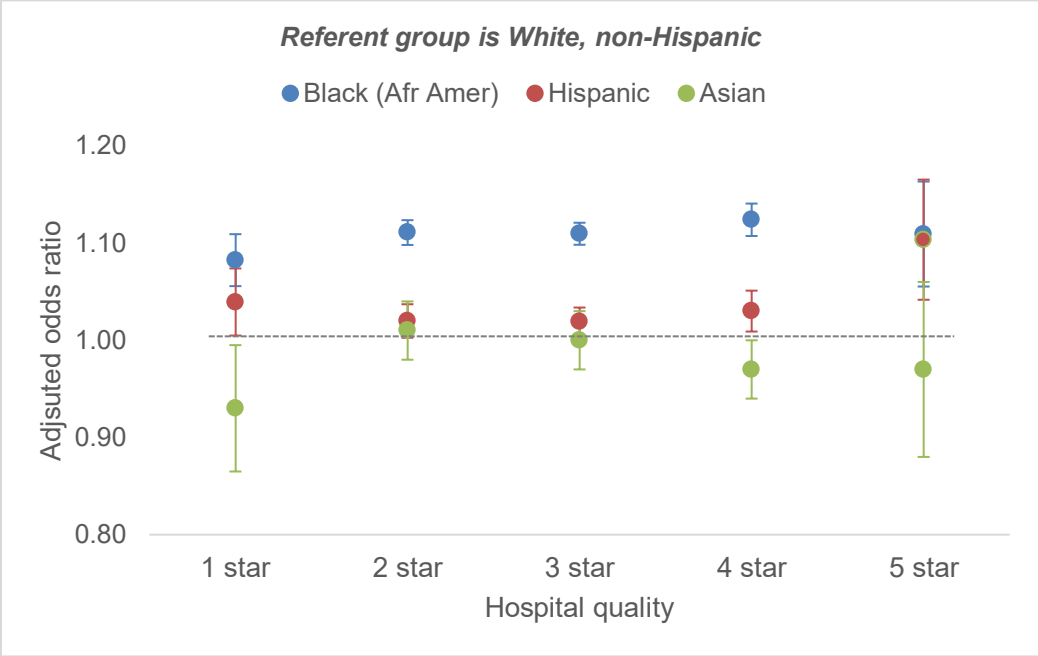
We present the most notable findings below.

Hospital Quality

Research Question 1: Among Medicare FFS beneficiaries, is there consistency in the association between race and ethnicity, potentially disabling condition status, Medicare-Medicaid dual-eligibility status, and rurality and 30-day hospital inpatient readmissions, stratified by *level of hospital quality*?

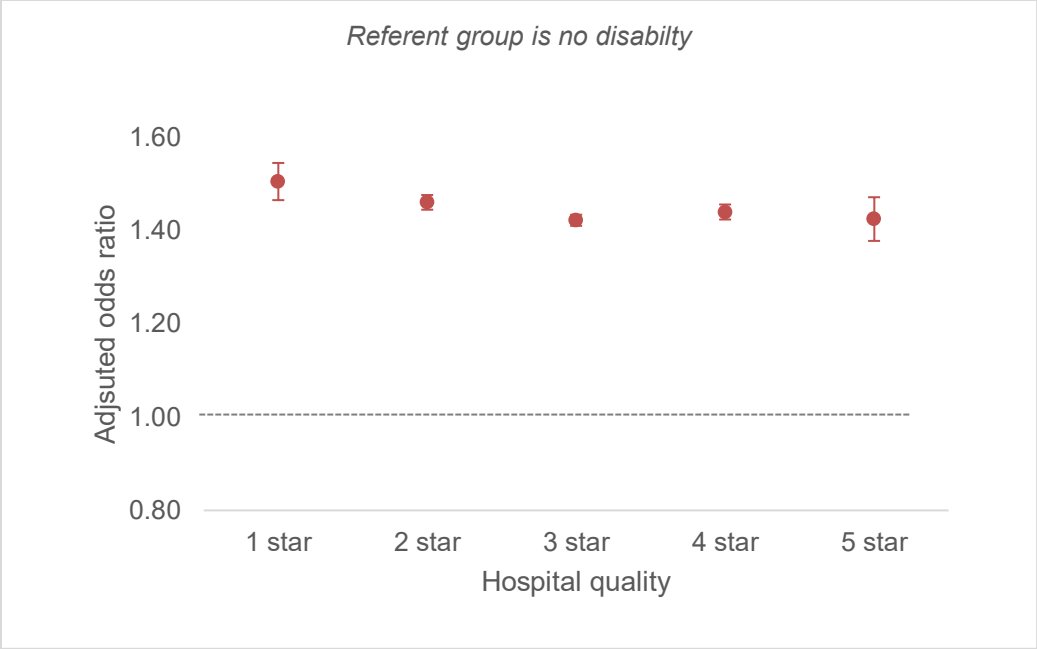
In adjusted models, the odds of readmission for race and ethnicity, potentially disabling condition status, dual-eligibility status, and rurality were generally consistent across hospital quality star levels (Appendix A, Tables 2a–2dii). Notably, beneficiaries who were Black/African American had higher odds of readmission than non-Hispanic Whites across all levels of hospital quality (Appendix A, Table 2a). Adjusted odds ratios (aOR) for readmission among Black/African American beneficiaries relative to non-Hispanic White beneficiaries ranged from 1.08–1.12 (all p-values were statistically significant at $p < .0001$) (Figure 2) across star levels. Interestingly, Hispanic beneficiaries had slightly increased odds of readmission relative to non-Hispanic Whites across all star levels, but was most pronounced among discharges from 5-star hospitals. Asian beneficiaries had either similar or lower odds of readmission relative to non-Hispanic Whites across star levels; most notably, Asian beneficiaries had lower odds of readmission than non-Hispanic Whites among discharges from 1-star hospitals.

Figure 2. Adjusted odds ratios and 95% confidence intervals for readmission by race and ethnicity among each hospital quality star level at index admission.



Beneficiaries of all ages with one or more potentially disabling conditions had higher odds of readmission relative to those without potentially disabling conditions across all levels of hospital quality. Of this group, beneficiaries 65 years and older who were hospitalized at a 1- or 2-star hospital had slightly higher aORs of readmission than those admitted to higher-quality hospitals (Figure 3 and Appendix A, Table 2cii).

Figure 3. Adjusted odds ratios and 95% confidence intervals for readmission by potentially disabling condition status among hospital quality star levels at index admission, 65 years of age and older.



Diagnosis at Index Hospitalization

Research Question 2: Among Medicare FFS beneficiaries, is there consistency in the association between race and ethnicity, potentially disabling condition status, Medicare-Medicaid dual-eligibility status, and rurality and 30-day hospital inpatient readmissions, stratified by *select primary diagnosis at index hospitalization*?

Across high-frequency diagnoses at index hospitalization (e.g. septicemia, congestive heart failure, COPD, complication of device, and pneumonia), there were generally higher adjusted odds of readmission for non-White beneficiaries, those with a potentially disabling condition, and those who were dually eligible, and lower odds of readmission for those in rural areas (Appendix A, Tables 3a–3dii).

Beneficiaries who were Black/African American had consistently higher adjusted odds of readmission, regardless of diagnosis at index hospitalization, relative to those who were non-Hispanic White, ranging from slightly increased odds for congestive heart failure and COPD (each aOR=1.04, $p < 0.05$) to an aOR of 1.14 for pneumonia ($p < 0.0001$) (Appendix A, Table 3a).

Similarly, beneficiaries of all ages with one or more potentially disabling conditions had higher odds of readmission, relative to those without a potentially disabling condition, although there was some variation in disparity. Among beneficiaries 18–64 years old, those with a potentially disabling condition with an index hospitalization for CHF or COPD had noticeably higher aORs of readmission than those initially hospitalized for septicemia or pneumonia (Appendix A, Table 3ci). For example, the aOR of readmission for beneficiaries with a potentially disabling condition versus those who did not have a potentially disabling condition was 1.46 for CHF and 1.27 for pneumonia at index hospitalization. This finding suggests a larger disparity for

beneficiaries with a potentially disabling condition who are diagnosed with CHF or COPD at index hospitalization.

Dual-eligibility was generally associated with increased odds of readmission relative to those who were not dually eligible, and the magnitude of the gap between these groups was largely consistent across primary diagnoses at index hospitalization. Exceptions included discharges from septicemia and pneumonia hospitalizations among beneficiaries 65 years and older, where the odds of readmission were similar among dually eligible and non-dual eligible beneficiaries (septicemia aOR=1.00, $p > 0.05$; pneumonia aOR=1.04, $p < 0.05$) (Appendix A, Table 3dii).

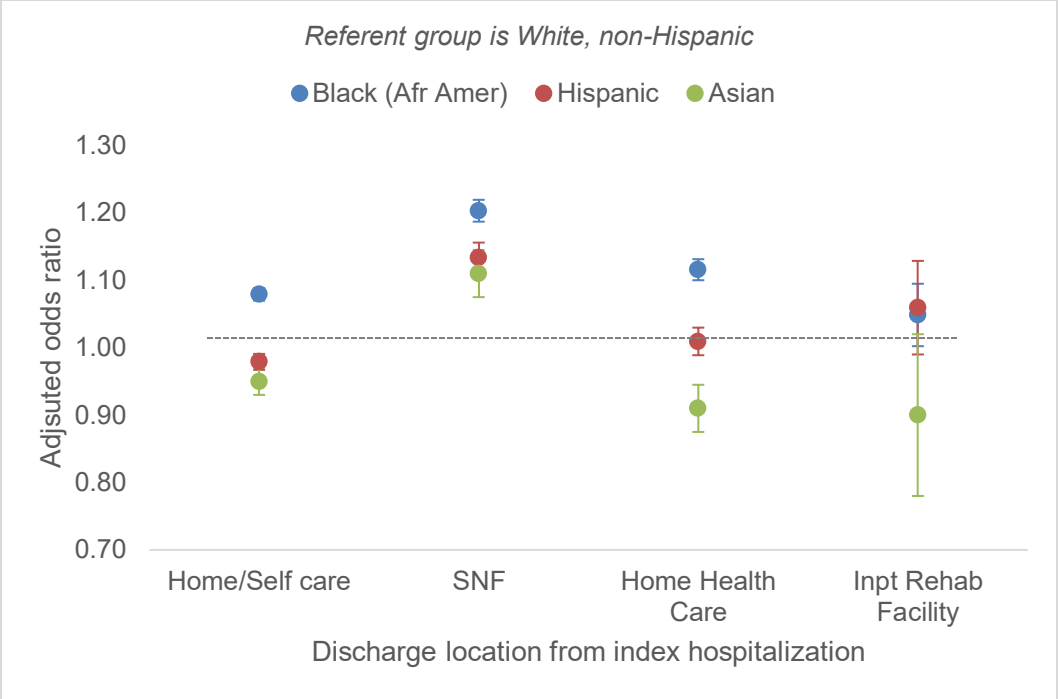
Discharge Setting

Research Question 3: Among Medicare FFS beneficiaries, is there consistency in the association between race and ethnicity, potentially disabling condition status, Medicare-Medicaid dual-eligibility status, and rurality and 30-day hospital inpatient readmissions, stratified by *setting of discharge from index hospitalization*?

A majority of discharges were to home/self-care, SNFs, home health care, and inpatient rehabilitation facility settings; these four settings accounted for 95.8% of all discharges (Appendix A, Tables 4a-4dii). Generally, across all major discharge categories, beneficiaries who were Black/African American had higher odds of readmission than non-Hispanic Whites, and beneficiaries with potentially disabling conditions had higher odds than those without potentially disabling conditions.

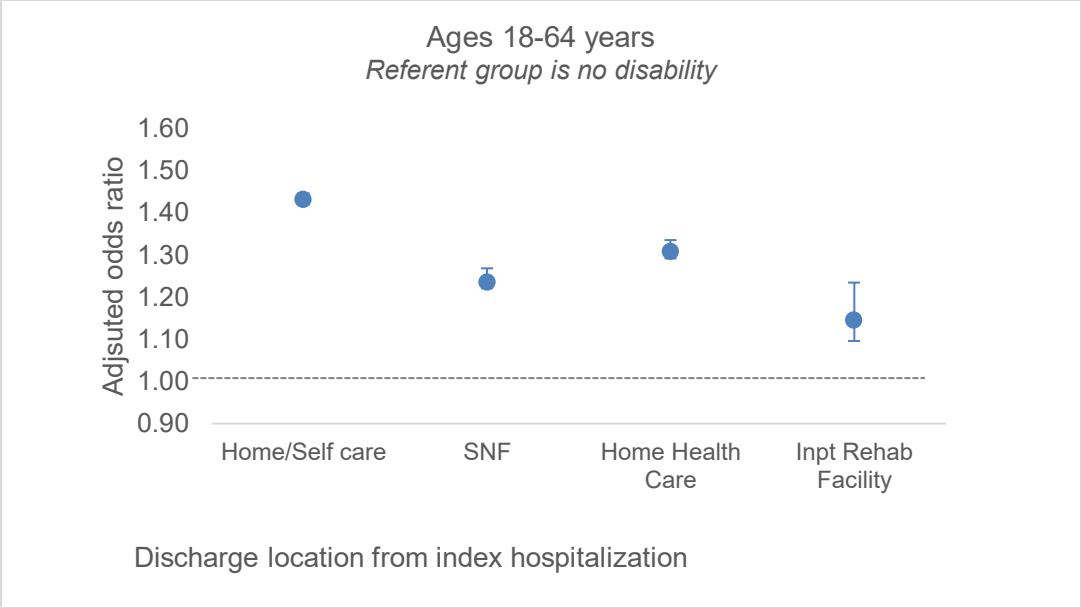
Figure 4 (and Appendix A, Table 4a) shows increased readmissions among Black/African American, Hispanic, and Asian beneficiaries discharged to SNFs, relative to non-Hispanic Whites discharged to SNFs (aOR=1.20, 1.13, 1.11, respectively). Among each racial and ethnic group, the aOR was higher for SNF discharge settings than for non-SNF discharge settings. Among Asian beneficiaries, SNF was the only discharge location associated with increased odds of readmission.

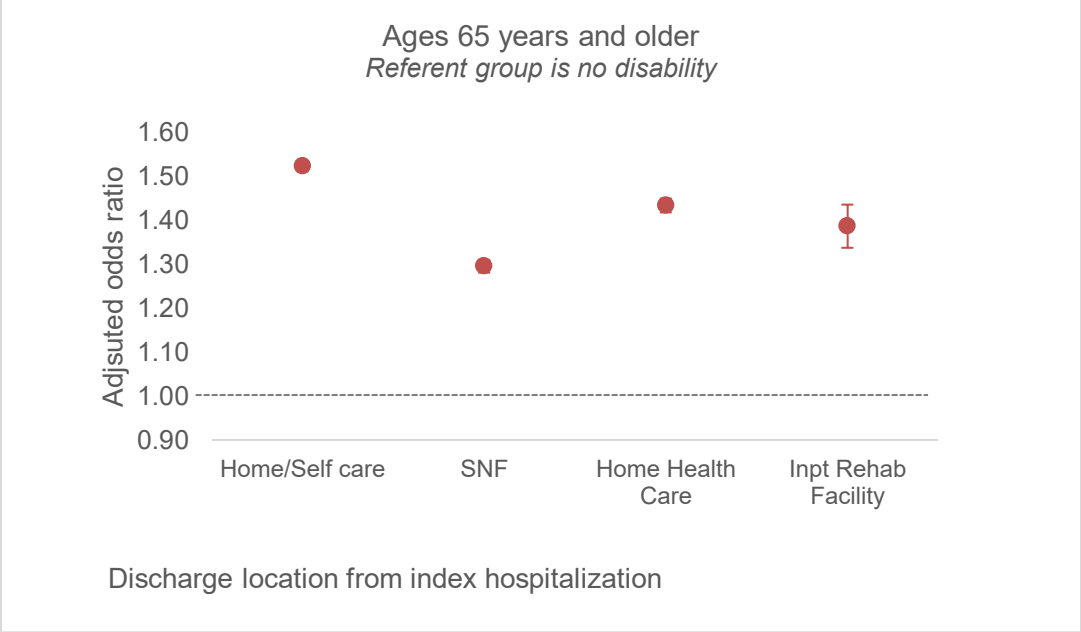
Figure 4. Adjusted odds ratios and 95% confidence intervals for readmission by race and ethnicity among most common discharge locations from index admissions.



For both age groups (18–64 years of age and 65 years of age and older), beneficiaries with a potentially disabling condition, including such conditions as cerebral palsy and Alzheimer's disease, had higher odds of readmission relative to those without potentially disabling conditions across all discharge settings, and the odds were highest for beneficiaries discharged to home/self-care (Figures 5a and 5b; Appendix A, Tables 4ci and 4cii).

Figures 5a and 5b. Adjusted odds ratios and 95% confidence intervals for readmission by potentially disabling conditions among most common discharge locations from index admissions, by age group.

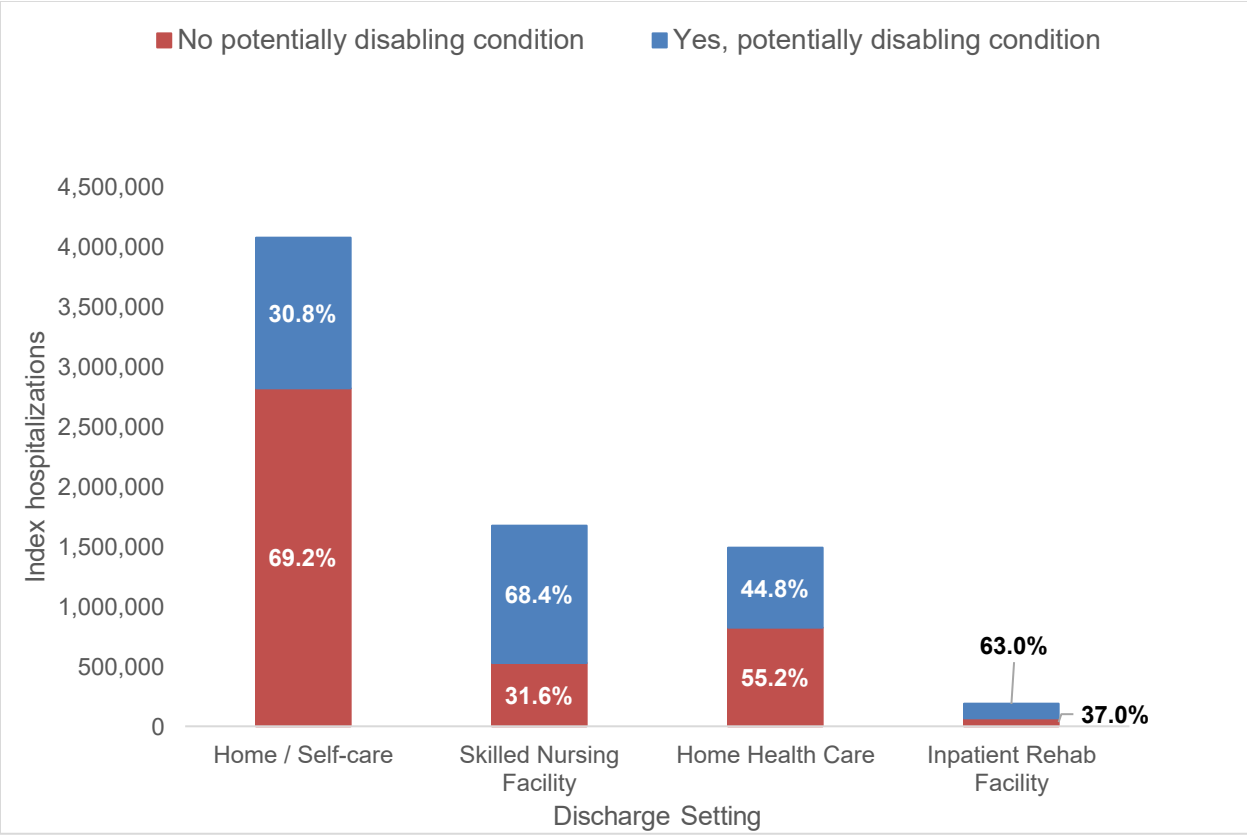




To contextualize the findings, we examined the distribution of index hospital stays by presence or absence of one or more potentially disabling conditions among discharge settings (Figure 6). As shown below, while the proportion of index admissions among beneficiaries with one or more potentially disabling conditions discharged to home/self-care and home health care is lower than among those without a disabling condition, the overall volume of beneficiaries with one or more potentially disabling conditions discharged to these settings is large. Specifically, beneficiaries with a potentially disabling condition discharged to home/self-care represent a substantial proportion of the overall sample (16.2%). Overall, of the 1,258,151 beneficiaries with

one or more potentially disabling conditions who were discharged to home/self-care, there were 237,196 30-day readmissions.

Figure 6. Index hospitalizations by potentially disabling condition among most common discharge settings (all ages).



In the adjusted models, the odds of readmission for dual-eligibility varied by discharge setting (Appendix A, Tables 4di and 4dii). Among both age groups, dual-eligibility conferred similarly increased odds of readmission for beneficiaries discharged to home/self-care, home health care, and inpatient rehabilitation facilities (aORs ranging from 1.11–1.18). Interestingly, among both age groups, those with dual-eligibility discharged to SNFs did not have increased odds of readmission relative to non-dually eligible beneficiaries.

Geography

Research Question 4: Among Medicare FFS beneficiaries, is there consistency in the association between race and ethnicity, potentially disabling condition status, Medicare-Medicaid dual eligibility status, and rurality and 30-day hospital inpatient readmissions, stratified by *Census division*?

Racial and ethnic disparities in readmission varied by Census division (Appendix A, Tables 5a–5dii). Black/African American beneficiaries had higher odds of readmission than non-Hispanic

Whites across all Census divisions, and there was some indication that this disparity was greater in the Mountain and Pacific divisions. Beneficiaries of Hispanic ethnicity living in the Middle Atlantic, South Atlantic, and Pacific divisions had slightly increased odds of readmission relative to non-Hispanic Whites (aOR ranging from 1.04–1.09), but this was not the case in the other Census divisions (Appendix A, Table 5a).

Rurality was associated with lower readmission rates across all Census divisions, except for the Middle Atlantic, where there was no difference in readmission rates by urban/rural status (Appendix A, Table 5b). While rurality appeared to provide an even greater protective effect relative to urban status on readmissions in the New England, Mountain, and Pacific divisions, this could simply reflect reduced access to care in rural areas. Additional research is required to determine whether this is the case.

DISCUSSION

This study examined factors associated with 30-day hospital readmissions among Medicare FFS beneficiaries. Both organizational-level and beneficiary-level characteristics were identified that may aid in more precise targeting of improvements designed to reduce disparities in readmission.

Racial and Ethnic Disparities

The results of this study indicate widespread racial and ethnic disparities in 30-day hospital readmissions, appearing across hospital quality levels, diagnoses at index hospitalization, discharge settings, and Census divisions. Although some findings suggest smaller gaps in readmission rates across some racial and ethnic disparity groups than others, two findings are particularly notable and appear to offer the greatest opportunity for improvements: (1) Black/African American beneficiaries experience persistent readmission disparities, and (2) Black/African American beneficiaries discharged to SNFs likely require additional attention and support.

Black/African American Beneficiaries Have Persistent Higher Rates of Readmission

Nearly all findings suggest persistent readmission disparities for Black/African American beneficiaries relative to non-Hispanic White beneficiaries. This corroborates previous findings in the existing body of literature on readmissions disparities. Nevertheless, it is key because it identifies an area for improvements with a high degree of impact.

Targeting lower quality (1–3-star) hospitals with quality improvement initiatives could have the greatest impact on lessening racial and ethnic readmission disparities, because Black/African American beneficiaries are more likely to receive care in these facilities. This could be due to a need for education about the importance of selecting high-quality treatment facilities or a lack of available 4- and 5-star hospitals in the communities where these beneficiaries often reside. Still, across the range of hospital quality ratings, Black/African American beneficiaries experience higher rates of hospital inpatient readmission than White, non-Hispanic beneficiaries.

Black/African American Patients Discharged to SNFs Warrant Additional Attention
Discharge setting is an important consideration, particularly for beneficiaries who are Black/African American or Hispanic. The greatest racial and ethnic-related readmission disparity finding from the analysis of discharge settings occurred among Black/African American and Hispanic beneficiaries who were discharged to SNFs. These populations have higher odds of readmission relative to non-Hispanic White beneficiaries. Set in the context of persistent racial and ethnic residential segregation in the U.S., high-quality SNFs may not be in adequate supply in communities where racial and ethnic minority beneficiaries are concentrated. It is not uncommon for patients to want to use post-acute care facilities that are close to home so their family members can more easily visit without traveling long distances. Discharging hospitals may not select the most appropriate discharge setting for beneficiaries in these populations, potentially due to non-concordance in the race and ethnicity of patient and provider, which may lead to cultural and/or linguistically driven misunderstandings.

Disability-Related Disparities in Readmissions

Approximately half of the discharges examined in this study were among beneficiaries who had one or more potentially disabling conditions. Broadly, both the unadjusted and adjusted models showed that beneficiaries who have potentially disabling conditions are at increased risk for hospital inpatient readmission, regardless of age group, compared with those who do not have potentially disabling conditions. Across all strata examined,[3] beneficiaries with one or more potentially disabling conditions had increased odds of readmission. More attention during the discharge planning process and post-discharge period, as well as better coordination of care and improved matching of patients with discharge setting intensity, may be of particular benefit to beneficiaries with potentially disabling conditions.

Patients with Potentially Disabling Conditions Discharged to Home/Self-Care Warrant Closer Attention
The results of the adjusted analyses suggest that improvements targeting beneficiaries who have one or more potentially disabling conditions and are discharged to home/self-care may yield the greatest positive impact on reducing readmissions for this population of beneficiaries. Beneficiaries with one or more potentially disabling conditions discharged to home/self-care had higher odds of readmission than their counterparts discharged to any other post-acute setting. These individuals may have added difficulty in accessing follow-up care due to transportation-related and/or other numerous potential barriers to care, and thus may need higher-intensity discharge settings and closer attention during the care coordination process. Beneficiaries with one or more potentially disabling conditions may also need special assistance in adhering to post-discharge treatment plans.

Readmission Rates are High Among Patients with Substance Use Disorder
Results indicated that beneficiaries with substance use disorder had among the highest rate of readmissions of any subgroup examined. The findings of this analysis corroborate prior research demonstrating the relatively high rate of readmission among individuals with substance use disorder (Reif et al., 2017; Ahmedani et al., 2015; Becker et al., 2017). While beyond the scope of this report, results support the need for further integration of substance use disorder

[3]Hospital quality, diagnosis at index hospitalization, discharge setting, and geographic regions.

management with patients' overall healthcare concerns.

Opportunities for Improvement

These findings demonstrate opportunities to encourage improvement in the areas of hospital quality and discharge planning. Data also suggest that policies targeting larger urban hospitals, particularly those of lower quality, present the richest opportunity for policy intervention.

Hospital Quality

Stratification may be used to report hospital performance measures among race and ethnicity groups, allowing for a focus on closing health and health care delivery gaps between racial and ethnic groups (HealthPartners, 2016). Hospitals could consider focusing on quality reporting for beneficiaries by racial and ethnic group

Targeted pay-for-performance incentives may be another option for encouraging improvement efforts. Incentives rewarding facilities that achieve significant and meaningful improvement in readmissions among racial and ethnic minority beneficiaries could enhance the effectiveness of the recommendation. Quality reporting could have the potential to be perceived as punitive by the provider community if it is not accompanied by an incentive-based policy to reward success in the reduction of racial and ethnic disparities. Targeting 1–3-star hospitals with such quality improvement initiatives may spur efforts to reduce racial and ethnic disparities for Black/African American beneficiaries, as index hospital stays for this subpopulation of beneficiaries tend to occur in these facilities. Such initiatives also have the potential to reduce disparities for beneficiaries with potentially disabling conditions.

Beneficiaries with index stays at 1–3-star hospitals also experienced more readmissions than those discharged from 4- or 5-star hospitals. Taken together, the results of the study underscore the important role of urban, large, and lower-quality hospitals in hospital readmissions; in addition, the results may provide targeted guidance for the design and focus on the quality of care and improvements that will have the greatest impact, both financially and on the number of beneficiary lives affected.

Discharge Planning

Another pathway to disparities reduction involves efforts targeting discharge planning and post-acute coordination of care. Such efforts could encourage facilities to focus on matching discharge-setting intensity with beneficiary needs, with a special focus on Black/African American) beneficiaries, those with potentially disabling conditions, and individuals with substance use disorder.

Black/African American beneficiaries who are discharged to SNFs also require closer attention, which may involve educating beneficiaries and their families about SNF quality during the discharge planning process, while also acknowledging that it may be important to the beneficiary to remain close to home during a stay in a post-acute care facility. Incorporating and adhering to the National CLAS Standards (U.S. Department of Health & Human Services, n.d.) may help prevent cultural and linguistic misunderstandings between patients and medical staff. This could improve the chances of racial and ethnic minority beneficiaries being discharged to settings that more closely align with *both* their medical and social needs and preferences. It also could

increase the likelihood that patients and their families will be educated about SNF quality in a way that they can understand, enabling them to make informed decisions about their discharge settings.

People with disabilities may experience barriers (e.g. transportation, disability accessibility of facility) that prevent them from obtaining prescribed follow-up care if they are discharged to home/self-care. As a result, providers may need to confirm that appropriate assistance is available in the home and, if it is not, these beneficiaries may need to be discharged to a higher-intensity setting. Facilities may need to augment care coordination with additional resources for beneficiaries with potentially disabling conditions to allow for confirmation of follow-up care post-discharge and coordination of resources that can assist in carrying out post-discharge treatment plans.

Similarly, for patients with substance use disorder, targeted discharge planning is important to reduce readmissions. Discharging patients with SUD to settings and treatment plans consistent with the acuity and nature of their disorder may help reduce readmissions (Reif et al., 2017). Prior to discharge, providers may evaluate patients with substance use disorder for potential barriers to care and use diagnostic information to assess risk for readmission and plan accordingly. For example, elderly female patients' readmission risk may be reduced by discharge treatment focusing on psychiatric disorders and accident risk, for which they are most likely to be re-admitted (Brennan et al., 2015).

LIMITATIONS

This study has several limitations. First, chronic conditions flags in the CCW were used to identify beneficiaries with potentially disabling conditions. Although these flags are created using diagnosis and procedure codes from health care claims, they do not capture severity of symptoms or degree of impairment. For example, some beneficiaries who are flagged as having a particular potentially disabling condition may be high-functioning and may not identify as "disabled," while others with the same condition may be low-functioning and identify as disabled. Additionally, some beneficiaries who would identify as disabled or as having a disability are not flagged as having a potentially disabling condition because they do not have claims with the specific diagnosis and/or procedure codes related to their disabling condition.

Second, claims data do not contain information on many social determinants of health that are known to affect the likelihood of hospital readmission. Although they allow for a large sample size to examine and account for a complex set of demographic, clinical, and hospital-related factors, their use does not enable assessment of equity concerns such as housing instability, food insecurity, economic vulnerability, transportation and accessibility issues, medical mistrust, and lack of social support.

Third, Hospital Compare data were used to present stratified results across levels of hospital quality. The hospital quality metric incorporates seven measure groups (i.e. mortality, safety of care, patient experience, effectiveness of care, timeliness of care, efficient use of medical imaging, and readmission). In this analysis, readmission was the outcome variable. The readmission measure represents around 20% of the overall hospital quality metric's weight

(Medicare.gov, 2017). The present analysis assessed disparities by risk factor on the likelihood of readmission in each of the five star levels of hospital quality. To prevent endogeneity bias, hospital quality was not included as a covariate in the adjusted analyses stratified by other characteristics (index diagnosis, discharge setting, and Census division). Endogeneity biases results from the correlation that occurs when a measure is part of both the predictor and the outcome. In future analyses, it will be useful to explore whether and to what extent including a modified hospital quality covariate that removes the readmission component of the metric improves model precision.

Fourth, the definition of rural for this study may have affected the results of this study, where "micropolitan" was included in the definition of rurality. This definition may lead to criteria that are too broad and heterogeneous to detect the effect of having a truly "rural" address.

CONCLUSIONS

Improved understanding of how demographic, clinical, and geographic factors representative of social risk are associated with 30-day hospital inpatient readmissions in Medicare FFS beneficiaries is important because of the increasing emphasis on value-based purchasing programs and the financial implications of these programs for hospitals with "excess readmissions." This study's findings are consistent with existing literature, such as the finding of lower odds of 30-day hospital readmission among beneficiaries with a rural residential address.

The results suggest that disparities in readmissions rates across racial and ethnic groups and potentially disabling condition status offer opportunity for targeted interventions to improve care, both from the standpoint of hospital quality improvement for 1–3-star hospitals and with respect to improvement in discharge planning and coordination of care for identified key populations. At the organization level, this study encourages improvements in the areas of hospital quality and discharge planning with the potential for meaningful impact, especially among larger urban hospitals, particularly those of lower quality.

Future research should explore which potentially disabling conditions group or groups are most strongly associated with increased likelihood of hospital inpatient readmission (i.e. mobility, cognitive, hearing, or vision). Additional research is also warranted to further examine the association with substance use disorder and hospital readmission. These analyses would allow for an examination of whether the magnitude of disparity by race and ethnicity varies by type of potentially disabling condition or disorder. Furthermore, future research examining the impact of discharge setting on the rates of readmission for those with disabilities could help determine whether discordance between the intensity of the discharge setting and the needs that people with certain potentially disabling condition types may be driving some of the disparity for this population.

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APPENDIX A: COMPLETE FINDINGS

Table 1. Admission and readmission among risk factors, stratification characteristics, and other covariates

Attribute	Index Stays (N)	Index Stays (%)	Readmissions (N)	Readmissions (%)	30-Day Readmission Rate (%)
Total	**7,756,376**	**100.0**	**1,138,043**	**100.0**	**14.7**
PRIMARY CLINICAL AND SOCIAL RISK FACTORS					
Race/Ethnicity					
Non-Hispanic White	6,049,162	78.0	832,704	73.2	13.8
Black/African-American	972,058	12.5	189,007	16.6	19.4
Hispanic	448,288	5.8	75,183	6.6	16.8
Asian/Pacific Islander	127,614	1.6	18,290	1.6	14.3
American Indian/Alaska Native	58,303	0.8	9,269	0.8	15.9
Other	45,585	0.6	6,710	0.6	14.7
Unknown	55,366	0.7	6,880	0.6	12.4
Rurality					
Urban	6,141,895	79.2	919,294	80.8	15.0
Rural	1,614,481	20.8	218,749	19.2	13.5
Potentially Disabling Condition					
Yes	3,414,696	44.0	623,402	54.8	18.3
Ages 18–64	*615,394*	*7.9*	*147,630*	*13.0*	*24.0*
Ages 65 and older	*2,799,302*	*36.1*	*475,772*	*41.8*	*17.0*
No	4,341,680	56.0	514,641	45.2	11.9
Ages 18–64	*1,089,473*	*14.0*	*186,876*	*16.4*	*17.2*
Ages 65 and Older	*3,252,207*	*41.9*	*327,765*	*28.8*	*10.1*
Dual Eligible					
Yes	2,576,168	33.2	499,799	43.9	19.4
Ages 18–64	*1,182,100*	*15.2*	*254,318*	*22.3*	*21.5*
Ages 65 and older	*1,394,068*	*18.0*	*245,481*	*21.6*	*17.6*
No	5,180,208	66.8	638,244	56.1	12.3
Ages 18–64	*522,767*	*6.7*	*80,188*	*7.0*	*15.3*
Ages 65 and Older	*4,657,441*	*60.0*	*558,056*	*49.0*	*12.0*
KEY CHARACTERISTICS FOR STRATIFICATION					
Index Hospital Quality Rating					
1-Star (lowest rating)	311,725	4.0	55,547	4.9	17.8
2-Star	1,841,126	23.7	291,404	25.6	15.8
3-Star	3,120,369	40.2	454,316	39.9	14.6
4-Star	1,813,234	23.4	243,557	21.4	13.4
5-Star	233,268	3.0	26,712	2.3	11.5
Primary Diagnosis at Index Hospitalization Leading to Highest Frequency of Readmission					
Septicemia	542,014	7.0	103,277	9.1	19.1
Congestive heart failure	338,219	4.4	76,422	6.7	22.6
COPD	253,823	3.3	50,279	4.4	19.8
Complication of device	281,535	3.6	45,957	4.0	16.3
Pneumonia	230,538	3.0	42,785	3.8	18.6
Septicemia	542,014	7.0	103,277	9.1	19.1
Setting at Discharge from Index Stay					
Home/Self-Care	4,081,802	52.6	568,260	49.9	13.9
SNF	1,675,169	21.6	260,557	22.9	15.6
Home Health Care	1,493,242	19.3	225,884	19.9	15.1
Inpatient Rehabilitation Facility	186,298	2.4	23,244	2.0	12.5
Intermediate Care Facility	102,245	1.3	17,737	1.6	17.3

Attribute	Index Stays (N)	Index Stays (%)	Readmissions (N)	Readmissions (%)	30-Day Readmission Rate (%)
Long-Term Care Hospital	82,294	1.1	13,605	1.2	16.5
Inpatient Psychiatric Hospital	11,228	0.1	3,721	0.3	33.1
Hospice	57,848	0.7	3,775	0.3	6.5
Critical Access Hospital	852	0.0	256	0.0	30.0
Other	65,398	0.8	21,004	1.8	32.1
Census Division					
New England	455,057	5.9	70,632	6.2	15.5
Middle Atlantic	1,029,761	13.3	155,958	13.7	15.1
East North Central	1,302,969	16.8	192,921	17.0	14.8
West North Central	548,253	7.1	73,964	6.5	13.5
South Atlantic	1,700,160	21.9	255,317	22.4	15.0
East South Central	611,451	7.9	91,991	8.1	15.0
West South Central	886,319	11.4	131,609	11.6	14.8
Mountain	411,968	5.3	50,517	4.4	12.3
Pacific	810,438	10.4	115,134	10.1	14.2
COVARIATES					
Sex					
Male	3,516,948	45.3	541,590	47.6	15.4
Female	4,239,428	54.7	596,453	52.4	14.1
Age					
18–44	389,420	5.0	90,206	7.9	23.2
45–64	1,315,447	17.0	244,300	21.5	18.6
65–84	4,569,533	58.9	601,280	52.8	13.2
85 and older	1,481,976	19.1	202,257	17.8	13.6
Substance Use Disorder					
Yes	1,299,401	16.8	302,791	26.6	23.3
No	6,456,975	83.2	835,252	73.4	12.9
Length of Index Stay					
1st quartile (<2 days)	2,396,602	30.9	277,043	24.3	11.6
2nd quartile (2–3 days)	1,482,091	19.1	188,231	16.5	12.7
3rd quartile (3–6 days)	2,144,675	27.7	349,314	30.7	16.3
4th quartile (Longest Stay; >6 days)	1,733,008	22.3	323,455	28.4	18.7
HCC Risk Score in Month of Discharge					
1st quartile (lowest risk; <0.817)	1,936,933	25.0	159,417	14.0	8.2
2nd quartile (0.817–1.487)	1,942,341	25.0	230,652	20.3	11.9
3rd quartile (1.488–2.929)	1,937,498	25.0	290,925	25.6	15.0
4th quartile (highest risk; >2.929)	1,939,034	25.0	457,002	40.2	23.6
Medical School Affiliation for Index Stay					
Major Affiliation	1,879,312	24.2	285,416	25.1	15.2
Limited Affiliation	1,539,569	19.8	222,083	19.5	14.4
Graduate Affiliation	381,374	4.9	56,446	5.0	14.8
No Affiliation	3,954,370	51.0	573,714	50.4	14.5
Index Hospital DSH Share Percentage**					
No DSH identified	1,040,376	13.4	140,006	12.3	13.5
Q1 (lowest share; <0.089)	1,676,561	21.6	230,423	20.2	13.7
Q2 (0.089–0.135)	1,684,301	21.7	245,505	21.6	14.6
Q3 (0.136–0.203)	1,677,316	21.6	247,407	21.7	14.8
Q4 (highest share; >0.203)	1,677,822	21.6	274,702	24.1	16.4
Number of Beds at Index Hospital					
Small (<100 beds)	892,208	11.5	121,568	10.7	13.6

Attribute	Index Stays (N)	Index Stays (%)	Readmissions (N)	Readmissions (%)	30-Day Readmission Rate (%)
Medium (100–199 beds)	1,318,587	17.0	195,826	17.2	14.9
Large (≥200 beds)	5,544,050	71.5	820,290	72.1	14.8

*Quality rating is missing for claims from behavioral health hospitals, hospitals that do not submit a minimum threshold of measures that are used in calculating the overall star rating, and those in the VA system

**Quartiles for disproportionate share hospital (DSH) status drawn from hospitals with values identified; hospitals not identified did not report DSH payments in 2016

Stratification by HOSPITAL QUALITY

Separate models constructed for each level of hospital quality

Table 2a. Rate, unadjusted and adjusted[α] odds of readmission by race and ethnicity of beneficiaries for each level of hospital quality

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Race and ethnicity	**1-Star Hospitals**								
White, non-Hispanic	179,434	28,528	15.90	ref			ref		
Black/African American	86,421	18,479	21.38	1.44***	1.41	1.47	1.08***	1.06	1.11
Hispanic	32,647	6,323	19.37	1.27***	1.23	1.31	1.04*	1.01	1.07
Asian/Pacific Islander	6,208	959	15.45	0.97	0.90	1.04	0.93	0.87	1.00
Amer Indian/AK Native	2,143	411	19.18	1.26***	1.13	1.40	1.15*	1.03	1.29
Other	2,473	437	17.67	1.14*	1.02	1.26	1.07	0.96	1.19
Unknown	2,399	410	17.09	1.09	0.98	1.21	1.10	0.98	1.23
	2-Star Hospitals								
White, non-Hispanic	1,363,258	201,722	14.80	ref			ref		
Black/African American	286,647	57,661	20.12	1.45***	1.44	1.47	1.11***	1.10	1.12
Hispanic	122,059	21,304	17.45	1.22***	1.20	1.24	1.02*	1.00	1.04
Asian/Pacific Islander	31,512	4,894	15.53	1.06**	1.03	1.09	1.01	0.98	1.04
Amer Indian/AK Native	14,210	2,375	16.71	1.16***	1.11	1.21	0.99	0.94	1.04
Other	11,191	1,750	15.64	1.07*	1.01	1.12	0.99	0.94	1.05
Unknown	12,249	1,698	13.86	0.93*	0.88	0.98	1.00	0.94	1.05
	3-Star Hospitals								
White, non-Hispanic	2,499,001	345,385	13.82	ref			ref		
Black/African American	339,031	64,952	19.16	1.48***	1.47	1.49	1.11***	1.10	1.12
Hispanic	174,232	28,554	16.39	1.22***	1.21	1.24	1.02*	1.00	1.03
Asian/Pacific Islander	46,181	6,590	14.27	1.04*	1.01	1.07	1.00	0.97	1.03
Amer Indian/AK Native	23,419	3,738	15.96	1.18***	1.14	1.23	1.02	0.98	1.06
Other	17,335	2,539	14.65	1.07*	1.03	1.12	1.04	0.99	1.08
Unknown	21,170	2,558	12.08	0.86***	0.82	0.89	0.97	0.92	1.01
	4-Star Hospitals								
White, non-Hispanic	1,492,226	190,802	12.79	ref			ref		
Black/African American	162,075	29,593	18.26	1.52***	1.50	1.54	1.12***	1.11	1.14
Hispanic	89,563	14,007	15.64	1.26***	1.24	1.29	1.03*	1.01	1.05
Asian/Pacific Islander	33,199	4,434	13.36	1.05*	1.02	1.09	0.97	0.94	1.00
Amer Indian/AK Native	11,539	1,751	15.17	1.22***	1.16	1.28	1.01	0.96	1.06
Other	10,937	1,482	13.55	1.07*	1.01	1.13	1.02	0.96	1.07
Unknown	13,695	1,488	10.87	0.83***	0.79	0.88	0.96	0.91	1.02
	5-Star Hospitals								
White, non-Hispanic	194,861	20,901	10.73	ref			ref		
Black/African American	16,654	2,797	16.79	1.68***	1.61	1.75	1.11***	1.06	1.16
Hispanic	12,211	1,888	15.46	1.52***	1.45	1.60	1.10**	1.04	1.17
Asian/Pacific Islander	4,698	580	12.35	1.17**	1.07	1.28	0.97	0.88	1.06
Amer Indian/AK Native	1,284	144	11.21	1.05	0.88	1.25	0.98	0.82	1.18
Other	1,415	170	12.01	1.14	0.97	1.34	1.08	0.91	1.27
Unknown	2,145	232	10.82	1.01	0.88	1.16	1.23*	1.06	1.42

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, dual-eligibility status, rurality, Census division, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 2b. Rate, unadjusted and adjusted[α] odds of readmission by urban/rural of beneficiaries for each level of hospital quality

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Rurality	**1-star hospitals**								
Urban	277,539	50,419	18.17	ref			ref		
Rural	34,186	5,128	15.00	0.80***	0.77	0.82	0.91***	0.88	0.95
	2-star hospitals								
Urban	1,524,491	244,224	16.02	ref			ref		
Rural	316,635	47,180	14.90	0.92***	0.91	0.93	0.94***	0.93	0.95
	3-star hospitals								
Urban	377,506	352,343	14.82	ref			ref		
Rural	742,863	101,973	13.73	0.92***	0.91	0.92	0.95***	0.94	0.96
	4-star hospitals								
Urban	1,434,449	196,701	13.71	ref			ref		
Rural	378,785	46,856	12.37	0.89***	0.88	0.90	0.93***	0.92	0.94
	5-star hospitals								
Urban	192,259	22,563	11.74	ref			ref		
Rural	41,009	4,149	10.12	0.85***	0.82	0.88	0.95*	0.91	0.98

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, Census division, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 2ci. Rate, unadjusted and adjusted[α] odds of readmission by potentially disabling condition of beneficiaries for each level of hospital quality, among ages 18—64 years

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Disability	**1-star hospitals**								
No disability	55,385	10,949	19.77	ref			ref		
Disability	34,269	8,990	26.23	1.44***	1.40	1.49	1.39***	1.34	1.44
	2-star hospitals								
No disability	268,578	47,903	17.84	ref			ref		
Disability	158,010	39,602	25.06	1.54***	1.52	1.56	1.40***	1.37	1.42
	3-star hospitals								
No disability	415,486	69,477	16.72	ref			ref		
Disability	236,063	55,499	23.51	1.53***	1.51	1.55	1.36***	1.35	1.38
	4-star hospitals								
No disability	215,581	34,155	15.84	ref			ref		
Disability	124,342	28,220	22.70	1.56***	1.53	1.59	1.38***	1.35	1.40
	5-star hospitals								
No disability	23,122	3,418	14.78	ref			ref		
Disability	12,633	2,681	21.22	1.55***	1.47	1.64	1.31***	1.23	1.39

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, rurality, Census division, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 2cii. Rate, unadjusted and adjusted[α] odds of readmission by potentially disabling condition of beneficiaries for each level of hospital quality, among ages 65 years and older

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Disability	**1-star hospitals**								
No disability	105,355	12,547	11.91	ref			ref		
Disability	116,716	23,061	19.76	1.82***	1.78	1.87	1.51***	1.47	1.55
	2-star hospitals								
No disability	734,016	80,555	10.97	ref			ref		
Disability	680,522	123,344	18.12	1.80***	1.78	1.81	1.46***	1.44	1.48
	3-star hospitals								
No disability	1,330,616	136,201	10.24	ref			ref		
Disability	1,138,204	193,139	16.97	1.79***	1.78	1.81	1.42***	1.41	1.43
	4-star hospitals								
No disability	817,452	76,742	9.39	ref			ref		
Disability	655,859	104,440	15.92	1.83***	1.81	1.85	1.44***	1.42	1.46
	5-star hospitals								
No disability	119,149	9,324	7.83	ref			ref		
Disability	78,364	11,289	14.41	1.98***	1.93	2.04	1.42***	1.38	1.47

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, rurality, Census division, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 2di. Rate, unadjusted and adjusted[α] odds of readmission by <u>dual-eligibility status</u> of beneficiaries for each level of hospital quality, among ages 18-to-64-years

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Dual-eligibility	**1-star hospitals**								
Not dually eligible	22,703	3,807	16.77	ref			ref		
Dually eligible	66,951	16,132	24.10	1.58***	1.52	1.64	1.17***	1.12	1.23
	2-star hospitals								
Not dually eligible	126,339	20,224	16.01	ref			ref		
Dually eligible	300,249	67,281	22.41	1.52***	1.49	1.54	1.15***	1.12	1.17
	3-star hospitals								
Not dually eligible	202,738	30,510	15.05	ref			ref		
Dually eligible	448,811	94,466	21.05	1.51***	1.48	1.53	1.14***	1.12	1.16
	4-star hospitals								
Not dually eligible	114,310	16,650	14.57	ref			ref		
Dually eligible	225,613	45,725	20.27	1.49***	1.46	1.52	1.13***	1.10	1.15
	5-star hospitals								
Not dually eligible	14,417	1,946	13.50	ref			ref		
Dually eligible	21,338	4,153	19.46	1.55***	1.46	1.64	1.14**	1.06	1.21

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, rurality, Census division, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 2dii. Rate, unadjusted and adjusted[α] odds of readmission by dual-eligibility status of beneficiaries for each level of hospital quality, among ages 65 years and older

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Dual-eligibility	**1-star hospitals**								
Not dually eligible	141,229	19,405	13.74	ref			ref		
Dually eligible	80,842	16,203	20.04	1.57***	1.54	1.61	1.15***	1.12	1.18
	2-star hospitals								
Not dually eligible	1,042,292	134,870	12.94	ref			ref		
Dually eligible	372,246	69,029	18.54	1.53***	1.52	1.55	1.10***	1.09	1.11
	3-star hospitals								
Not dually eligible	1,900,412	230,076	12.11	ref			ref		
Dually eligible	568,408	99,264	17.46	1.54***	1.52	1.55	1.08***	1.07	1.09
	4-star hospitals								
Not dually eligible	1,190,094	134,491	11.30	ref			ref		
Dually eligible	283,217	46,691	16.49	1.55***	1.53	1.57	1.09***	1.07	1.10
	5-star hospitals								
Not dually eligible	171,981	16,662	9.69	ref			ref		
Dually eligible	25,532	3,951	15.47	1.71***	1.64	1.77	1.09**	1.04	1.14

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, rurality, Census division, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Stratification by DIAGNOSIS AT INDEX HOSPITALIZATION

Separate models constructed for each diagnosis

Table 3a. Rate, unadjusted and adjusted[α] odds of readmission by race and ethnicity of beneficiaries for select primary diagnoses at index hospitalization

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Race and ethnicity	**Septicemia**								
White, non-Hispanic	417,466	76,301	18.28	ref			ref		
Black/African American	62,622	14,592	23.30	1.36***	1.33	1.39	1.11***	1.09	1.14
Hispanic	37,019	7,727	20.87	1.18***	1.15	1.21	1.08***	1.05	1.11
Asian/Pacific Islander	12,769	2,414	18.91	1.04	1.00	1.09	1.04	0.99	1.09
Amer Indian/AK Native	5,142	939	18.26	1.00	0.93	1.07	0.98	0.91	1.05
Other	3,647	704	19.30	1.07	0.99	1.16	1.02	0.94	1.11
Unknown	3,349	600	17.92	0.98	0.89	1.07	1.01	0.92	1.10
	Congestive heart failure								
White, non-Hispanic	256,821	55,572	21.64	ref			ref		
Black/African American	51,854	13,678	26.38	1.30***	1.27	1.33	1.04*	1.02	1.07
Hispanic	18,522	4,620	24.94	1.20***	1.16	1.25	1.01	0.97	1.05
Asian/Pacific Islander	5,445	1,241	22.79	1.07*	1.00	1.14	0.99	0.92	1.06
Amer Indian/AK Native	2,379	573	24.09	1.15*	1.05	1.26	1.07	0.97	1.17
Other	1,896	449	23.68	1.12*	1.01	1.25	1.02	0.91	1.13
Unknown	1,302	289	22.20	1.03	0.91	1.18	0.97	0.85	1.11
	COPD								
White, non-Hispanic	208,712	40,499	19.40	ref			ref		
Black/African American	28,377	6,521	22.98	1.24***	1.20	1.28	1.04*	1.01	1.08
Hispanic	10,302	2,065	20.04	1.04	0.99	1.09	0.92*	0.87	0.97
Asian/Pacific Islander	2,540	419	16.50	0.82**	0.74	0.91	0.83*	0.74	0.92
Amer Indian/AK Native	1,842	380	20.63	1.08	0.96	1.21	1.06	0.94	1.19
Other	1,073	203	18.92	0.97	0.83	1.13	0.92	0.79	1.08
Unknown	977	192	19.65	1.02	0.87	1.19	1.02	0.86	1.20
	Complication of device								
White, non-Hispanic	168,327	28,597	16.99	ref			ref		
Black/African American	37,580	9,016	23.99	1.54***	1.50	1.59	1.12***	1.09	1.15
Hispanic	15,694	3,469	22.10	1.39***	1.33	1.44	1.09**	1.04	1.14
Asian/Pacific Islander	3,778	775	20.51	1.26***	1.16	1.37	1.08	0.99	1.17
Amer Indian/AK Native	1,708	314	18.38	1.10	0.97	1.25	0.94	0.83	1.07
Other	1,570	316	20.13	1.23*	1.09	1.39	1.05	0.93	1.20
Unknown	1,881	298	15.84	0.92	0.81	1.04	0.92	0.81	1.05
	Pneumonia								
White, non-Hispanic	229,826	36,315	15.80	ref			ref		
Black/African American	26,513	5,494	20.72	1.39***	1.35	1.44	1.14***	1.10	1.18
Hispanic	14,905	2,532	16.99	1.09**	1.04	1.14	0.96	0.91	1.00
Asian/Pacific Islander	4,594	695	15.13	0.95	0.88	1.03	0.94	0.86	1.02
Amer Indian/AK Native	2,986	494	16.54	1.06	0.96	1.16	1.05	0.95	1.16
Other	1,442	223	15.46	0.98	0.85	1.13	0.93	0.81	1.08
Unknown	1,269	204	16.08	1.02	0.88	1.19	1.01	0.87	1.18

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, dual-eligibility status, rurality, Census division, potentially disabling condition, substance use disorder, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 3b. Rate, unadjusted and adjusted[α] odds of readmission by urban/rural of beneficiaries for select primary diagnoses at index hospitalization

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Rurality	**Septicemia**								
Urban	435,452	84,649	19.44	ref			ref		
Rural	106,562	18,628	17.48	0.88***	0.88	0.89	0.95***	0.93	0.97
	Congestive heart failure								
Urban	264,045	60,164	22.79	ref			ref		
Rural	74,174	16,258	21.92	0.88***	0.86	0.89	0.99	0.97	1.02
	COPD								
Urban	189,325	38,380	20.27	ref			ref		
Rural	64,498	11,899	18.45	0.95***	0.93	0.97	0.98	0.96	1.01
	Complication of device								
Urban	187,590	35,779	19.07	ref			ref		
Rural	42,948	7,006	16.31	0.89***	0.87	0.91	0.92***	0.89	0.95
	Pneumonia								
Urban	204,234	34,109	16.70	ref			ref		
Rural	77,301	11,848	15.33	0.83***	0.80	0.85	0.98	0.96	1.01

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, Census division, potentially disabling condition, substance use disorder, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 3ci. Rate, unadjusted and adjusted[α] odds of readmission by potentially disabling condition of beneficiaries for select primary diagnoses at index hospitalization, among ages 18—64 years

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Disability	**Septicemia**								
No disability	58,505	10,940	18.70	ref			ref		
Disability	56,915	14,311	25.14	1.46***	1.42	1.50	1.29***	1.25	1.33
	Congestive heart failure								
No disability	30,737	7,991	26.00	ref			ref		
Disability	13,949	5,128	36.76	1.66***	1.59	1.73	1.46***	1.40	1.53
	COPD								
No disability	40,167	8,128	20.24	ref			ref		
Disability	13,630	4,356	31.96	1.85***	1.77	1.93	1.45***	1.39	1.52
	Complication of device								
No disability	42,317	8,283	19.57	ref			ref		
Disability	27,463	7,535	27.44	1.55***	1.50	1.61	1.40***	1.35	1.46
	Pneumonia								
No disability	28,358	4,910	17.31	ref			ref		
Disability	16,659	3,920	23.53	1.47***	1.40	1.54	1.27***	1.20	1.33

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, rurality, Census division, substance use disorder, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 3cii. Rate, unadjusted and adjusted[α] odds of readmission by potentially disabling condition of beneficiaries for select primary diagnoses at index hospitalization, among ages 65 years and older

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Disability	**Septicemia**								
No disability	187,277	27,273	14.56	ref			ref		
Disability	239,317	50,753	21.21	1.58***	1.55	1.61	1.39***	1.36	1.41
	Congestive heart failure								
No disability	154,667	28,906	18.69	ref			ref		
Disability	138,866	34,397	24.77	1.43***	1.41	1.46	1.40***	1.37	1.42
	COPD								
No disability	123,963	19,593	15.81	ref			ref		
Disability	76,063	18,202	23.93	1.68***	1.64	1.71	1.46***	1.43	1.50
	Complication of device								
No disability	86,506	11,213	12.96	ref			ref		
Disability	74,252	15,754	21.22	1.81***	1.76	1.86	1.47***	1.43	1.52
	Pneumonia								
No disability	121,123	15,819	13.06	ref			ref		
Disability	115,395	21,308	18.47	1.51***	1.47	1.54	1.36***	1.32	1.39

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, rurality, Census division, substance use disorder, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 3di. Rate, unadjusted and adjusted[α] odds of readmission by dual-eligibility status of beneficiaries for select primary diagnoses at index hospitalization, among ages 18—64 years

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Dual-eligibility	**Septicemia**								
Not dually eligible	32,617	6,081	18.64	ref			ref		
Dually eligible	82,803	19,170	23.15	1.32***	1.27	1.36	1.07**	1.04	1.11
	Congestive heart failure								
Not dually eligible	14,979	3,635	24.27	ref			ref		
Dually eligible	29,707	9,484	31.93	1.46***	1.40	1.53	1.20***	1.14	1.26
	COPD								
Not dually eligible	15,839	3,051	19.26	ref			ref		
Dually eligible	37,958	9,433	24.85	1.39***	1.32	1.45	1.14***	1.09	1.20
	Complication of device								
Not dually eligible	24,067	4,493	18.67	ref			ref		
Dually eligible	45,713	11,325	24.77	1.44***	1.38	1.49	1.12***	1.08	1.17
	Pneumonia								
Not dually eligible	14,081	2,364	16.79	ref			ref		
Dually eligible	30,936	6,466	20.90	1.31***	1.24	1.38	1.06*	1.00	1.12

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, rurality, Census division, potentially disabling condition, substance use disorder, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 3dii. Rate, unadjusted and adjusted[α] odds of readmission by dual-eligibility status of beneficiaries for select primary diagnoses at index hospitalization, among ages 65 years and older

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Dual-eligibility	**Septicemia**								
Not dually eligible	291,226	49,392	16.96	ref			ref		
Dually eligible	135,368	28,634	21.15	1.31***	1.29	1.34	1.00	0.99	1.02
	Congestive heart failure								
Not dually eligible	218,002	44,381	20.36	ref			ref		
Dually eligible	75,531	18,922	25.05	1.31***	1.28	1.33	1.11***	1.09	1.14
	COPD								
Not dually eligible	136,995	23,729	17.32	ref			ref		
Dually eligible	63,031	14,066	22.32	1.37***	1.34	1.40	1.13***	1.10	1.16
	Complication of device								
Not dually eligible	123,914	18,915	15.26	ref			ref		
Dually eligible	36,844	8,052	21.85	1.55***	1.51	1.60	1.12***	1.08	1.15
	Pneumonia								
Not dually eligible	173,233	25,531	14.74	ref			ref		
Dually eligible	63,285	11,596	18.32	1.30***	1.27	1.33	1.04*	1.01	1.07

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, rurality, Census division, potentially disabling condition, substance use disorder, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Stratification by INDEX HOSPITALIZATION DISCHARGE SETTING

Separate models constructed for each discharge setting

Table 4a. Rate, unadjusted and adjusted[α] odds of readmission by race and ethnicity of beneficiaries for each index hospitalization discharge setting

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Race and ethnicity	**Home/Self-care**								
White, non-Hispanic	3,115,334	402,228	12.91	ref			ref		
Black/African American	540,957	102,644	18.97	1.58***	1.57	1.59	1.08***	1.07	1.09
Hispanic	258,536	40,881	15.81	1.27***	1.25	1.28	0.98**	0.97	0.99
Asian/Pacific Islander	67,435	8,885	13.18	1.02*	1.00	1.05	0.95***	0.93	0.97
Amer Indian/AK Native	38,622	5,822	15.07	1.20***	1.16	1.23	0.98	0.95	1.01
Other	25,050	3,414	13.63	1.06**	1.03	1.10	1.00	0.97	1.04
Unknown	35,868	4,386	12.23	0.94**	0.91	0.97	0.99	0.96	1.03
	Skilled Nursing Facility								
White, non-Hispanic	1,368,204	200,553	14.66	ref			ref		
Black/African American	180,910	37,267	20.60	1.51***	1.49	1.53	1.20***	1.19	1.22
Hispanic	75,770	14,269	18.83	1.35***	1.33	1.38	1.13***	1.11	1.16
Asian/Pacific Islander	26,746	4,507	16.85	1.18***	1.14	1.22	1.11***	1.08	1.15
Amer Indian/AK Native	8,654	1,488	17.19	1.21***	1.14	1.28	1.10*	1.04	1.16
Other	8,402	1,482	17.64	1.25***	1.18	1.32	1.14***	1.08	1.21
Unknown	6,483	991	15.29	1.05	0.98	1.12	1.03	0.96	1.11
	Home Health Care								
White, non-Hispanic	1,173,121	167,326	14.26	ref			ref		
Black/African American	181,388	36,337	20.03	1.51***	1.49	1.52	1.12***	1.10	1.13
Hispanic	85,005	14,673	17.26	1.25***	1.23	1.28	1.01	0.99	1.03
Asian/Pacific Islander	26,169	3,789	14.48	1.02	0.98	1.05	0.91***	0.88	0.95
Amer Indian/AK Native	7,630	1,307	17.13	1.24***	1.17	1.32	1.05	0.98	1.12
Other	9,367	1,371	14.64	1.03	0.97	1.09	0.96	0.91	1.02
Unknown	10,562	1,081	10.23	0.69***	0.64	0.73	0.90*	0.84	0.96
	Inpatient Rehabilitation Facility								
White, non-Hispanic	149,459	18,095	12.11	ref			ref		
Black/African American	22,350	3,251	14.55	1.24***	1.19	1.29	1.05*	1.00	1.10
Hispanic	9,098	1,288	14.16	1.20***	1.13	1.27	1.06	0.99	1.13
Asian/Pacific Islander	2,530	277	10.95	0.89	0.79	1.01	0.90	0.79	1.03
Amer Indian/AK Native	673	82	12.18	1.01	0.80	1.27	0.91	0.72	1.15
Other	1,108	130	11.73	0.96	0.80	1.16	0.92	0.76	1.11
Unknown	1,080	121	11.20	0.92	0.76	1.11	1.01	0.83	1.23
	Intermediate Care Facility								
White, non-Hispanic	83,068	13,623	16.40	ref			ref		
Black/African American	12,183	2,606	21.39	1.39***	1.32	1.45	1.09**	1.04	1.15
Hispanic	4,495	1,026	22.83	1.51***	1.40	1.62	1.21***	1.12	1.31
Asian/Pacific Islander	969	177	18.27	1.14	0.97	1.34	1.09	0.92	1.29
Amer Indian/AK Native	798	174	21.80	1.42***	1.20	1.68	1.28*	1.07	1.52
Other	474	89	18.78	1.18	0.94	1.49	1.06	0.83	1.34
Unknown	258	42	16.28	0.99	0.71	1.38	0.96	0.68	1.34
	Long-Term Care Hospital								

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
White, non-Hispanic	55,223	9,103	16.48	ref			ref		
Black/African American	16,119	2,647	16.42	1.00	0.95	1.04	1.02	0.97	1.07
Hispanic	7,740	1,356	17.52	1.08*	1.01	1.15	1.14**	1.07	1.22
Asian/Pacific Islander	1,592	248	15.58	0.93	0.81	1.07	1.04	0.90	1.20
Amer Indian/AK Native	792	120	15.15	0.90	0.74	1.10	1.02	0.83	1.24
Other	424	68	16.04	0.97	0.75	1.26	0.96	0.74	1.25
Unknown	404	63	15.59	0.94	0.71	1.23	0.93	0.71	1.22
	Inpatient Psychiatric Hospital								
White, non-Hispanic	8,112	2,791	34.41	ref			ref		
Black/African American	2,018	557	27.60	0.73***	0.65	0.81	0.76***	0.67	0.86
Hispanic	658	233	35.41	1.05	0.89	1.23	1.18	0.98	1.42
Asian/Pacific Islander	204	65	31.86	0.89	0.66	1.20	1.23	0.89	1.71
Amer Indian/AK Native	92	29	31.52	0.88	0.56	1.37	0.85	0.52	1.38
Other	63	24	38.10	1.17	0.70	1.95	1.54	0.87	2.72
Unknown	81	22	27.16	0.71	0.43	1.16	0.76	0.45	1.29
	Hospice								
White, non-Hispanic	45,868	2,548	5.56	ref			ref		
Black/African American	6,811	760	11.16	2.14***	1.96	2.33	1.63***	1.49	1.79
Hispanic	3,326	312	9.38	1.76***	1.56	1.99	1.41***	1.23	1.61
Asian/Pacific Islander	1,030	85	8.25	1.53**	1.22	1.92	1.58**	1.25	2.00
Amer Indian/AK Native	331	23	6.95	1.27	0.83	1.94	1.05	0.68	1.62
Other	311	26	8.36	1.55*	1.04	2.32	1.35	0.90	2.03
Unknown	171	21	12.28	2.38**	1.51	3.76	1.88*	1.18	3.02
	Critical Access Hospital								
White, non-Hispanic	724	203	28.04	ref			ref		
Black/African American	59	31	52.54	2.84**	1.66	4.86	1.67	0.83	3.34
Hispanic	40	14	35.00	1.38	0.71	2.70	1.03	0.45	2.35
Asian/Pacific Islander	---	---	13.33	na	na	na	na	na	na
Amer Indian/AK Native	---	---	80.00	na	na	na	na	na	na
Other	---	---	16.67	na	na	na	na	na	na
Unknown	---	---	33.33	na	na	na	na	na	na
	Other settings								
White, non-Hispanic	50,049	16,234	32.44	ref			ref		
Black/African American	9,263	2,907	31.38	0.95*	0.91	1.00	0.98	0.93	1.03
Hispanic	3,620	1,131	31.24	0.95	0.88	1.02	1.07	0.99	1.16
Asian/Pacific Islander	924	255	27.60	0.79*	0.69	0.92	0.96	0.83	1.12
Amer Indian/AK Native	706	220	31.16	0.94	0.80	1.11	0.98	0.83	1.16
Other	380	105	27.63	0.80*	0.63	1.00	0.84	0.66	1.06
Unknown	456	152	33.33	1.04	0.86	1.27	1.10	0.89	1.34

*p<0.05; **p<0.001; ***p<0.0001

--- Suppressed due to small cell size

[α] Adjusted for age, sex, dual-eligibility status, rurality, Census division, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 4b. Rate, unadjusted and adjusted[α] odds of readmission by urban/rural of beneficiaries for each index hospitalization discharge setting

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Rurality	**Home/Self-care**								
Urban	3,188,713	457,140	14.34	ref			ref		
Rural	893,089	111,120	12.44	0.85***	0.84	0.86	0.94***	0.93	0.95
	Skilled Nursing Facility								
Urban	1,327,503	210,992	15.89	ref			ref		
Rural	347,666	49,565	14.26	0.88***	0.87	0.89	0.94***	0.92	0.95
	Home Health Care								
Urban	1,219,691	185,530	15.21	ref			ref		
Rural	273,551	40,354	14.75	0.96***	0.95	0.98	0.95***	0.94	0.97
	Inpatient Rehabilitation Facility								
Urban	160,853	20,148	12.53	ref			ref		
Rural	25,445	3,096	12.17	0.97	0.93	1.01	1.00	0.96	1.04
	Intermediate Care Facility								
Urban	74,291	13,287	17.89	ref			ref		
Rural	27,954	4,450	15.92	0.87***	0.84	0.90	0.93**	0.89	0.97
	Long-Term Care Hospital								
Urban	66,254	11,305	17.06	ref			ref		
Rural	16,040	2,300	14.34	0.81***	0.78	0.85	0.84***	0.80	0.88
	Inpatient Psychiatric Hospital								
Urban	9,155	3,035	33.15	ref			ref		
Rural	2,073	686	33.09	1.00	0.90	1.10	0.84*	0.75	0.95
	Hospice								
Urban	46,975	3,098	6.59	ref			ref		
Rural	10,873	677	6.23	0.94	0.86	1.02	0.88*	0.80	0.97
	Critical Access Hospital								
Urban	332	120	36.14	ref			ref		
Rural	520	136	26.15	0.63*	0.46	0.84	1.28	0.83	1.97
	Other settings								
Urban	48,128	14,639	30.42	ref			ref		
Rural	17,270	6,365	36.86	1.34***	1.29	1.38	1.18***	1.13	1.24

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, Census division, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 4ci. Rate, unadjusted and adjusted[α] odds of readmission by <u>potentially disabling condition</u> of beneficiaries for each index hospitalization discharge setting, among ages 18—64 years

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Disability	**Home/Self-care**								
No disability	841,048	143,612	17.08	ref			ref		
Disability	342,690	84,485	24.65	1.59***	1.57	1.60	1.43***	1.42	1.45
	Skilled Nursing Facility								
No disability	64,798	10,738	16.57	ref			ref		
Disability	112,576	25,509	22.66	1.47***	1.44	1.51	1.24***	1.20	1.27
	Home Health Care								
No disability	141,499	23,681	16.74	ref			ref		
Disability	102,551	24,948	24.33	1.60***	1.57	1.63	1.31***	1.28	1.34
	Inpatient Rehabilitation Facility								
No disability	9,759	1,326	13.59	ref			ref		
Disability	14,042	2,322	16.54	1.26***	1.17	1.36	1.15**	1.06	1.24
	Intermediate Care Facility								
No disability	4,751	1,041	21.91	ref			ref		
Disability	14,264	3,274	22.95	1.06	0.98	1.15	1.18**	1.08	1.28
	Long-Term Care Hospital								
No disability	8,043	1,238	15.39	ref			ref		
Disability	14,406	2,447	16.99	1.12*	1.04	1.21	1.14*	1.05	1.23
	Inpatient Psychiatric Hospital								
No disability	4,660	1,230	26.39	ref			ref		
Disability	2,964	1,040	35.09	1.51***	1.36	1.67	1.34***	1.19	1.50
	Hospice								
No disability	2,464	309	12.54	ref			ref		
Disability	2,465	334	13.55	1.09	0.93	1.29	1.07	0.89	1.27
	Critical Access Hospital								
No disability	79	39	49.37	ref			ref		
Disability	57	31	54.39	1.22	0.62	2.42	1.97	0.58	6.73
	Other settings								
No disability	12,372	3,662	29.60	ref			ref		
Disability	9,379	3,240	34.55	1.26***	1.19	1.33	1.24***	1.16	1.32

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, rurality, Census division, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 4cii. Rate, unadjusted and adjusted[α] odds of readmission by potentially disabling condition of beneficiaries for each index hospitalization discharge setting, among ages 65 years and older

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Disability	**Home/Self-care**								
No disability	1,982,603	187,452	9.45	ref			ref		
Disability	915,461	152,711	16.68	1.92***	1.90	1.93	1.52***	1.51	1.54
	Skilled Nursing Facility								
No disability	465,139	52,454	11.28	ref			ref		
Disability	1,032,656	171,856	16.64	1.57***	1.55	1.59	1.30***	1.28	1.31
	Home Health Care								
No disability	682,190	71,368	10.46	ref			ref		
Disability	567,002	105,887	18.67	1.97***	1.95	1.99	1.43***	1.42	1.45
	Inpatient Rehabilitation Facility								
No disability	59,129	5,028	8.50	ref			ref		
Disability	103,368	14,568	14.09	1.77***	1.71	1.83	1.39***	1.34	1.44
	Intermediate Care Facility								
No disability	11,342	1,541	13.59	ref			ref		
Disability	71,888	11,881	16.53	1.26***	1.19	1.33	1.20***	1.14	1.28
	Long-Term Care Hospital								
No disability	16,721	2,557	15.29	ref			ref		
Disability	43,124	7,363	17.07	1.14***	1.09	1.20	1.20***	1.14	1.26
	Inpatient Psychiatric Hospital								
No disability	949	292	30.77	ref			ref		
Disability	2,655	1,159	43.65	1.74***	1.49	2.04	1.58***	1.32	1.89
	Hospice								
No disability	15,535	853	5.49	ref			ref		
Disability	37,384	2,279	6.10	1.12*	1.03	1.21	1.21***	1.11	1.32
	Critical Access Hospital								
No disability	334	73	21.86	ref			ref		
Disability	382	113	29.58	1.50*	1.07	2.11	1.76*	1.12	2.76
	Other settings								
No disability	18,265	6,147	33.65	ref			ref		
Disability	25,382	7,955	31.34	0.90***	0.86	0.94	1.08*	1.03	1.13

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, rurality, Census division, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 4di. Rate, unadjusted and adjusted[α] odds of readmission by dual-eligibility status of beneficiaries for each index hospitalization discharge setting, among ages 18-to-64-years

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Dual-eligibility	**Home/Self-care**								
Not dually eligible	379,469	56,245	14.82	ref			ref		
Dually eligible	804,269	171,852	21.37	1.56***	1.54	1.58	1.16***	1.15	1.17
	Skilled Nursing Facility								
Not dually eligible	36,934	6,275	16.99	ref			ref		
Dually eligible	140,440	29,972	21.34	1.33***	1.29	1.37	1.04*	1.00	1.07
	Home Health Care								
Not dually eligible	81,585	13,003	15.94	ref			ref		
Dually eligible	162,465	35,626	21.93	1.48***	1.45	1.51	1.13***	1.10	1.16
	Inpatient Rehabilitation Facility								
Not dually eligible	9,044	1,134	12.54	ref			ref		
Dually eligible	14,757	2,514	17.04	1.43***	1.33	1.54	1.18**	1.08	1.28
	Intermediate Care Facility								
Not dually eligible	1,256	267	21.26	ref			ref		
Dually eligible	17,759	4,048	22.79	1.09	0.95	1.26	0.97	0.84	1.13
	Long-Term Care Hospital								
Not dually eligible	5,555	930	16.74	ref			ref		
Dually eligible	16,894	2,755	16.31	0.97	0.89	1.05	0.88*	0.81	0.96
	Inpatient Psychiatric Hospital								
Not dually eligible	1,847	454	24.58	ref			ref		
Dually eligible	5,777	1,816	31.44	1.41***	1.25	1.59	1.35***	1.18	1.54
	Hospice								
Not dually eligible	1,595	174	10.91	ref			ref		
Dually eligible	3,334	469	14.07	1.34*	1.11	1.61	1.15	0.94	1.40
	Critical Access Hospital								
Not dually eligible	40	20	50.00	ref			ref		
Dually eligible	96	50	52.08	1.09	0.52	2.27	0.94	0.28	3.18
	Other settings								
Not dually eligible	5,442	1,686	30.98	ref			ref		
Dually eligible	16,309	5,216	31.98	1.05	0.98	1.12	1.01	0.94	1.09

*p<0.05
**p<0.001
***p<0.0001

[α]Adjusted for age, sex, race and ethnicity, rurality, Census division, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 4dii. Rate, unadjusted and adjusted[α] odds of readmission by dual-eligibility status of beneficiaries for each index hospitalization discharge setting, among ages 65 years and older

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Dual-eligibility	**Home/Self-care**								
Not dually eligible	2,401,506	257,509	10.72	ref			ref		
Dually eligible	496,558	82,654	16.65	1.66***	1.65	1.68	1.18***	1.17	1.19
	Skilled Nursing Facility								
Not dually eligible	986,923	135,083	13.69	ref			ref		
Dually eligible	510,872	89,227	17.47	1.33***	1.32	1.35	0.99*	0.98	1.00
	Home Health Care								
Not dually eligible	990,985	125,718	12.69	ref			ref		
Dually eligible	258,207	51,537	19.96	1.72***	1.70	1.74	1.18***	1.17	1.20
	Inpatient Rehabilitation Facility								
Not dually eligible	132,734	15,067	11.35	ref			ref		
Dually eligible	29,763	4,529	15.22	1.40***	1.35	1.45	1.11***	1.07	1.15
	Intermediate Care Facility								
Not dually eligible	38,919	5,655	14.53	ref			ref		
Dually eligible	44,311	7,767	17.53	1.25***	1.20	1.30	1.00	0.95	1.04
	Long-Term Care Hospital								
Not dually eligible	35,253	6,124	17.37	ref			ref		
Dually eligible	24,592	3,796	15.44	0.87***	0.83	0.91	0.84***	0.80	0.88
	Inpatient Psychiatric Hospital								
Not dually eligible	1,800	775	43.06	ref			ref		
Dually eligible	1,804	676	37.47	0.79**	0.69	0.91	0.85*	0.72	1.00
	Hospice								
Not dually eligible	37,737	1,911	5.06	ref			ref		
Dually eligible	15,182	1,221	8.04	1.64***	1.52	1.77	1.29***	1.19	1.40
	Critical Access Hospital								
Not dually eligible	529	133	25.14	ref			ref		
Dually eligible	187	53	28.34	1.18	0.81	1.71	0.81	0.49	1.34
	Other settings								
Not dually eligible	31,055	10,081	32.46	ref			ref		
Dually eligible	12,592	4,021	31.93	0.98	0.93	1.02	0.94*	0.89	0.98

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, rurality, Census division, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Stratification by CENSUS DIVISION

Separate models constructed for each Census division

Table 5a. Rate, unadjusted and adjusted[α] odds of readmission by race and ethnicity of beneficiaries for each Census division

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Race and ethnicity	**New England**								
White, non-Hispanic	399,982	60,501	15.13	ref			ref		
Black/African American	22,093	4,582	20.74	1.47***	1.42	1.52	1.11***	1.07	1.15
Hispanic	19,839	3,621	18.25	1.25***	1.21	1.30	0.99	0.96	1.03
Asian/Pacific Islander	4,335	710	16.38	1.10*	1.01	1.19	1.10*	1.01	1.19
Amer Indian/AK Native	623	99	15.89	1.06	0.86	1.31	0.86	0.69	1.07
Other	3,303	524	15.86	1.06	0.96	1.16	0.94	0.86	1.04
Unknown	4,882	595	12.19	0.78***	0.72	0.85	0.88*	0.81	0.97
	Middle Atlantic								
White, non-Hispanic	805,325	115,000	14.28	ref			ref		
Black/African American	125,727	24,624	19.59	1.46***	1.44	1.49	1.13***	1.11	1.15
Hispanic	60,430	10,687	17.68	1.29***	1.26	1.32	1.06***	1.04	1.09
Asian/Pacific Islander	18,801	2,765	14.71	1.04	0.99	1.08	0.97	0.93	1.02
Amer Indian/AK Native	1,193	217	18.19	1.34**	1.15	1.55	1.04	0.90	1.22
Other	8,336	1,339	16.06	1.15***	1.08	1.22	1.05	0.99	1.12
Unknown	9,949	1,326	13.33	0.92*	0.87	0.98	1.02	0.96	1.08
	East North Central								
White, non-Hispanic	1,069,888	149,103	13.94	ref			ref		
Black/African American	167,913	34,049	20.28	1.57***	1.55	1.59	1.13***	1.12	1.15
Hispanic	34,449	5,521	16.03	1.18***	1.15	1.21	0.99	0.96	1.02
Asian/Pacific Islander	10,749	1,537	14.30	1.03	0.98	1.09	1.01	0.96	1.07
Amer Indian/AK Native	3,616	616	17.04	1.27***	1.16	1.38	1.04	0.95	1.14
Other	6,184	892	14.42	1.04	0.97	1.12	1.00	0.93	1.08
Unknown	10,170	1,203	11.83	0.83***	0.78	0.88	0.97	0.91	1.03
	West North Central								
White, non-Hispanic	487,050	62,862	12.91	ref			ref		
Black/African American	35,962	7,235	20.12	1.70***	1.65	1.75	1.15***	1.12	1.19
Hispanic	8,585	1,295	15.08	1.20***	1.13	1.27	1.00	0.94	1.06
Asian/Pacific Islander	3,322	488	14.69	1.16*	1.06	1.28	1.00	0.90	1.10
Amer Indian/AK Native	7,524	1,323	17.58	1.44***	1.36	1.53	1.08*	1.02	1.15
Other	2,047	287	14.02	1.10	0.97	1.25	0.97	0.86	1.11
Unknown	3,763	474	12.60	0.97	0.88	1.07	1.00	0.90	1.10
	South Atlantic								
White, non-Hispanic	1,270,390	175,917	13.85	ref			ref		
Black/African American	320,531	60,899	19.00	1.46***	1.45	1.48	1.09***	1.08	1.10
Hispanic	70,821	13,046	18.42	1.41***	1.38	1.43	1.09***	1.07	1.11
Asian/Pacific Islander	15,678	2,215	14.13	1.02	0.98	1.07	0.99	0.95	1.04
Amer Indian/AK Native	3,370	604	17.92	1.36***	1.24	1.48	1.03	0.94	1.12
Other	8,284	1,210	14.61	1.06*	1.00	1.13	1.01	0.95	1.07
Unknown	11,086	1,426	12.86	0.92*	0.87	0.97	0.99	0.94	1.05
	East South Central								
White, non-Hispanic	497,024	71,420	14.37	ref			ref		

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Black/African American	103,808	18,966	18.27	1.33***	1.31	1.36	1.08***	1.06	1.10
Hispanic	3,853	606	15.73	1.11*	1.02	1.21	1.01	0.93	1.11
Asian/Pacific Islander	1,873	288	15.38	1.08	0.96	1.23	1.08	0.95	1.23
Amer Indian/AK Native	811	141	17.39	1.25*	1.05	1.50	0.99	0.82	1.19
Other	1,563	246	15.74	1.11	0.97	1.28	1.03	0.89	1.19
Unknown	2,519	324	12.86	0.88*	0.78	0.99	0.97	0.86	1.10
	West South Central								
White, non-Hispanic	629,517	86,613	13.76	ref			ref		
Black/African American	125,475	24,214	19.30	1.50***	1.48	1.52	1.12***	1.10	1.14
Hispanic	100,585	16,173	16.08	1.20***	1.18	1.22	0.99	0.97	1.01
Asian/Pacific Islander	8,798	1,305	14.83	1.09*	1.03	1.16	1.02	0.96	1.09
Amer Indian/AK Native	15,042	2,331	15.50	1.15***	1.10	1.20	1.01	0.97	1.06
Other	3,115	452	14.51	1.06	0.96	1.18	1.06	0.96	1.18
Unknown	3,787	521	13.76	1.00	0.91	1.10	1.10	1.00	1.21
	Mountain								
White, non-Hispanic	331,676	38,551	11.62	ref			ref		
Black/African American	14,566	2,791	19.16	1.80***	1.73	1.88	1.19***	1.14	1.25
Hispanic	38,985	5,453	13.99	1.24***	1.20	1.28	0.99	0.96	1.02
Asian/Pacific Islander	5,137	730	14.21	1.26***	1.16	1.36	1.08	0.99	1.17
Amer Indian/AK Native	16,009	2,374	14.83	1.32***	1.27	1.39	1.04	0.99	1.09
Other	2,429	319	13.13	1.15*	1.02	1.29	1.08	0.95	1.22
Unknown	3,166	299	9.44	0.79**	0.70	0.89	0.95	0.84	1.07
	Pacific								
White, non-Hispanic	558,310	72,737	13.03	ref			ref		
Black/African American	55,983	11,647	20.80	1.75***	1.72	1.79	1.19***	1.16	1.22
Hispanic	110,741	18,781	16.96	1.36***	1.34	1.39	1.04**	1.02	1.06
Asian/Pacific Islander	58,921	8,252	14.01	1.09***	1.06	1.11	0.97*	0.94	0.99
Amer Indian/AK Native	10,115	1,564	15.46	1.22***	1.16	1.29	1.01	0.95	1.07
Other	10,324	1,441	13.96	1.08*	1.02	1.15	1.05	0.99	1.11
Unknown	6,044	712	11.78	0.89*	0.82	0.96	0.98	0.90	1.06

*p<0.05
**p<0.001
***p<0.0001
[α] Adjusted for age, sex, dual-eligibility status, rurality, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 5b. Rate, unadjusted and adjusted[α] odds of readmission by urban/rural status of beneficiaries for each Census division

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Rurality	**New England**								
Urban	390,338	62,234	15.94	ref			ref		
Rural	64,719	8,398	12.98	0.79***	0.77	0.81	0.87***	0.85	0.89
	Middle Atlantic								
Urban	940,558	143,171	15.22	ref			ref		
Rural	89,203	12,787	14.33	0.93***	0.91	0.95	0.99	0.97	1.02
	East North Central								
Urban	1,011,219	153,776	15.21	ref			ref		
Rural	291,750	39,145	13.42	0.86***	0.85	0.87	0.96***	0.95	0.97
	West North Central								
Urban	328,633	46,604	14.18	ref			ref		
Rural	219,620	27,360	12.46	0.86***	0.85	0.88	0.96***	0.94	0.98
	South Atlantic								
Urban	1,424,840	215,115	15.10	ref			ref		
Rural	275,320	40,202	14.60	0.96***	0.95	0.97	0.95***	0.94	0.96
	East South Central								
Urban	354,285	53,397	15.07	ref			ref		
Rural	257,166	38,594	15.01	1.00	0.98	1.01	0.96***	0.94	0.97
	West South Central								
Urban	649,870	98,899	15.22	ref			ref		
Rural	236,449	32,710	13.83	0.89***	0.88	0.91	0.95***	0.93	0.96
	Mountain								
Urban	311,937	39,851	12.78	ref			ref		
Rural	100,031	10,666	10.66	0.82***	0.80	0.83	0.88***	0.86	0.90
	Pacific								
Urban	730,215	106,247	14.55	ref			ref		
Rural	80,223	8,887	11.08	0.73***	0.72	0.75	0.88***	0.86	0.90

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 5ci. Rate, unadjusted and adjusted[α] odds of readmission by potentially disabling condition of beneficiaries for each Census division, among ages 18—64 years

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Disability	**New England**								
No disability	68,832	12,746	18.52	ref			ref		
Disability	37,147	9,342	25.15	1.48***	1.43	1.52	1.36***	1.32	1.41
	Middle Atlantic								
No disability	131,489	22,716	17.28	ref			ref		
Disability	77,736	18,512	23.81	1.50***	1.46	1.53	1.40***	1.36	1.43
	East North Central								
No disability	181,080	30,457	16.82	ref			ref		
Disability	108,443	25,748	23.74	1.54***	1.51	1.57	1.36***	1.33	1.39
	West North Central								
No disability	80,561	12,998	16.13	ref			ref		
Disability	47,067	10,442	22.19	1.48***	1.44	1.53	1.35***	1.31	1.39
	South Atlantic								
No disability	238,036	42,618	17.90	ref			ref		
Disability	130,466	32,978	25.28	1.55***	1.53	1.58	1.41***	1.38	1.43
	East South Central								
No disability	104,463	16,902	16.18	ref			ref		
Disability	49,545	11,688	23.59	1.60***	1.56	1.64	1.39***	1.35	1.43
	West South Central								
No disability	126,413	21,422	16.95	ref			ref		
Disability	78,093	18,763	24.03	1.55***	1.52	1.59	1.42***	1.39	1.46
	Mountain								
No disability	50,996	7,963	15.61	ref			ref		
Disability	26,892	5,877	21.85	1.51***	1.46	1.57	1.36***	1.31	1.42
	Pacific								
No disability	107,603	19,054	17.71	ref			ref		
Disability	60,005	14,280	23.80	1.45***	1.42	1.49	1.35***	1.31	1.38

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, rurality, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 5cii. Rate, unadjusted and adjusted[α] odds of readmission by potentially disabling condition of beneficiaries for each Census division, among ages 65 years and older

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Disability	**New England**								
No disability	185,399	20,285	10.94	ref			ref		
Disability	163,679	28,259	17.26	1.70***	1.67	1.73	1.39***	1.36	1.42
	Middle Atlantic								
No disability	426,157	45,580	10.70	ref			ref		
Disability	394,379	69,150	17.53	1.78***	1.75	1.80	1.43***	1.41	1.45
	East North Central								
No disability	548,392	56,654	10.33	ref			ref		
Disability	465,054	80,062	17.22	1.81***	1.78	1.83	1.44***	1.43	1.46
	West North Central								
No disability	247,105	23,799	9.63	ref			ref		
Disability	173,520	26,725	15.40	1.71***	1.68	1.74	1.37***	1.34	1.40
	South Atlantic								
No disability	709,551	72,004	10.15	ref			ref		
Disability	622,107	107,717	17.31	1.85***	1.84	1.87	1.46***	1.45	1.48
	East South Central								
No disability	245,040	25,931	10.58	ref			ref		
Disability	212,403	37,470	17.64	1.81***	1.78	1.84	1.46***	1.43	1.48
	West South Central								
No disability	344,762	33,212	9.63	ref			ref		
Disability	337,051	58,212	17.27	1.96***	1.93	1.99	1.52***	1.50	1.55
	Mountain								
No disability	200,555	16,966	8.46	ref			ref		
Disability	133,525	19,711	14.76	1.87***	1.83	1.92	1.45***	1.42	1.49
	Pacific								
No disability	345,246	33,334	9.66	ref			ref		
Disability	297,584	48,466	16.29	1.82***	1.79	1.85	1.40***	1.38	1.42

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, dual-eligibility status, rurality, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 5di. Rate, unadjusted and adjusted[α] odds of readmission by dual-eligibility status of beneficiaries for each Census division, among ages 18—64 years

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Dual-eligibility	**New England**								
Not dually eligible	21,056	3,421	16.25	ref			ref		
Dually eligible	84,923	18,667	21.98	1.45***	1.40	1.51	1.13***	1.08	1.18
	Middle Atlantic								
Not dually eligible	69,574	10,901	15.67	ref			ref		
Dually eligible	139,651	30,327	21.72	1.49***	1.46	1.53	1.15***	1.12	1.18
	East North Central								
Not dually eligible	84,810	12,868	15.17	ref			ref		
Dually eligible	204,713	43,337	21.17	1.50***	1.47	1.53	1.15***	1.12	1.18
	West North Central								
Not dually eligible	37,072	5,410	14.59	ref			ref		
Dually eligible	90,556	18,030	19.91	1.46***	1.41	1.50	1.10***	1.06	1.14
	South Atlantic								
Not dually eligible	121,611	19,194	15.78	ref			ref		
Dually eligible	246,891	56,402	22.84	1.58***	1.55	1.61	1.16***	1.14	1.19
	East South Central								
Not dually eligible	54,108	8,085	14.94	ref			ref		
Dually eligible	99,900	20,505	20.53	1.47***	1.43	1.51	1.12***	1.08	1.15
	West South Central								
Not dually eligible	72,719	11,758	16.17	ref			ref		
Dually eligible	131,787	28,427	21.57	1.43***	1.39	1.46	1.08***	1.06	1.11
	Mountain								
Not dually eligible	25,176	3,494	13.88	ref			ref		
Dually eligible	52,712	10,346	19.63	1.52***	1.45	1.58	1.16***	1.11	1.21
	Pacific								
Not dually eligible	36,641	5,057	13.80	ref			ref		
Dually eligible	130,967	28,277	21.59	1.72***	1.67	1.78	1.22***	1.18	1.26

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, rurality, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

Table 5dii. Rate, unadjusted and adjusted[α] odds of readmission by dual-eligibility status of beneficiaries for each Census division, among ages 65 years and older

	Index Stays	N Readmit	% Readmit	Odds Ratio	95% CI		Adjusted Odds Ratio[α]	95% CI	
Dual-eligibility	**New England**								
Not dually eligible	257,954	32,732	12.69	ref			ref		
Dually eligible	91,124	15,812	17.35	1.45***	1.42	1.48	1.06***	1.04	1.09
	Middle Atlantic								
Not dually eligible	620,182	78,313	12.63	ref			ref		
Dually eligible	200,354	36,417	18.18	1.54***	1.52	1.56	1.08***	1.07	1.10
	East North Central								
Not dually eligible	806,992	99,626	12.35	ref			ref		
Dually eligible	206,454	37,090	17.97	1.56***	1.54	1.58	1.09***	1.07	1.10
	West North Central								
Not dually eligible	347,922	38,651	11.11	ref			ref		
Dually eligible	72,703	11,873	16.33	1.56***	1.53	1.60	1.08***	1.06	1.11
	South Atlantic								
Not dually eligible	1,050,435	127,990	12.18	ref			ref		
Dually eligible	281,223	51,731	18.40	1.63***	1.61	1.64	1.12***	1.11	1.14
	East South Central								
Not dually eligible	337,337	41,979	12.44	ref			ref		
Dually eligible	120,106	21,422	17.84	1.53***	1.50	1.56	1.09***	1.07	1.11
	West South Central								
Not dually eligible	510,790	61,811	12.10	ref			ref		
Dually eligible	171,023	29,613	17.32	1.52***	1.50	1.54	1.05***	1.03	1.07
	Mountain								
Not dually eligible	281,676	28,744	10.20	ref			ref		
Dually eligible	52,404	7,933	15.14	1.57***	1.53	1.61	1.09***	1.06	1.12
	Pacific								
Not dually eligible	444,153	48,210	10.85	ref			ref		
Dually eligible	198,677	33,590	16.91	1.67***	1.65	1.70	1.13***	1.11	1.15

*p<0.05
**p<0.001
***p<0.0001

[α] Adjusted for age, sex, race and ethnicity, rurality, potentially disabling condition, substance use disorder, primary diagnosis category at index hospitalization, length of index stay, index discharge location, HCC score, number of beds at index hospital, index hospital medical school affiliation, and disproportionate share hospital status

APPENDIX B: VARIABLES

Table A.1. Variables for Task 2.5 Hospital Readmissions Analysis

Item	Variable Name—Label	Values	Data Source
Outcome			
Hospital Readmission	ADMSN_DT, DSCHRG_DT, Provider Number, Claim Facility Type Code	0—Not a readmission 1—Readmission	2016 Institutional claims data—MedPAR file
Primary risk factors			
Race and ethnicity	RTI_RACE_CD	Non-Hispanic White Black (African American) Asian/Pacific Islander Hispanic American Indian/Alaska Native Other Unknown	Master Beneficiary Summary File—Base (A/B/D) 2016
Rurality	CBSA_TYPE	Rural (Non-Core-Based Statistical Area, Micropolitan) Urban (Metropolitan)	Geographic Variation File 2016
Potentially disabling condition	CERPAL_MEDICARE, CYSFIB_MEDICARE, MOBIMP_MEDICARE, MULSCL_MEDICARE, MUSDYS_MEDICARE, SPIBIF_MEDICARE, SPIINJ_MEDICARE, LEADIS_MEDICARE, INTDIS_MEDICARE, AUTISM_MEDICARE, BRAINJ_MEDICARE, OTHDEL_MEDICARE, ALZH_DEME, HEARIM_MEDICARE, VISUAL_MEDICARE	0 = Beneficiary did not meet claims criteria or have sufficient FFS coverage 1 = Beneficiary met claims criteria but did not have sufficient FFS coverage 2 = Beneficiary did not meet claims criteria but had sufficient FFS coverage 3 = Beneficiary met claims criteria and had sufficient FFS coverage Value of 1 or 3 indicates condition. If one or more condition indicated, Yes; if no condition indicated, No	Master Beneficiary Summary File—Chronic Conditions & Other Chronic or Potentially Disabling Conditions 2016
Dual-eligibility status in 2016	DUAL_ELGBL_MOS_NUM- Months of Dual-Eligibility recoded to ever dually eligible during the year	Dually eligible ever during the year—Yes Not dually eligible ever during the year—No	Master Beneficiary Summary File—Base (A/B/D) 2016
Key characteristics for stratification			
Hospital quality	OVERALL_HOSPITAL_RATING	1 (lowest)–5 (highest) stars	CMS Hospital Compare 2016

Item	Variable Name—Label	Values	Data Source
Census division of beneficiary	Recoded using STATE_CD	New England (CT, ME, MA, NH, RI, VT,) Middle Atlantic (NJ, NY, PA) East North Central (IN, IL, MI, OH, WI) West North Central (IA, KS, MN, MO, NE, ND, SD) South Atlantic (AL, AR, DE, DC, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA, WV) East South Central (AL, KY, MS, TN) West South Central (AR, LA, OK, TX) Mountain (AZ, CO, ID, NM, MT, UT, NV, WY) Pacific (AK, CA, HI, OR, WA)	Master Beneficiary Summary File—Base (A/B/D) 2016
Index hospitalization primary diagnosis	DGNS_1_CD—Claim Principal Diagnosis Code	AHRQ CCS Diagnosis categories based on ICD-10 Diagnosis Codes (Oct 2015-2016) Top five highest frequency of readmission: 1. Septicemia (except in labor) 2. Congestive heart failure, non-hypertensive 3. Chronic obstructive pulmonary disease and bronchiectasis 4. Complication of device, implant, or graft 5. Pneumonia (except that caused by TB or STD)	2016 Institutional claims data—MedPAR file
Discharge setting	DSCHRG_DSTNTN_CD—Patient discharge status code	Home/Self-care Skilled Nursing Facility (SNF) Home Health Care Inpatient Rehabilitation Facility Intermediate Care Facility (ICF) Long-Term Care Hospital (LTCH) Inpatient Psychiatric Hospital Hospice Critical Access Hospital (CAH) Other (includes federal hospital, court/law enforcement, designated disaster alternative care site, or other institution/hospital not otherwise specified)	2016 Institutional claims data—MedPAR file
Covariates			
Age	BENE_AGE_AT_END_REF_YR—Age of beneficiary at end of year	18–44 years 45–64 years 65–84 years ≥85 years	Master Beneficiary Summary File—Base (A/B/D) 2016
Sex	BENE_SEX_IDENT_CD—Sex	Male Female	Master Beneficiary Summary File—Base (A/B/D) 2016
Substance use disorder	ALCO_MEDICARE, DRUG_MEDICARE	0 = Beneficiary did not meet claims criteria or have sufficient FFS coverage 1 = Beneficiary met claims criteria but did not have sufficient FFS coverage 2 = Beneficiary did not meet claims criteria but had sufficient FFS coverage 3 = Beneficiary met claims criteria and had sufficient FFS coverage	Master Beneficiary Summary File – Other Chronic or Potentially Disabling Conditions 2016

Item	Variable Name—Label	Values	Data Source
		Value of 1 or 3 indicates condition. If one or more condition indicated, Yes; if no condition indicated, No	
Length of index stay	LOS_DAY_CNT	Numeric field derived within MEDPAR from admission and discharge dates	2016 Institutional claims data—MedPAR file
HCC risk score in month of index discharge	HCC_SCORE01–HCC_SCORE12	Score obtained from month of index hospitalization discharge	2016 Institutional claims data—MedPAR file
Disproportionate share hospital (index stay)	DSH_SHARE_PERCENTAGE	DSH share percentage by hospital	IME_GME data from CMS Cost Reports FY 2016
Number of hospital beds (index stay)	CRTFD_BED_CNT	Integer indicating certified number in 2016 <100 beds 100–199 beds ≥200 beds	2016 Provider file
Medical school affiliation (index stay)	MDCL_SCHL_AFLTN_CD	Major affiliation Limited affiliation Graduate affiliation No affiliation	2016 Provider file