CBE ID

5275

Title

Hospital-Level, Risk-Standardized 30-day All-Cause Readmission Following Hospitalization for Sepsis

Project

Cost and Efficiency

Endorsement Status

Endorsed

Is Under Review

No

Next Maintenance Cycle

Fall 2030

Previous Endorsement Cycle

Fall 2025

Initial Endorsement

Wed, 02/25/2026 - 14:11

Steward

Centers for Medicare & Medicaid Services

1.0 New or Maintenance

New

1.1 Measure Structure

Single Measure

1.3 Electronic Clinical Quality Measure (eCQM)

No

1.6 Measure Description

The Hospital-Level, Risk-Standardized 30-day All-Cause Readmission measure is a risk-adjusted measure that assesses the readmission rate within 30 days following an index hospitalization for sepsis. The target population for this measure are Medicare Fee-For-Service (FFS) and Medicare Advantage (MA) beneficiaries that are 65 years and older.

1.7 Measure Type

Outcome

1.8 Level of Analysis

Facility

1.9 Care Setting

Hospital: Inpatient

1.10 Measure Rationale

Sepsis is a life-threatening condition that affects millions of adults in the U.S. and is a main cause of hospitalization. It is also one of the leading causes of death and readmissions in U.S hospitals. The goal of this measure is to improve patient outcomes by providing patients, physicians, hospitals, and policymakers with information about hospital-level, risk-standardized all-cause unplanned readmission rates following hospitalization for sepsis, which will inform efforts to improve care pathways that impact sepsis outcomes. Measuring hospital-level rates of Sepsis Readmission is crucial due to the significant disease burden and economic impact associated with sepsis. Sepsis is costly to treat with an estimated cost of $62 billion per year. (Goodwin et al., 2018, Buchman et al., 2020) This condition leads to frequent hospitalizations and readmissions; 30-day readmission rates following a sepsis admission range from 17% to 26%, contributing to post-sepsis morbidity and mortality (Jones et al., 2015). Readmission following a sepsis hospitalization may be a result of inadequate treatment of the initial infection or complications of hospital care, or secondary to the myriads of challenges in implementation of care transitions and immediate post-discharge care among a complex patient population. (Ackermann et al., 2025, Gadre et al. 2019) Hospital quality improvement efforts that are sepsis specific, such as post-discharge interventions to ensure the completion of antimicrobial therapies, as well as broadly focused, such as care transitional coaching and post-discharge engagement with ambulatory care, are likely to contribute to improvement in measure scores. These improvements will also have an impact on overall cost of sepsis because sepsis-related readmission costs are higher relative to the cost of other readmission measures in CMS reporting and payment programs. (Mayr et al. 2017)

Readmissions among sepsis survivors are often preventable, highlighting the need for targeted interventions to reduce sepsis-related morbidity and improve post-discharge outcomes. (Prescott et al., 2017) Hospital-specific readmission rates can be influenced by care processes, and the considerable variation in readmission rates between hospitals suggests that better management strategies can improve these rates. This measure is being developed to identify institutions whose performance is better or worse than would be expected based on their patient case mix. The Sepsis Readmission measure will incentivize hospitals to enhance patient safety and clinical effectiveness across the continuum of care. Specifically, the Sepsis Readmission measure will promote adherence to evidence-based practices during the index hospitalization, including standardized clinical protocols and optimized antibiotic stewardship. It will also incentivize the development of structured care coordination processes between acute and post-acute care settings, investment in transitional care models, and implementation of targeted post-discharge interventions such as, care collaboration/coordination with primary care providers and community-based programs, home visits, telephone follow-ups, patient and family education to recognize signs and symptoms and use their ambulatory resources effectively, medication reconciliation, appropriate discharge planning, and telemonitoring, all of which have been identified as effective strategies not only for reducing hospital readmissions, but also to improve overall outcomes for the population. These care transitions are uniquely crucial to sepsis

outcomes because of the dependence on post-discharge anti-microbial medication adherence, physical rehabilitation services, medication reconciliation after the resolution of an infectious episode, and implementation of interventions to reduce the risk of future opportunistic and community acquired infections. (Taylor et al., 2017, Kowalkowski et al. 2019, CDC 2025, Prescott et al., 2018, Ceschi et al., 2021) These system-level improvements are intended to reduce preventable adverse events, lower the incidence of unplanned readmissions, improve patient engagement, ensure continuity of care, and contribute to more efficient resource utilization. (Kash et al., 2018) Measuring and reporting readmission rates enhances transparency and offers consumers meaningful insights about the quality of care received by Medicare patients. This measure has been specified to include both Medicare Fee-for-Service (FFS) and Medicare Advantage (MA) beneficiaries; including MA beneficiaries in CMS hospital outcome measures helps ensure that hospital quality is measured across all Medicare beneficiaries and not limited to the FFS population.

References

Ackermann K, Lynch I, Aryal N, Westbrook J, Li L. Hospital readmission after surviving sepsis: A systematic review of readmission reasons and meta-analysis of readmission rates. Journal of Critical Care. 2025/02/01/ 2025;85:154925. doi:https://doi.org/10.1016/j.jcrc.2024.154925

Buchman TG, Simpson SQ, Sciarretta KL, et al. Sepsis Among Medicare Beneficiaries: 3. The Methods, Models, and Forecasts of Sepsis, 2012–2018*. Critical Care Medicine. 2020;48(3):302-318. doi:10.1097/ccm.0000000000004225

Centers for Disease Control and Prevention. Life After Sepsis: What Survivors Neet to Know. 2025. https://www.cdc.gov/sepsis/media/pdfs/life-after-sepsis-fact-sheet-508…

Ceschi A, Noseda R, Pironi M, et al. Effect of Medication Reconciliation at Hospital Admission on 30-Day Returns to Hospital: A Randomized Clinical Trial. JAMA Network Open. 2021;4(9):e2124672-e2124672. doi:10.1001/jamanetworkopen.2021.24672

Gadre SK, Shah M, Mireles-Cabodevila E, Patel B, Duggal A. Epidemiology and Predictors of 30-Day Readmission in Patients With Sepsis. CHEST. 2019;155(3):483-490. doi:10.1016/j.chest.2018.12.008

Goodwin AJ, Ford DW. Readmissions Among Sepsis Survivors: Risk Factors and Prevention. Clinical Pulmonary Medicine. 2018;25(3):79-83. doi:10.1097/cpm.0000000000000254

Jones TK, Fuchs BD, Small DS, et al. Post–Acute Care Use and Hospital Readmission after Sepsis. Annals of the American Thoracic Society. 2015;12(6):904-913. doi:10.1513/AnnalsATS.201411-504OC

Kash B, Baek J, Cheon O, Coleman N, Jones S. Successful hospital readmission reduction initiatives: Top five strategies to consider implementing today. Journal of Hospital Administration. 10/21 2018;7:16. doi:10.5430/jha.v7n6p16

Kowalkowski M, Chou SH, McWilliams A, et al. Structured, proactive care coordination versus usual care for Improving Morbidity during Post-Acute Care Transitions for Sepsis (IMPACTS): a

pragmatic, randomized controlled trial. Trials. Nov 29 2019;20(1):660. doi:10.1186/s13063-019-3792-7

Mayr FB, Talisa VB, Balakumar V, Chang C-CH, Fine M, Yende S. Proportion and Cost of Unplanned 30-Day Readmissions After Sepsis Compared With Other Medical Conditions. JAMA. 2017;317(5):530-531. doi:10.1001/jama.2016.20468

Prescott HC, Angus DC. Postsepsis Morbidity. JAMA. 2018;319(1):91-91. doi:10.1001/jama.2017.19809

Prescott HC, Langa KM, Iwashyna TJ. Readmission diagnoses after hospitalization for severe sepsis and other acute medical conditions. Jama. Mar 10 2015;313(10):1055-7. doi:10.1001/jama.2015.1410

Taylor SP, Murphy S, Rios A, et al. Effect of a Multicomponent Sepsis Transition and Recovery Program on Mortality and Readmissions After Sepsis: The Improving Morbidity During Post-Acute Care Transitions for Sepsis Randomized Clinical Trial. Crit Care Med. Mar 1 2022;50(3):469-479. doi:10.1097/ccm.0000000000005300

1.13 Data Dictionary

Attached

1.13a Attach Data Dictionary

5275-1.13a-DataDictionary-Fall2025.xlsx

1.14 Numerator

The outcome for the measure is all-cause unplanned readmissions within 30 days of discharge from an eligible index hospitalization for sepsis. Planned readmissions, which are generally not a signal of quality of care, are not considered readmissions in the measure outcome.

1.14a Numerator Details

The measure includes readmissions to any acute care hospital for any cause within 30 days of the date of discharge of an eligible index hospitalization for sepsis. Only an unplanned inpatient admission to a short-term acute care hospital can qualify as a readmission. Planned readmissions, which are generally not a signal of quality of care, are not considered in the measure outcome, as defined below.

All unplanned readmissions are considered as outcomes, regardless of cause. There are a number of reasons for including unplanned readmissions for all causes in the Sepsis Readmission measure. First, from a patient's perspective, an unplanned readmission for any cause is an adverse event. In addition, making inferences about quality of care based solely on the documented cause of readmission is difficult. For example, a patient with sepsis may ultimately be readmitted for heart failure. (Jentzer et al., 2023) In this context, considering the readmission to be unrelated to the care that the patient received during the index admission would be inappropriate. Sepsis hospitalizations may cause clinical deterioration because of muscle atrophy, deterioration of organ function, malnutrition, exposure to infectious organisms, episodes of

delirium and complications of routine and therapeutic procedures. Studies have shown that most 30-day readmissions are caused by events during and circumstances around the index hospitalization, the most prominent of which is poor transitional care from hospital to post-discharge setting. (Gadre et al., 2019, Goodwin et al., 2018, CMS 2025, National Coalition for Hospice and Palliative Care 2012, Psotka et al., 2020)

The measure uses a 30-day time frame because most patients are more vulnerable to adverse health outcomes in the immediate post-discharge period. Readmission occurring within 30 days of discharge can be influenced by hospital care and the inappropriate transition to the non-acute care setting. The 30-day time frame is a clinically meaningful period for hospitals to collaborate with their communities in an effort to reduce readmissions using strategies like: ensuring patients are clinically ready at discharge; reducing risk of infection through education and home care services; reconciling medications; improving communication among providers in transitions of care; and encouraging mechanisms that promote disease self-management principles like educating patients on what symptoms to monitor, whom to contact with questions, and where and when to seek follow-up care. Monitoring for readmissions during periods shorter than 30 days following discharge may be inadequate to capture all relevant outcomes and may provide insufficient power to capture meaningful hospital performance variation. By including the full 30-day window, this measure captures a more complete picture of post-discharge risk and hospital quality, particularly for sepsis survivors who remain vulnerable beyond the initial week or two post-discharge. In addition, using a 30-day timeframe encourages hospitals to focus not just on short-term discharge planning, but also on ensuring longer-term outpatient follow-up and care coordination. Extending the assessment period beyond 30 days may capture events more heavily impacted by factors outside of hospital's control, including ambulatory quality of care. Furthermore, this outcome period is consistent with other CMS publicly reported readmission measures.

Planned Readmission Algorithm (Version 4.0)

The planned readmission algorithm (see Ad.2. Planned Readmission Algorithm Version 4.0 2023 Flowchart) is a set of criteria for classifying readmissions as planned using Medicare claims and encounters. The algorithm identifies admissions that are typically planned and may occur within 30 days of discharge from the hospital.

The planned readmission algorithm has three fundamental principles:

1. A few specific, limited types of care are always considered planned (transplant surgery, maintenance chemotherapy/ immunotherapy, rehabilitation);
2. Otherwise, a planned readmission is defined as a non-acute readmission for a scheduled procedure; and,
3. Admissions for acute illness or complications of care are never planned.

The algorithm was developed in 2011 as part of the Hospital-Wide Readmission measure. In 2013, CMS applied the algorithm to its other readmission measures. In applying the algorithm to condition- and procedure-specific measures, teams of clinical experts reviewed the algorithm in the context of each measure-specific patient cohort and, where clinically indicated, adapted the content of the algorithm to better reflect the likely clinical experience of each measure's patient cohort. The planned readmission algorithm is applied to the Sepsis Readmission measure without

modifications.

Please see Sepsis Readmission Risk Variable Complications of Care Tab 5 in the Excel file **Sepsis_Readmission_Data Dictonary**.xlsx. for the list of potential complications referred to in Step 3 of the planned readmission algorithm.

References

Burton R. Improving Care Transitions. *Health Affairs*. 2012;Health Policy Brief. doi:https://doi.org/10.1377/hpb20120913.327236

Centers for Medicare & Medicaid Services. Guide for Reducing Disparities in Readmissions. 2025. https://www.cms.gov/about-cms/agency-information/omh/downloads/omh_read...

Gadre SK, Shah M, Mireles-Cabodevila E, Patel B, Duggal A. Epidemiology and Predictors of 30-Day Readmission in Patients With Sepsis. CHEST. 2019;155(3):483-490. doi:10.1016/j.chest.2018.12.008

Goodwin AJ, Ford DW. Readmissions Among Sepsis Survivors: Risk Factors and Prevention. Clinical Pulmonary Medicine. 2018;25(3):79-83. doi:10.1097/cpm.0000000000000254

Jentzer JC, Lawler PR, Van Houten HK, Yao X, Kashani KB, Dunlay SM. Cardiovascular Events Among Survivors of Sepsis Hospitalization: A Retrospective Cohort Analysis. Journal of the American Heart Association. 2023;12(3):e027813. doi:doi:10.1161/JAHA.122.027813

National Consensus Project for Quality Palliative Care. Clinical Practice Guidelines for Quality Palliative Care, 4th edition. Richmond, VA: National Coalition for Hospice and Palliative Care; 2018. https://www. nationalcoalitionhpc.org/ncp

Psotka MA, Fonarow GC, Allen LA, et al. The Hospital Readmissions Reduction Program: Nationwide Perspectives and Recommendations: A JACC: Heart Failure Position Paper. JACC: Heart Failure. 2020/01/01/ 2020;8(1):1-11. doi:https://doi.org/10.1016/j.jchf.2019.07.012

1.15 Denominator

The target population for this measure is Medicare FFS beneficiaries or MA patients aged 65 years and older hospitalized at non-federal short-term acute care hospitals. The cohort includes admissions for patients discharged from the hospital with an index hospitalization for sepsis and with a continuous 12-month Medicare enrollment period prior to admission.

1.15a Denominator Details

This measure includes index admissions for patients who meet all the following criteria:

- Principal hospital discharge diagnosis of sepsis, including post-procedural sepsis (see tab “Sepsis Readmission Cohort Inclusions” of the attached data dictionary for ICD-10 codes that define the cohort);
- Enrolled in Medicare FFS or MA during the index admission and for the 12 months prior to the date of admission;

- Aged 65 or older;
- Discharged alive from a non-federal short-term acute care hospital;
- Not transferred to another acute care facility.

1.15b Denominator Exclusions

This measure excludes index admissions for patients who meet any of the following exclusion criteria:

- Admissions during which patients leave hospital against medical advice (AMA);
- Admissions for patients without at least 30 days post-discharge enrollment in Medicare FFS or MA;
- Admissions resulting in patients discharged to hospice;
- Sepsis admissions captured in the pneumonia readmission measure;
- Sepsis admissions within 30 days of an eligible sepsis index admission (because they are considered readmissions, not index admissions); and
- With a secondary diagnosis code of COVID-19 coded as present on admission (POA) on the index admission claim.
- Note: As the years of data used for measure development include data CMS has determined were impacted by the COVID-19 pandemic, any hospitalizations with a principal diagnosis code of COVID-19 or with a secondary diagnosis code of COVID-19 coded as POA on the index admission claims were not included in the measure cohort. However, this exclusion will be removed prior to the measure's program implementation since the data will no longer include the COVID-19 public health emergency period.

1.15c Denominator Exclusions Details

- **Patients who leave hospital against medical advice (AMA)**[*]
  - *Rationale:* We exclude hospital stays for patients who are discharged AMA because providers did not have the opportunity to deliver full care and prepare the patient for discharge.
- **Patients without at least 30 days post-discharge enrollment in Medicare FFS or MA**[*]
  - *Rationale:* We exclude these hospital stays because the 30-day readmission outcome cannot be assessed in this group.
- **Patients discharged to hospice**
  - *Rationale:* We exclude hospital stays for patients discharged to hospice because readmission may not be a meaningful outcome for these patients; the primary focus of hospice care is comfort, quality of life, and symptom management (which may require readmission) rather than curative treatment or aggressive medical interventions.
- **Sepsis patients captured in the Hospital 30-day All-Cause Risk-Standardized Readmission Rate (RSRR) following Pneumonia Hospitalization measure (CBE# 0506)**
  - *Rationale:* Patients with a principal discharge diagnosis of sepsis AND a secondary diagnosis of pneumonia that is present on admission (POA), but NO secondary diagnosis of severe sepsis are excluded to avoid overlap with the pneumonia readmission measure because these patients are already captured in that measure

cohort and to avoid double counting the same event under different measures.

- **Additional sepsis admissions within 30 days**
  - *Rationale:* If a patient has one or more additional sepsis admissions within 30 days of discharge from an index sepsis admission, the additional sepsis admissions are not considered as index admissions (they are considered as potential readmissions). Thus, any sepsis admission is either an index admission or a readmission, but not both, to avoid double counting.

Note: During measure development, patients with a secondary diagnosis of COVID-19 coded as present on admission (POA) were excluded from the cohort, as the development dataset, Medicare FFS and MA data from 2022 and 2023, included periods that CMS identified as impacted by the COVID-19 pandemic.

*Denominator exclusions are similar to the exclusions of existing CMS readmission measures to ensure alignment and harmonization

1.15d Age Group

Older Adults (65 years and older)

1.16 Type of Score

Rate/proportion

1.17 Measure Score Interpretation

Better performance = Lower score

1.18 Calculation of Measure Score

The denominator population for this measure is Medicare FFS or MA beneficiaries aged 65 years and older hospitalized at non-federal short-term acute care hospitals who are discharged alive following a sepsis admission and with a continuous 12-month Medicare enrollment period prior to the index hospitalization.

The measure denominator excludes patients who are < 65 years old; discharged against medical advice (AMA); without at least 30 days post-discharge enrollment in Medicare FFS or MA; discharged to hospice; sepsis patients with admissions captured in the pneumonia readmission measure; sepsis admissions within 30 days of the initial sepsis hospitalization (which are counted as readmissions); and sepsis admissions with a secondary diagnosis code of COVID-19 coded as present on admission on the index admission claim.

The measure numerator includes unplanned readmissions within 30 days of discharge from an eligible index sepsis hospitalization.

To account for differences in case mix across hospitals, the measure includes adjustments for patient factors such as age, comorbid diseases, and indicators of patient frailty, which are clinically relevant and have relationships with the outcome. This measure also adjusts for the pathogenicity of the organism causing sepsis, transplant recipient indicator, and clinical markers of severe sepsis. For each patient, risk-adjustment variables are obtained from inpatient,

outpatient, and physician Medicare administrative claims data extending up to 12 months prior to the index hospitalization, and secondary diagnoses (POA) data for the index hospitalization itself. Complications that arise during the course of the index hospitalization are not used in risk adjustment.

The measure is used to calculate hospital-level 30-day all-cause risk-standardized readmission rates (RSRRs), which are estimated using a hierarchical logistic regression model. In brief, the approach simultaneously models data at the patient and hospital levels to account for the variance in patient outcomes within and between hospitals. At the patient level, it models the log-odds of hospital readmission within 30 days of discharge using age, selected clinical covariates, and a hospital-specific effect. At the hospital level, the approach models the hospital-specific effect as arising from a normal distribution. The hospital effect represents the underlying risk of a readmission at the hospital, after accounting for patient risk. The hospital-specific effects are given a distribution to account for the clustering (non-independence) of patients within the same hospital. If there were no differences between hospitals, then after adjusting for patient risk, the hospital effects should be identical across all hospitals.

The RSRR is calculated as the ratio of the number of “predicted” readmissions to the number of “expected” readmissions at a given hospital multiplied by the national observed readmission rate, as illustrated in the attached Sepsis Readmission Measure Score Calculation Diagram.

For each hospital, the numerator of the ratio is the number of readmissions within 30 days predicted based on the hospital’s performance with its observed case mix; the denominator is the number of readmissions expected based on average national level of performance with that hospital’s case mix. This approach is analogous to a ratio of “observed” to “expected” used in other types of statistical analyses. It conceptually allows a particular hospital’s performance, given its case mix, to be compared to an average hospital’s performance with the same case mix. Thus, a lower ratio indicates lower-than-expected readmission rates or better quality, while a higher ratio indicates higher-than-expected readmission rates or worse quality. We then calculate hospital-specific risk-standardized readmission rates (RSRRs). These rates are obtained as the ratio of predicted to expected readmissions, multiplied by the national unadjusted rate.

The “predicted” number of readmissions (the numerator) is calculated by using the coefficients estimated by regressing the risk factors and the hospital-specific effect on the risk of readmission. The estimated hospital-specific effect is added to the sum of the estimated regression coefficients multiplied by the patient characteristics. The results are transformed using the inverse-link-function and summed over all patients attributed to a hospital to calculate a predicted value. The “expected” number of readmissions (the denominator) is obtained in the same manner, except that a common effect using all hospitals in our sample is added in place of the hospital-specific effect. These results are also transformed using the inverse-link-function and summed over all patients attributed to a hospital to calculate an expected value. To assess hospital performance for each reporting period, we re-estimate the model coefficients using the years of data in that time period.

1.18a Attach measure score calculation diagram

5275-1.18a-MeasureCalculation-Fall2025.pdf

1.19 Measure Stratification Details

This is a new measure, and it is not currently stratified.

1.20 Types of Data Sources

Administrative Data, Claims Data

1.21a Data Collection Tool URL(s)

http://example.com

1.25 Data Source Details

Medicare Fee-for-Service (FFS) claims and Medicare Advantage (MA) encounters, in addition to Medicare administrative data, are used to derive all components of the measure.

1.26 Minimum Sample Size

The measure does not have a minimum sample size.

2.1 Attach Logic Model

5275-2.1-LogicModel-Fall2025.pdf

2.2 Evidence of Measure Importance

Sepsis is a life-threatening condition characterized by a dysregulated inflammatory response to infection or injury. (Chiu & Legrand, 2021) According to the CDC, at least 1.7 million adults in the U.S. develop sepsis, and at least 350,000 patients die as a result each year. Advances in care, and increased recognition and early treatment of sepsis, have led to improved in-hospital mortality rates. However, the incidence of sepsis continues to rise, likely due to an aging population with more comorbidities, and with increasing use of device technology and invasive procedures which may introduce infections. (Rhee & Klompas, 2020, Esper & Martin, 2009) Consequently, the decline in short-term mortality along with the increasing incidence of sepsis have resulted in a growing number of sepsis survivors. The growing number of sepsis survivors indicates that more patients may be at risk of 30-day readmission. (Singer et al., 2016)

Research indicates that 30-day readmission rates following sepsis hospitalization range from 17% to 26%, contributing to substantial excess costs. (Jones et al., 2015) Readmissions also adversely affect patient morbidity and mortality and impose a significant financial burden on patients and the healthcare system. Preventable readmissions can pose risks of iatrogenic infections, medication errors, muscle weakening, and pressure injuries such as decubitus ulcers. For sepsis survivors, unnecessary readmissions can increase the risk of re-infection, intensive care unit admissions and mortality, as well as long-term complications including cognitive impairment, functional disability, psychiatric problems, and increased healthcare utilization, which all lead to poor quality of life. (Goodwin & Ford, 2018) Sepsis and infection are the most common causes for hospital readmission after the index sepsis hospitalization. (Ackermann et al., 2025, Prescott et

al., 2015, Sun et al., 2016) Sepsis is also a main reason why patients are readmitted to the hospital following other conditions or procedures and has been reported to be associated with higher costs compared to other conditions selected for CMS reporting. (Weiss & Jiang, 2021) The estimated annual cost of index hospitalizations for sepsis in the United States has been reported to exceed $23.3 billion. The average cost per 30-day readmission was calculated at $16,852, contributing to an estimated annual burden of over $3.5 billion, and 30-day readmissions following an index sepsis hospitalization account for approximately 13% of total sepsis-related hospitalization costs nationwide. (Gadre et al., 2019)

Given that there are currently no existing Sepsis Readmission measures, there is a clear gap in tracking, capturing, and reporting on hospital sepsis readmissions. By focusing on readmissions, the Sepsis Readmission measure will encourage hospitals to prioritize implementation of timely guideline-based sepsis therapy, patient safety during all aspects of care, and appropriate discharge planning. Specifically, the Sepsis Readmission measure will lead to improvements in the treatment of sepsis during index hospitalization including implementation of standard of care protocol and antibiotic stewardship, while implementing care coordination between hospital and discharge site, investing in transitional care programs, and development of post discharge interventions to reduce preventable sepsis-related complications, unplanned readmissions, and cost.

References

Ackermann K, Lynch I, Aryal N, Westbrook J, Li L. Hospital readmission after surviving sepsis: A systematic review of readmission reasons and meta-analysis of readmission rates. Journal of Critical Care. 2025/02/01/ 2025;85:154925. doi:https://doi.org/10.1016/j.jcrc.2024.154925

Chiu C, Legrand M. Epidemiology of sepsis and septic shock. Current Opinion in Anesthesiology. 2021;34(2):71-76. doi:10.1097/aco.0000000000000958

Esper AM, Martin GS. Extending international sepsis epidemiology: the impact of organ dysfunction. Crit Care. 2009;13(1):120. doi:10.1186/cc7704

Gadre SK, Shah M, Mireles-Cabodevila E, Patel B, Duggal A. Epidemiology and Predictors of 30-Day Readmission in Patients With Sepsis. CHEST. 2019;155(3):483-490. doi:10.1016/j.chest.2018.12.008

Goodwin AJ, Ford DW. Readmissions Among Sepsis Survivors: Risk Factors and Prevention. Clin Pulm Med. May 2018;25(3):79-83. doi:10.1097/cpm.0000000000000254

Jones TK, Fuchs BD, Small DS, et al. Post–Acute Care Use and Hospital Readmission after Sepsis. Annals of the American Thoracic Society. 2015;12(6):904-913. doi:10.1513/AnnalsATS.201411-504OC

Prescott HC, Langa KM, Iwashyna TJ. Readmission diagnoses after hospitalization for severe sepsis and other acute medical conditions. Jama. Mar 10 2015;313(10):1055-7

Rhee C, Klompas M. Sepsis trends: increasing incidence and decreasing mortality, or changing denominator? J Thorac Dis. Feb 2020;12(Suppl 1):S89-s100. doi:10.21037/jtd.2019.12.51

Singer M, Deutschman CS, Seymour CW, et al. The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). JAMA. 2016;315(8):801-810. doi:10.1001/jama.2016.0287

Sun A, Netzer G, Small DS, et al. Association Between Index Hospitalization and Hospital Readmission in Sepsis Survivors*. Critical Care Medicine. 2016;44(3):478-487. doi:10.1097/ccm.0000000000001464

Weiss A, Jiang J. Overview of clinical conditions with frequent and costly hospital readmissions by payer, 2018 #278. hcup-us.ahrq.gov. Published 2021. https://hcup-us.ahrq.gov/reports/statbriefs/sb278-Conditions-Frequent-R...;

2.3 Anticipated Impact

Thirty-day readmission rates represent an important health care quality indicator as they are partly driven by substandard quality hospital care, poor discharge planning, and ineffective coordination of post-discharge services. Preventable hospital readmissions are associated with poor outcomes, including, in the case of sepsis, exposure of communities to resistant organisms which increases the specter of higher incidence of sepsis cases that are more difficult to treat, (Martínez et al., 2020, Furuya & Lowy, 2006) and contributes to high costs. To address this problem, CMS has implemented readmission measures for specific conditions and procedures in the Inpatient Quality Reporting (IQR) program and Hospital Readmission Reduction Program (HRRP).

Early studies on the impact of the HRRP have indicated an association with a reduction in hospital readmissions. Readmission rate among Medicare beneficiaries remained relatively stable between 19.0% and 19.5% from 2007 to 2011. However, this rate decreased to 18.5% in 2012 and further to 17.5% in 2013 after the HRRP was implemented. The decrease in readmission rate was estimated to result in 150,000 fewer hospital readmissions between January 2012 and December 2013. (McIlvennan et al., 2015) Other studies also reported positive findings, (Zuckerman et al., 2016, Desai et al., 2016, Wasfy et al., 2017) indicating that the HRRP reduced 30-day readmission rates by up to 1% each year and estimated that these reductions in readmissions saved Medicare $620 million annually. (Gupta, 2017) Even among non-Medicare populations, readmission rates for patients in Medicaid and private insurance has decreased as a result of the implementation of the readmission measures in these programs. (Ferro et al., 2019)

Although hospital-level readmissions are not expected to be zero, variations in risk-standardized rates of readmissions are indicators that there are opportunities for improvements in patient care and transitions of care. The risk of readmission is highly influenced by the quality of care provided during hospitalization and the transition to outpatient care. Both hospitals and clinicians share responsibility for improving these rates. Tracking readmissions can drive investment in quality improvement, more accurate assessments of discharge readiness, and smoother patient transitions to outpatient settings. Research studies indicate that comprehensive, multi-modal interventions provided during, and post-discharge including but not limited to medication reconciliation, systematic symptom monitoring, timely post-acute care visits by registered nurses, and early outpatient follow-up with healthcare providers may be more effective at preventing readmission than targeting individual components of the discharge process. (O'Connor et al., 2022, Tyler et al., 2023, Naylor et al., 1994) These initiatives ultimately aim to reduce preventable

readmissions, enhance patient outcomes, and optimize resource utilization across healthcare systems, all of which will decrease future costs and improve morbidity and mortality. Additional benefits include the lowering of cases of infections related to resistant organisms in the community.

References

Desai NR, Ross JS, Kwon JY, et al. Association Between Hospital Penalty Status Under the Hospital Readmission Reduction Program and Readmission Rates for Target and Nontarget Conditions. Jama. Dec 27 2016;316(24):2647-2656. doi:10.1001/jama.2016.18533

Ferro EG, Secemsky EA, Wadhera RK, et al. Patient Readmission Rates For All Insurance Types After Implementation Of The Hospital Readmissions Reduction Program. Health Affairs. 2019;38(4):585-593. doi:10.1377/hlthaff.2018.05412

Furuya EY, Lowy FD. Antimicrobial-resistant bacteria in the community setting. Nature Reviews Microbiology. 2006/01/01 2006;4(1):36-45. doi:10.1038/nrmicro1325

Gupta, Atul, Impacts of Performance Pay for Hospitals: The Readmissions Reduction Program (October 16, 2017). Becker Friedman Institute for Research in Economics Working Paper No. 2017-07, Available at SSRN: https://ssrn.com/abstract=3054172 or http://dx.doi.org/10.2139/ssrn.3054172

Martínez ML, Plata-Menchaca EP, Ruiz-Rodríguez JC, Ferrer R. An approach to antibiotic treatment in patients with sepsis. J Thorac Dis. Mar 2020;12(3):1007-1021. doi:10.21037/jtd.2020.01.47

McIlvennan CK, Eapen ZJ, Allen LA. Hospital readmissions reduction program. Circulation. May 19 2015;131(20):1796-803. doi:10.1161/circulationaha.114.010270

Naylor M, Brooten D, Jones R, Lavizzo-Mourey R, Mezey M, Pauly M. Comprehensive discharge planning for the hospitalized elderly. A randomized clinical trial. *Ann Intern Med*. 1994;120(12):999-1006. doi:10.7326/0003-4819-120-12-199406150-00005

O'Connor M, Kennedy EE, Hirschman KB, et al. Improving transitions and outcomes of sepsis survivors (I-TRANSFER): a type 1 hybrid protocol. BMC Palliative Care. 2022/06/02 2022;21(1):98. doi:10.1186/s12904-022-00973-w

Tyler N, Hodkinson A, Planner C, et al. Transitional Care Interventions From Hospital to Community to Reduce Health Care Use and Improve Patient Outcomes: A Systematic Review and Network Meta-Analysis. JAMA Network Open. 2023;6(11):e2344825-e2344825. doi:10.1001/jamanetworkopen.2023.44825

Wasfy JH, Zigler CM, Choirat C, Wang Y, Dominici F, Yeh RW. Readmission Rates After Passage of the Hospital Readmissions Reduction Program: A Pre-Post Analysis. Ann Intern Med. Mar 7 2017;166(5):324-331. doi:10.7326/m16-0185

Zuckerman RB, Sheingold SH, Orav EJ, Ruhter J, Epstein AM. Readmissions, Observation, and the Hospital Readmissions Reduction Program. N Engl J Med. Apr 21 2016;374(16):1543-51.

doi:10.1056/NEJMsa1513024

2.4 Performance Gap

Table 1 and Figure 1 (see the Figures and Tables Supplemental Attachment) show the distribution of measure scores in the risk-standardized readmission visit rate, or RSRR, for hospitals with greater than or equal to 25 admissions (minimum threshold for public reporting) using the most recent data from January 1, 2022-December 31, 2023. The data includes both FFS and MA beneficiaries. RSRRs range from 12.9% to 24.9%; the median is 18%; the 25th percentile is 17.3%, and the 75th percentile is 18.8%.

Table 1. Performance Scores by Decile

Performance Gap

	Overall	Minimum	Decile_1	Decile_2	Decile_3	Decile_4	Decile_5	Decile_6	Decile_7	Decile_8	Decile_9	Decile_10	Maximum
Mean Performance Score	18.06	12.97	16.13	17.1	17.51	17.77	17.93	18.04	18.24	18.53	19.05	20.31	24.94
N of Entities	4287	1	428	429	429	429	428	429	429	429	429	428	1
N of Persons / Encounters / Episodes	1326427	1453	226805	157962	118013	76898	47786	53248	74939	127905	191850	251021	372

2.4a Attach Performance Gap Results

5275-FiguresAndTables-Fall2025.pdf

2.5 Health Care Quality Landscape

There are currently no other measures that focus on 30-day risk-standardized readmissions after hospitalization for sepsis.

2.6 Meaningfulness to Target Population

Hospital readmission, for any reason, is disruptive and harmful to patients and caregivers, costly to the healthcare system and policyholders, and puts patients and their communities at additional risk of hospital-acquired infections and complications. Readmissions are also a major source of patient and family stress and may contribute substantially to loss of functional ability and independence, particularly in older patients. We interviewed patients and caregivers for a Technical Expert Panel (TEP) related to the Sepsis Readmission measure; patients and caregivers shared their stories of frustration, confusion, and suffering, as they or their loved ones faced unexpected returns to the hospital after discharge. In our interviews, they cited experiences such as returning to the hospital following exacerbation of a condition caused by changes in medication after discharge, returns to the hospital due to unresolved or de novo infections, and other signs of poor coordination of care including insufficient communication from providers and hospital staff. These experiences take a toll—emotionally, physically, and financially—on both patients and caregivers.

In addition, a recent study comparing patients' perspectives on the causes and preventability of, and underlying reasons for, a readmission with those of registered nurses (RNs) and physicians

showed that patients were more likely than physicians to identify a readmission as preventable, and to identify system issues as an underlying reason for their readmission (58% of cases vs 2%, patients vs physicians, respectively). (Smeraglio et al., 2019) Furthermore, RNs and patients had similar assessments as to the preventability of their readmission. In another study that assessed patient and provider perspectives on 30-day readmissions, patients noted the important impact of the 30-day readmission measure on care provision, including improved patient education at discharge, review of medications, and the assessment of home resources. (Pugh et al., 2021)

Input regarding measure meaningfulness and whether the measure produces information that is valuable in making care decisions was collected from patients and caregivers during TEP meetings. Of the four TEP members representing the patient and caregiver perspective, three responded to the measure importance question. All three respondents (100%) strongly agreed that the measure, as specified, is meaningful and generates information that is valuable for informing care decisions. This unanimous strong agreement underscores the perceived relevance and utility of the measure from the patient and caregiver standpoint. In addition, qualitative feedback was positive, with these TEP members actively engaging in discussions and contributing constructive input throughout the TEP process.

As previously noted, there are currently no other measures that focus on 30-day risk-standardized readmissions after hospitalization for sepsis, therefore, this measure addresses an important quality measurement area and enhances the information available to patients choosing among hospitals and transparency to the public.

References

Pugh J, Penney LS, Noël PH, et al. Evidence based processes to prevent readmissions: more is better, a ten-site observational study. BMC Health Services Research. 2021/03/01 2021;21(1):189. doi:10.1186/s12913-021-06193-x

Smeraglio A, Heidenreich PA, Krishnan G, Hopkins J, Chen J, Shieh L. Patient vs provider perspectives of 30-day hospital readmissions. BMJ Open Qual. 2019;8(1):e000264. doi:10.1136/bmjoq-2017-000264

3.1 Contributions Towards Closing Care Gaps

This section is optional for developers.

4.1a Data Structure and Availability

This is a claims-based measure; the measure score is calculated automatically from claims data, which are routinely generated during the delivery of care. No data are collected by facilities; therefore, this measure imposes no burden on measured entities and no implementation effort. CMS will monitor feedback from the public and measured entities through CMS's Q&A portal on *QualityNet*. There are also no concerns about patient confidentiality because the measure is based on claims data submitted by facilities to CMS, and CMS then uses that data for calculation of the measure score. We did not perform an analysis of missing data for the measure because it is based

on a 100% sample of paid, final action claims submitted by facilities for payment. To ensure complete claims, we allow at least 3 months to pass after the end of the performance period before accessing the data.

4.1b Implementation Costs and Burden

This is a claims-based measure; the measure score is calculated automatically from claims data, which are routinely generated during the delivery of care. No data are collected by facilities; therefore, this measure imposes no burden on measured entities and no implementation efforts are needed.

4.1c Confidentiality

There are also no concerns about patient confidentiality because the measure is based on claims data confidentially submitted by facilities to CMS as part of routine care and processed with similarly stringent security measures as CMS uses for its financial data.

4.3 Feasibility Informed Final Measure

As this is a claims-based measure, there are no feasibility concerns and no burden on the facility; the measure is calculated by CMS using claims data submitted by facilities for payment.

There are no missing data concerns for the measure because it uses final action claims submitted by facilities for payment. To ensure complete claims, we allow at least 3 months of time between accessing the data and the end of the performance period.

4.4 Proprietary Information

Not a proprietary measure and no proprietary components

5.1.1 Data Used for Testing

Medicare Fee-for-Service (FFS) and Medicare Advantage (MA) claims and encounter data are used to derive all components of the measure for development and testing. We used a two-year dataset including all index hospitalizations with discharge dates from January 1, 2022, to December 31, 2023. We used Medicare enrollment and inpatient claims data to identify the cohort; pre-index diagnosis codes from 12 months prior to and including claims on admission to the index hospitalization. Codes from inpatient, outpatient, and professional claims are used for risk adjustment; and inpatient claims data during 30 days post discharge from the index hospitalization are used to identify the outcome.

5.1.1a Dates of Testing Data

January 1, 2022, to December 31, 2023

5.1.2 Differences in Data

None.

5.1.3 Characteristics of Measured Entities

See response in section 5.1.4 for characteristics of measured entities.

5.1.4 Characteristics of Units of the Eligible Population

We used data from January 1, 2022 – December 31, 2023, which included 4,287 hospitals participating in the Inpatient Quality Reporting (IQR) comprised of subsection D hospitals and critical access hospitals (CAH). Across these measured entities, 1,326,427 discharges were included in the testing and analysis. Of these, 49% are from MA data, and 23% are dually eligible for Medicare and Medicaid.

The administrative dataset was randomly divided into two subsets: a "development" sample and a "validation" sample. The development sample was employed to construct and refine the risk model, while the validation sample was subsequently used to assess the model's performance. The development sample consisted of 664,328 discharges from 4,278 hospitals. Patients in the development sample were majority female [348,573] (52.47%) and had an average age of 77.35 years. The validation sample consisted of 662,099 discharges from 4,278 hospitals. Patients in the validation sample were majority female [347,668] (52.51%) and had an average age of 77.35 years.

5.2.1 Level(s) of Reliability Testing Conducted

Person or encounter level (i.e., data element) (e.g., inter–abstractor reliability), Accountable entity level (i.e., measure score) (e.g., signal-to-noise analysis)

5.2.2 Method(s) of Reliability Testing

Measure Score Reliability

Split-half reliability, also called split-sample reliability (SSR), is a method used to assess the internal consistency of a measurement. This method involves dividing the data into two random halves, scoring each half separately, and comparing the results. Specifically, for the testing of the Sepsis Readmission measure, using two years of data (January 1, 2022 – December 31, 2023), we randomly sampled half of the patients within each hospital, calculated the measure score for each hospital, and repeated the calculation using the second half of patients. Thus, each hospital is measured twice, but each measurement is made using an entirely distinct set of patients. We repeated this process, randomly sampling the data 100 times without replacement, and, as a metric of agreement, we calculated the average intra-class correlation coefficient across all 100 samples. (Nieser & Harris, 2024, Shrout & Fleiss, 1979) The agreement of the two measure scores was quantified for hospitals in each sample using the intra-class correlation as defined by ICC (2,1), (Shrout & Fleiss 1979) and a correction using the Spearman-Brown prophecy formula was

performed.

Next, we employ a two-step method that estimates hospital-level reliability using a split-sample reliability coefficient and median hospital volume. This approach begins by calculating split-sample reliability as described above. Then, using Spearman-Brown prophecy, we calculate the ICC, correlation of two observations from the same group, by assuming the split-sample reliability is the for a hospital with a median hospital volume. Using this ICC and hospital volume, we calculate the reliability for each hospital.

The Partnership for Quality Measurement at Battelle has set the reliability consensus threshold of ≥ 0.6 for at least 70% of accountable entities (hospitals).

Reliability of Claims-Based Variables

We provide literature and evidence of auditing processes that support the reliability of claims-based data elements.

References

Nieser KJ, Harris AHS. Split-sample reliability estimation in health care quality measurement: Once is not enough. Health Serv Res. Aug 2024;59(4):e14310. doi:10.1111/1475-6773.14310

Shrout PE, Fleiss JL. Intraclass correlations: uses in assessing rater reliability. Psychol Bull. Mar 1979;86(2):420-8. doi:10.1037//0033-2909.86.2.420

5.2.3 Reliability Testing Results

Measure Score Reliability

Table 3 (see the Figures and Tables Supplemental Attachment) shows the split-half reliability results at the measure score level for hospitals with a minimum case of ≥ 2 cases and ≥ 25 cases (the proposed threshold for public reporting). Split-half reliability (at the measure score level) was 0.6 for hospitals with at least two admissions, and 0.6 for hospitals with at least 25 admissions.

Table 4 (see the Figures and Tables Supplemental Attachment) and the embedded Table 2 below, shows the accountable entity-level reliability results for hospitals with at least 25 cases (the proposed threshold for public reporting). 69% of accountable entities met the split-half reliability threshold of ≥ 0.60.

Reliability of Claims-Based Variables

CMS claims data, used for payment, are routinely used for quality measurement and are considered reliable. CMS has in place several hospital auditing programs used to assess overall claims code accuracy, to ensure appropriate billing, and for overpayment recoupment (CMS, FFS; CMS, Part C). CMS routinely conducts data analysis to identify potential problem areas and detect fraud, and audits important data fields used in our measures, including diagnosis and procedure codes and other elements that are consequential to payment.

Reliability is also supported by the evidence for validity, described in Section 5.3. In addition to the validity testing provided for the Sepsis Readmission measure, CORE has (for a number of other measures) demonstrated the validity of claims-based measures for profiling hospitals by comparing either the measure results or individual data elements against medical records. CMS validated six CBE-endorsed measures currently in public reporting (AMI, heart failure, and pneumonia mortality and readmission) with models that used chart-abstracted data for risk adjustment. Please see Section 5.3 for additional details.

References

Center for Medicare and Medicaid Services, FFS audits:
https://www.cms.gov/data-research/monitoring-programs/medicare-fee-serv...

Center for Medicare and Medicaid Services, Part C audits:
https://www.cms.gov/medicare/audits-compliance/part-c-d/program-audits

5.2.3a Attach Additional Reliability Testing Results

5275-FiguresAndTables-Fall2025_0.pdf

5.2.4 Interpretation of Reliability Results

Using two years of data from January 1, 2022, through December 31, 2023, the Sepsis Readmission measure demonstrated acceptable reliability based on the split-half method, both at the measure score level, and at the entity level. This indicates that the measure is sufficiently reliable for distinguishing between high- and low-performing hospitals, consistent with the minimum standard for reliability set forth by the Partnership for Quality Measurement at Battelle.

Table 2. Accountable Entity Level Reliability Testing Results by Denominator, Target Population Size

Accountable Entity-Level Reliability Testing Results

	Overall	Minimum	Decile_1	Decile_2	Decile_3	Decile_4	Decile_5	Decile_6	Decile_7	Decile_8	Decile_9	Decile_10	Maximum
Reliability	0.682	0.205	0.254	0.384	0.521	0.642	0.727	0.782	0.826	0.862	0.894	0.932	0.986
Mean Performance Score	18.085	18.107	17.944	17.984	17.939	18.037	18.064	18.155	18.074	18.177	18.264	18.21	20.756
N of Entities	3,053	21	312	296	309	305	306	302	308	305	306	304	1
N of Persons / Encounters / Episodes	1,315,690	525	10,421	18,064	33,027	53,529	79,658	105,855	142,821	186,672	253,832	431,811	6,769

5.3.1 Level(s) of Validity Testing Conducted

Person or encounter level (i.e., data element) (e.g., sensitivity and specificity), Accountable entity level (i.e., measure score) (e.g., criterion validity)

5.3.2 Type of Accountable Entity Level Validity Testing Conducted

Empirical validity testing at the accountable entity-level (e.g., criterion validity, construct validity, known groups analysis), Systematic assessment of face validity of the measure’s performance score as an indicator of quality or resource use

5.3.3 Method(s) of Validity Testing

The validity of the Sepsis Readmission measure is supported by three types of evidence (1) face validity, (2) construct validity, and (3) validity of the outcome.

Face Validity

We convened a Technical Expert Panel (TEP) composed of 14 subject matter experts in infectious diseases and other clinical specialties, methodologists, and measurement experts, alongside sepsis survivors, caregivers, and advocates, to gather input and feedback during measure development and assess face validity. Face validity was assessed using a standardized question: “Do you think that the measure, as specified, can distinguish between better and/or worse performance across hospitals?”. We measured agreement using a six-point scale (strongly agree, agree, somewhat agree, somewhat disagree, disagree, strongly disagree).

For list of TEP members, please see the Figures and Tables Supplemental Attachment, Table 5 (see the Figures and Tables Supplemental Attachment).

Empiric Validity (Construct Validity)

We validated the Sepsis Readmission measure through comparisons with quality measures where we would expect to see a relationship. To identify candidate measures for construct validity testing, we first reviewed the logic model (see Logic Model Attachment) to identify quality measures that reflect similar care pathways. From that candidate list of measures, we determined which measures had data publicly available at the hospital level. From this candidate list, we selected the following components from the Overall Hospital Star Rating: Readmission Group Score, Summary Score, Patient Experience Group Score (each measure is described in more detail below). We then assessed the relationship between those measures and the Sepsis Readmission measure score, as described below.

We examined correlations between the Sepsis Readmission measure scores and components of the Overall Hospital Star Ratings, including the Readmission Group Score (with and without the hospital-wide readmission measure, which has a cohort that overlaps with that of the sepsis readmission measure), the Summary Score (with and without the entire Readmission Group), and the Patient Experience Group score.

CMS’s Overall Hospital Star Rating assesses hospitals’ overall performance (expressed on Care Compare graphically, as stars) based on a weighted average of group scores from different domains of quality (Mortality, Readmissions, Safety, Patient Experience, Timely & Effective Care). For the validity testing in this submission, we used the April 2025 Overall Hospital Quality Star Rating preview.

The full methodology for the Overall Hospital Star Rating can be found at: https://qualitynet.cms.gov/files/603966dda413b400224ddf50?filename=Star...

Because the Sepsis Readmission measure is on a lower-is-better scale, and the Star Ratings measures and its components are on a higher-is-better scale, we hypothesized that the Sepsis Readmission measure would be negatively correlated (weakly to moderately) with Star Ratings-

related measures. The reasons we hypothesize a weak to moderate correlation include: the claims-based outcome measures in Star Ratings include only Fee-For-Service (FFS) admissions and not both FFS and MA admissions; the patient experience measure includes responses for patients 18 years (not limited to >65 years) and above, across all payers (not only Medicare); the component measures within the Readmission Group include outpatient measures that would not be expected to be highly correlated with an inpatient measure like Sepsis Readmission; and the distribution of Star Ratings-related measures is different across hospitals. We also hypothesized that removing the Hospital-Wide Readmission from the Readmission Group Measures (whose cohort overlaps with that of the Sepsis Readmission measure), would result in a weaker association between the Readmission Group Score and the Sepsis Readmission Measure. We calculated Pearson's correlation coefficients for the association between the Sepsis Readmission measure and each of these existing quality assessments on the same measured entities. For these analyses, we used January 1, 2022 to December 31, 2023 data for the Sepsis Readmission measure scores, and Star Ratings data from the April 2025 preview, which includes measure data dates ranging from July 2020 – December 2023.

Validity of the Outcome

To further evaluate the validity of the measure and its outcome, we conducted a literature review examining the days to first unplanned hospital encounter after sepsis index hospitalization and the primary reasons (i.e., principal discharge diagnoses) for hospital readmissions following discharge. From this search we identified studies showing the time window to readmission and the most common diagnoses for a readmission after a hospitalization for sepsis.

Validity of Claims-Based Variables

We provide literature that supports the validity of claims-based data elements.

5.3.4 Validity Testing Results

Face Validity

Table 6 (see the Figures and Tables Supplemental Attachment) shows the results of the TEP face validity vote, where TEP members indicated their agreement with the following statement: "Do you think that the Sepsis Readmission measure as specified, can distinguish between better and/or worse performance across hospitals?" Thirteen TEP members responded to the TEP survey; 12 out of 13 (93%) agreed (strongly agreed, moderately agreed, or somewhat agreed) with the face validity of the measure, indicating support for the validity of the Sepsis Readmission measure.

Empiric Validity

Construct Validity

Selection of Comparator Measures

Below we describe the results from our assessment of comparator measures for construct validity testing.

In our evaluation of the logic model, we identified the following comparator measures for construct validity testing:

Overall Hospital Star Rating Summary Score and Readmission Group Score: CMS's Overall Hospital Quality Star Rating assesses hospitals' overall performance (expressed on Care Compare graphically, as stars) based on a weighted average of group scores from different domains of quality (Mortality, Readmissions, Safety, Patient Experience, Timely & Effective Care).

The Readmission Group Score is calculated as the simple average of measures within the Readmission Group, which includes hospital-level (inpatient) readmission and Excess Days in Acute Care measures, and hospital visit measures following outpatient procedures. Because there is evidence that broad-based interventions are effective in reducing unplanned readmissions, we hypothesized that hospitals with lower (better) Sepsis Readmission measure scores would also perform better on the composite Overall Hospital Star Rating Summary Score and Readmission Group Score.

We also hypothesized a weak to moderate association between the Sepsis Readmission measure scores and the Overall Hospital Star Rating Summary Score and Readmission Group Score because the Overall Hospital Star Rating Summary Score incorporates both outcome and process measures across its component domains. However, not all hospitals that receive a summary score ultimately receive a star rating, as eligibility is contingent upon meeting certain reporting criteria.

Within each measure group, hospitals may not report on some measures due to insufficient data, while CAHs are not required to report on measures. This could mean that the measures that make up the hospital's score may span different hospital settings and include various measure types. Notably, the Readmission Measure Group is composed entirely of measures based on Medicare fee-for-service (FFS) patient data. While some measures in this domain are condition-specific, others are procedure-specific.

Among the condition-specific measures, sepsis is distinct due to its systemic nature, often manifesting as multiple organ dysfunction syndrome (MODS), unlike other conditions that typically affect a single organ system. Sepsis patients are also at heightened risk for complications such as Clostridium difficile infections, hospital-acquired infections, and recurrent or resistant infections often resulting from prior antibiotic treatment or incomplete therapy adding complexity to their post-discharge care. (Sun et al., 2016) Furthermore, both index admissions and reasons for readmission among sepsis patients tend to be more heterogeneous compared to other clinical conditions, reinforcing the need for careful consideration of sepsis-specific factors in hospital performance evaluation. (Sun et al., 2016, Chang et al., 2015, Jones et al., 2015, Ackermann et al., 2025)

Patient Experience Group Score: The Patient Experience Group Score is calculated from eight components of the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey, including important components of care coordination both during and after hospitalization, and for this reason, it was selected as a comparator measure. For example, components of HCAHPS in the Patient Experience Group Score include patients' assessments of doctor and nurse communication and whether patients understood their care instructions when they left the hospital. The score also includes patient reports of receiving instructions about

ambulatory follow-up and assessments of staff explaining patients' medications. This measure is calculated for a sample of patients aged 18 and over; we therefore expect a weak negative association between the patient experience and Sepsis Readmission measure.

Table 7 in the Figures and Tables Supplemental Attachment provides Pearson correlation coefficients that show the relationship between the Sepsis Readmission measure score and components of the Overall Hospital Quality Star Rating. Pearson correlation coefficients between the Sepsis Readmission measure and the comparator measures (Readmission Group Score, Readmission Group Score excluding hospital-wide readmission (HWR), Summary Score, Summary Score excluding HWR and, and the Patient Experience Group Score) were –0.35, -0.25, –0.17, -0.06, and -0.21 respectively (all p-values <.0001). These results show a significant association with the expected strength and in the expected direction with measures in the same care pathway, which supports the validity of the Sepsis Readmission measure.

Validity of the Outcome

Evidence consistently identifies infection or sepsis as the most common causes of readmission among sepsis survivors. A meta-analysis of readmission rates for these diagnoses reported that up to 16% of sepsis survivors were readmitted with a diagnosis of sepsis within one year after discharge. (Goodwin & Ford, 2018) Further evidence indicates that hospital readmissions among sepsis survivors are most often due to both recurrent infections related to the initial sepsis episode and new, unrelated infections (Sun et al., 2016, Demerle et al., 2017, Prescott et al., 2015, van der Poll et al., 2021) in addition to gaps in care quality that may be driving these recurrent events. Further, research provides evidence for the validity of the 30-day, all-cause outcome. These studies show that most readmissions occur within 30 days post discharge and that window captures events most closely related to the index hospitalization (Goodwin et al., 2015, Sun et al., 2016, Chang et al., 2015)

Validity of Claims-Based Variables

CORE did not provide patient/encounter validity testing for the Sepsis Readmission measure because this is a claims-based measure; the fields used to specify the measure are structured, used for reimbursement, and audited. Claims data are widely seen as valid and reliable for use in quality measurement.

CORE demonstrated for a number of prior measures, the validity of claims-based measures for profiling hospitals by comparing either the measure results or individual data elements against medical records. CMS validated six CBE-endorsed measures currently in public reporting (AMI, heart failure, and pneumonia mortality and readmission) with models that used chart-abstracted data for risk adjustment. Specifically, claims model validation was conducted by building comparable models using abstracted medical chart data for risk adjustment for heart failure patients (National Heart Failure data) (Krumholz et al., 2006, Keenan et al., 2008), AMI patients (Cooperative Cardiovascular Project data) (Krumholz et al., 2006), and pneumonia patients (National Pneumonia Project dataset). (Bratzler et al., 2011)

When both models were applied to the same patient population, the hospital risk-standardized rates estimated using the claims-based risk-adjustment models had a high level of agreement with the results based on the medical record model, supporting the use of the claims-based models for

public reporting.

References

Bratzler DW, Normand SL, Wang Y, et al. An administrative claims model for profiling hospital 30-day mortality rates for pneumonia patients. PLoS One 2011;6(4):e17401.

Demerle KM, Royer SC, Mikkelsen ME, Prescott HC. Readmissions for recurrent sepsis: New or relapsed infection? Article. Critical Care Medicine. 2017;45(10):1702-1708. doi:10.1097/CCM.0000000000002626.

Goodwin AJ, Rice DA, Simpson KN, Ford DW. Frequency, cost, and risk factors of readmissions among severe sepsis survivors. Crit Care Med. Apr 2015;43(4):738-46. doi:10.1097/ccm.0000000000000859.

Keenan PS, Normand SL, Lin Z, et al. An administrative claims measure suitable for profiling hospital performance on the basis of 30-day all-cause readmission rates among patients with heart failure. Circulation 2008;1(1):29-37.

Krumholz HM, Brindis RG, Brush JE, et al. Standards for Statistical Models Used for Public Reporting of Health Outcomes: An American Heart Association Scientific Statement From the Quality of Care and Outcomes Research Interdisciplinary Writing Group: Cosponsored by the Council on Epidemiology and Prevention and the Stroke Council Endorsed by the American College of Cardiology Foundation. Circulation. January 24, 2006 2006;113(3):456-462.

Krumholz HM, Wang Y, Mattera JA, et al. An administrative claims model suitable for profiling hospital performance based on 30-day mortality rates among patients with an acute myocardial infarction. Circulation 2006;113(13):1683-1701.

Prescott HC, Langa KM, Iwashyna TJ. Readmission Diagnoses After Hospitalization for Severe Sepsis and Other Acute Medical Conditions. JAMA. 2015;313(10):1055-1057. doi:10.1001/jama.2015.1410.

Sun A, Netzer G, Small DS, et al. Association Between Index Hospitalization and Hospital Readmission in Sepsis Survivors*. Critical Care Medicine. 2016;44(3):478-487.

van der Poll T, Shankar-Hari M, Wiersinga WJ. The immunology of sepsis. Immunity. 2021/11/09/ 2021;54(11):2450-2464. doi:https://doi.org/10.1016/j.immuni.2021.10.012.

5.3.4a Attach Additional Validity Testing Results

5275-FiguresAndTables-Fall2025_1.pdf

5.3.5 Interpretation of Validity Results

Both strong face validity and empiric validity testing results support the validity of the Sepsis Readmission measure. Ninety-three percent of TEP members voted in support of the face validity statement, and our empiric results show a significant association with the expected strength and in the expected direction with measures in the same casual pathway (see Table 6 in the Figures

and Tables Supplemental Attachment, and the Logic Model Supplemental Attachment), which supports the construct validity of this measure. In addition, we provide evidence for the validity of the 30-day, all-cause outcome. The interpretation of these results is discussed below.

Face Validity

The validity of the Sepsis Readmission measure is supported by strong face validity of the testing results. Ninety-three percent of TEP members voted in support of the face validity statement. As shown in Table 6 (in the Figures and Tables Supplemental Attachment), 12 of 13 (93%) TEP members strongly, moderately, or somewhat agreed to the standardized question: "Do you think that the Sepsis Readmission measure as specified, can distinguish between better and/or worse performance across hospitals."

Empirical Validity Testing

The empiric results show a significant correlation in the expected direction with measures in the same care pathway-the Overall Hospital Quality Star Rating Readmission Group Score (with and without the HWR measures), the Overall Hospital Quality Star Rating Summary Score (with and without the Readmission measures), and the Patient Experience Group Score with the expected strength and in the expected direction, which supports the construct validity of the Sepsis Readmission measure.

The correlation (in the expected strength and direction) between the Sepsis Readmission measure and other quality/cost measures in the causal pathway (see Logic Model Supplemental Attachment), such as the Star Rating readmission group score (without the HWR measures) and the Patient Experience Group Score. Because we know that (1) there are effective strategies that hospitals can implement to reduce post-discharge hospital use, and (2) hospitals have successfully implemented quality improvement programs to improve readmission rates which can be broad-based, we conclude with moderate certainty that the relationships we see between the Readmission Group and the Sepsis Readmission performance are directly related. This is further supported by the fact that the readmission measures all share the same outcome (post-discharge hospital acute care). The largest potential confounder of these relationships, patient comorbidities or case mix, is addressed through risk/case-mix adjustment of the individual measure.

Finally, when considering the three types of measures we analyzed, our results support the notion of convergent validity. Each of the measures examines a different quality domain (readmission and patient experience), with different data sources (patient-reported data vs. claims) and different measure calculation approaches. Yet our results show a pattern consistent with our hypothesis with correlations in the expected direction and strength across the domains.

Validity of the Outcome (30-day, all-cause)

The validity of the 30-day, all-cause outcome is supported by peer-reviewed evidence showing that readmission frequently occurs within 30 days after the index hospitalization and is a recurrence of infection or sepsis in the majority of cases. This suggests that these readmissions are temporally associated with the index admission. It also provides further evidence in support of a causal relationship, rather than random hospital visits for unrelated reasons. We show through literature that the most common reasons for readmission as indicated by principal discharge diagnoses are

clinically related to the index admission.

5.4.1 Methods Used to Address Risk Factors

Statistical risk adjustment model with risk factors

5.4.2 Conceptual Model Rationale

The conceptual approach utilized for risk adjustment for this measure is built upon the robust conceptual model, methodology, and testing of over 15 CMS hospital outcome measures including seven readmission measures that have received prior CBE endorsement and been successfully utilized in national quality improvement, public reporting and payment programs.

The goal of risk-adjustment is to adjust for case-mix differences across the hospitals when evaluating performance. Risk adjustment supports fair and accurate comparison of outcomes across measured entities by including an adjustment for factors such as age, comorbid diseases, and indicators of patient frailty, which are clinically relevant and have relationships with the outcome. The model adjusts for case-mix based on the patient's clinical condition at the time of index hospitalization. However, it excludes conditions that reflect adverse outcomes resulting from the quality of care provided during the index hospitalization, as these are considered aspects of care that are in the causal pathway. While these conditions may increase the likelihood of readmission, including them as risk adjustment variables could reduce the model's ability to accurately reflect the quality of care delivered by hospitals. The model also excludes hospital characteristics, such as teaching status, to ensure consistent quality standards across hospitals. Additionally, hospital characteristics may directly influence patient outcomes rather than serve as confounding variables, making them inappropriate for adjustment.

Risk variables were selected using a clinically and data-driven, empiric approach, followed by minor adjustments for face validity. For candidate risk variable selection, we used a 50% randomly-selected sample of data from the CY2022 and CY2023 dataset, and included all secondary ICD-10 codes documented as present-on-admission (POA) during the index hospitalization (except for the palliative care code of Z51.5, which, effective October 1, 2021, was considered POA-exempt), and both principal and secondary ICD-10 codes in the 12 months prior to admission from any inpatient, outpatient, and professional provider claims. We also included age, a vetted metric of patient frailty (see below), and an indicator for whether the admission was Medicare Advantage (MA) vs. Fee-for-Service (FFS) plan.

The variable selection of individual ICD codes mainly relied on clinically and data-driven methodologies involving two key steps: (1) pre-processing, and (2) evaluating association of all candidate risk variables with outcome.

In pre-processing, we screened and included index and history (pre-index) coded variables if their prevalence among those patients having an index hospitalization for sepsis exceeded 0.5% and 2.5%, respectively. Pairs of identical index and pre-index ICD-10 codes with similar odds ratios that acted in the same direction and where the difference in association with the outcome (measured by odds ratio (OR)) was less than 0.2 were merged. Co-occurring index and pre-index codes with Pearson correlation coefficients greater than 0.8 were combined into one risk variable.

Further, we included a claims-based indicator of frailty that was developed for CMS's Multiple Chronic Conditions (MCC) measure (Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation [YNHHSC/CORE], 2019) based on evidence from the literature, expert input, guidance from the consensus-based entity for measure endorsement, the Assistant Secretary for Planning and Evaluation (ASPE, 2020), and input from other stakeholders, as well as prior testing results.

Based on clinical expert recommendation and TEP consensus, we examined the association of specific pathogenic organism-associated and non-specific organism-associated sepsis diagnosis with the outcome; sepsis due to pathogenically aggressive organisms may place patients at higher risk of readmission compared to non-specific or less pathogenic organism-associated sepsis. (Burnham et al., 2018) We then grouped sepsis diagnoses based on type of organism, direction of association with the outcome, and frequency and significance.

Further, we included an indicator for transplant recipient status and neutropenia based on clinical expert recommendation and TEP consensus, as these are indicators for immunocompromised status, which increases the likelihood of readmission. (Hogan et al., 2019) The transplant indicator included indicators for kidney, heart, lung, liver, bone marrow, pancreas, and stem cell transplant.

We then included the candidate risk variables from the above steps, and age, in a multivariable logistic regression model that underwent variable selection through 1,000 iterations of bootstrapping. We selected variables that were statistically significantly ($p<0.05$) associated with the outcome (all-cause 30-day readmission) in at least 95% of the bootstrapped samples. We determined if additional variables should be added by examining if there was a resulting increase in c-statistic (using a threshold of at least 0.0005 for each additional variable or an increase of at least 0.005 after including additional variables within the next 5% of bootstrapped samples [e.g., moving from 95% to 80%]). We also determined whether additional variables that did not meet the level of statistical significance but were clinically relevant to the outcome should be included. Based on TEP feedback and clinical expert review, we included ICD-10 codes for sepsis pathogens and diagnoses that indicate organ compromise or failure and are markers of severe sepsis including acidosis, fluid or volume overload, hypoxemia, and hypotension.

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

The Sepsis Readmission measure does not account for healthcare supply factors such as discharge disposition, for example, discharge to skilled nursing facilities (SNFs) or nursing homes (NHs), access to outpatient services, or workforce availability. While hospitals operate within resource constraints, decisions regarding how resources are allocated often fall within their control and reflect the quality of care provided to patients. The discharge destination plays a critical role in patient outcomes. Patients discharged to SNFs or NHs may experience readmissions due to poor quality of care in these facilities. However, under the Sepsis Readmission measure, such readmissions are attributed to the hospital rather than the post-acute care facility, reinforcing the importance of hospitals ensuring appropriate discharge planning and transitions of care. One of the key strengths of readmission measures is their ability to drive critical evaluation of care processes across the continuum of care. These measures can help identify gaps in post-discharge

management and highlight opportunities for improvement, potentially reducing avoidable readmissions. Hospitals have some level of control over discharge planning, including where patients are transferred for post-acute care and multidisciplinary collaboration between hospitals and SNFs or NHs is essential to ensure seamless transitions and high-quality post-acute care. If a hospital identifies high readmission rates from a specific SNF or NH, then the hospital may consider redirecting patients to facilities with better quality of care or hospitals can bargain with SNF/NH facilities to collaboratively improve care processes and patient outcomes.

CMS also tracks and reports all-cause, unplanned hospital readmissions for SNF residents within 30 days of hospital discharge. This SNF measure is part of a pay-for-performance program, where SNFs receive incentive payments based on their performance in reducing readmissions. This accountability mechanism ensures that post-acute care providers are also held responsible for patient outcomes, aligning incentives across care settings. (Centers for Medicare & Medicaid Services, 2025) By ensuring effective discharge planning, post-acute care coordination, and monitoring readmission trends, hospitals can optimize patient outcomes while maintaining accountability within the healthcare system.

Hospital-level variables measure attributes of the hospital which may be related to patient risk. Examples of hospital-level variables used in studies include the proportion of dual eligible (both Medicare and Medicaid) patients served in the hospital. (Popescu et al., 2019, Basu et al., 2016, Salerno et al., 2017) Among hospital-level variables, factors such as hospital length of stay, use of critical care resources (e.g., non-invasive ventilation and intensive care), and discharge to long-term care or skilled nursing facilities were significant contributors to readmission.

It is incumbent upon health systems to tailor care pathways and post-discharge support services to meet the contextual needs of the patients they serve. It would be unethical for measure developers and CMS to expect lower standards for hospitals that serve patients populations who are poorer than those who are not. Furthermore, hospitals receive extra payment for CMS as part of the disproportionate share hospital adjustment, if they serve a high proportion of low-income patients. (Centers for Medicare & Medicaid Services, 2023, Health Affairs Blog, 2021)

Dual-eligible Status

Dual eligibility for Medicare and Medicaid is available at the patient level in the Medicare Master Beneficiary Summary File. The eligibility threshold for aged 65 or older Medicare patients considers both income and assets. For the dual-eligible (DE) indicator, there is a body of literature demonstrating differential health care and health outcomes among beneficiaries (ASPE, 2020).

To understand the impact of DE on the Sepsis Readmission measure, we assessed the following:

1. The distribution and prevalence of DE patients among hospitals.
2. Patient-level association between DE and the unadjusted readmission rate outcome to identify potential discordant performance.
3. Impact of DE status on model performance and measure scores to understand how overall performance is affected.
    1. We examined the correlation between measure scores calculated with and without DE status.
    2. We stratified the measure scores by the hospital-proportion of patients with DE status.

3. We compared model calibration for patients with DE status to those without DE status.

Results

Table 8 (see the Figures and Tables Supplemental Attachment) presents the median prevalence of DE across all hospitals. The median hospital prevalence of DE across all hospitals is 21.05%

Table 9 (see the Figures and Tables Supplemental Attachment) shows the unadjusted readmission rate for DE patients. Unadjusted readmission rates for patients with sepsis are higher among DE patients compared with patients that are not DE (20.74% vs 17.23%).

To determine the impact of DE in a multivariable model, we calculated the odds ratios for DE. Table 10 (see the Figures and Tables Supplemental Attachment) results show that, in a multivariable model that includes the DE variable and the existing risk variables (age plus clinical variables selected during risk variable selection), the odds ratio for the DE variable is (1.083 [95% CI: 1.071-1.095]).

We also examined model calibration for DE to determine if the risk model (without the DE variable) performs well for patients with DE compared with non-DE patients. Figure 2 (see the Figures and Tables Supplemental Attachment) results show that the model is well-calibrated for patients with, and without DE.

We assessed the impact of including DE in the risk model by evaluating the association between measure scores calculated with and without the inclusion of a DE indicator in the risk model. Measure scores calculated with and without DE in the model are highly correlated [Pearson correlation coefficient: 0.98 ($p < 0.0001$)]. This result suggests that including DE in the risk model does not substantially impact the measure score, indicating that its effect may already be captured by existing variables or adjustments (see Figure 3 in the Figures and Tables Supplemental Attachment).

We also examined the distribution of risk-standardized readmission rates (measure score) within quartiles of the hospital-proportion of patients with DE. The box plots in Figure 4 (see the Figures and Tables Supplemental Attachment) show that the interquartile range of risk-standardized readmission rate overlaps across quartiles. They also show that hospitals in the fourth quartile, that is, hospitals with a relatively larger proportion of patients with DE status can perform as well as hospitals in the 1st-3rd quartiles (hospitals with relatively fewer patients with DE status).

Overall, our results show that dually eligible patients have a higher risk of readmission following an index hospitalization for sepsis, but that there is little impact at the hospital level on measure scores. Dually eligible patients have higher unadjusted rates of the outcome, and even after adjusting for the clinical risk variables in the model, odds ratios remain greater than 1, and significant. However, we find that the impact of including the DE variable on measure scores is minimal: measure scores calculated with and without the DE variable are highly correlated. In addition, the distribution of measure scores across quartiles of the hospital proportion of patients with DE status overlaps.

Our results show that hospitals that serve a relatively larger proportion of DE patients can

perform as well as hospitals that serve relatively fewer DE patients. Thus, the impact of DE on the measure score is small. These empiric results support CMS' decision to not risk adjust for DE given that its effect may already be captured by existing clinical variables or adjustments.

Adjusting for DE may also mask signals that arise from systematic differences in the quality of care between hospitals serving more versus fewer DE patients and would hold hospitals that serve these patient population to different standards of care. While the Sepsis Readmission measure does not adjust for DE status, adjustment for safety-net hospitals and hospitals that serve more economically disadvantaged patients occurs beyond the measure development phase to account for differences of providers providing care for people with these challenges.

References

"Adjusting Medicare Payments For Social Risk To Better Support Social Needs", Health Affairs Blog, June 1, 2021. DOI: 10.1377/hblog20210526.933567

ASPE. Second Report to Congress on Social Risk and Medicare's Value-Based Purchasing Programs. Published June 29, 2020. https://aspe.hhs.gov/reports/second-report-congress-social-risk-medicar...

Basu J, Avila R, Ricciardi R. Hospital Readmission Rates in U.S. States: Are Readmissions Higher Where More Patients with Multiple Chronic Conditions Cluster? Health Services Research. 2016;51(3):1135-1151. doi:https://doi.org/10.1111/1475-6773.12401

Burnham JP, Kwon JH, Olsen MA, Babcock HM, Kollef MH. Readmissions With Multidrug-Resistant Infection in Patients With Prior Multidrug Resistant Infection. *Infection Control & Hospital Epidemiology*. 2018;39(1):12-19. doi:10.1017/ice.2017.254

Centers for Medicare & Medicaid Services. Acute Inpatient PPS. www.cms.gov. Published September 6, 2023. https://www.cms.gov/medicare/payment/prospective-payment-systems/acute-...

Centers for Medicare & Medicaid Services. The Skilled Nursing Facility Value-Based Purchasing (SNF VBP) Program | CMS. www.cms.gov. Published 2025. https://www.cms.gov/medicare/quality/nursing-home-improvement/value-bas...

Hogan J, Arenson MD, Adhikary SM, et al. Assessing Predictors of Early and Late Hospital Readmission After Kidney Transplantation. Transplantation Direct. 2019;5(8):e479. doi:10.1097/txd.0000000000000918

Popescu I, Fingar KR, Cutler E, Guo J, Jiang HJ. Comparison of 3 Safety-Net Hospital Definitions and Association With Hospital Characteristics. JAMA Network Open. 2019;2(8):e198577-e198577. doi:10.1001/jamanetworkopen.2019.8577

Salerno AM, Horwitz LI, Kwon JY, et al. Trends in readmission rates for safety net hospitals and non-safety net hospitals in the era of the US Hospital Readmission Reduction Program: a retrospective time series analysis using Medicare administrative claims data from 2008 to 2015. BMJ Open. Jul 13 2017;7(7):e016149. doi:10.1136/bmjopen-2017-016149

Yale New Haven Health Services Corporation/Center for Outcomes Research & Evaluation. Measure Information for the Multiple Chronic Care Conditions (MCC) Risk-standardized Hospital Admission Rates for Patients for the Merit-based Incentive Payment System (MIPS) Groups. Cms.gov. Published 2019. Accessed November 11, 2025. https://qpp.cms.gov/resources/document/750f3c88-e16c-46a5-a7f6-e8235aef...

5.4.2a Attach Conceptual Model

5275-5.4.2a-ConceptualModel-Fall2025.pdf

5.4.3 Variable Distribution Across Measured Entities

The frequencies of the risk variables in the final risk model are shown in Table 11 (see Figures and Tables Supplemental Attachment).

5.4.3a Attach Descriptive Statistics for Risk/Case-mix Variables

5275-FiguresAndTables-Fall2025_2.pdf

5.4.4 Risk/Case-Mix Adjustment Modeling and/or Stratification Results

Table 11 (see Figures and Tables Supplemental Attachment) shows the risk variable frequencies and odds ratios for the final risk variables in the model, selected by the process described in Section 5.4.2. Final model risk variables are also provided within the attached data dictionary (See the Excel attachment, Sepsis_Readmission_Data Dictionary.xlsx, for the code definitions (Tab 2).

5.4.4a Attach Risk/Case-mix Adjustment Modeling and/or Stratification Specifications

5275-FiguresAndTables-Fall2025_3.pdf

5.4.5 Calibration and Discrimination

To validate the performance of the statistical model we computed several summary statistics for assessing model performance which included: discrimination, predictive ability, calibration plots, and overfitting indices.

Discrimination measures how well the model can distinguish between patients at high-risk and low-risk of sepsis readmission. A model with good discrimination assigns higher predicted probabilities to individuals who experience the event and lower probabilities to those who do not. The c-statistic (concordance statistic) is used to assess discrimination.

Predictive ability measures the ability to distinguish high-risk patients from low-risk patients. For a model with good predictive ability, we would expect to see a wide range in observed outcomes between the lowest and highest deciles of predicted risk of readmission. To calculate predictive ability, we calculated the range of mean observed sepsis readmission between the lowest and highest predicted deciles of sepsis readmission probabilities.

Calibration plots assess the model's predictive accuracy that compares the observed and predicted readmission across deciles of predicted risks. The closer the observed readmission rate aligns with the predicted readmission rate, the better calibrated the model is.

Overfitting occurs when a risk model is good at predicting risk in the original data used to develop the model (development dataset) but less effective on new ("unseen") data. The overfitting indices are used to examine whether the model generalizes well to new patients. Estimated calibration values of γ0 close to 0 and estimated values of γ1 close 1 provide evidence of good calibration of the model.

5.4.5a Attach Calibration and Discrimination Testing Results

5275-FiguresAndTables-Fall2025_4.pdf

5.4.6 Interpretation of Risk/Case-mix Factor Findings

Model performance is strong across multiple domains including predictive performance and discrimination, and calibration.

The percentage of readmissions across deciles of risk is similar between predicted and observed datasets, in both the development and validation samples with strong model discrimination and fit.

Discrimination

The c-statistic of 0.65 in the development and validation sample indicates good model discrimination for a readmission-type measure. The model indicated a wide range between the lowest decile and highest decile, 7.30% to 33.50%, a range of 26.20%, indicating a strong ability to distinguish high-risk patients from low-risk patients.

Over-fitting (γ0, γ1)

If γ0 is substantially far from zero and γ1 is far from one, there is potential evidence of over-fitting. Our testing results show that while γ1 is almost one, γ0 is close to zero indicating that good calibration of the model (Table 12 [see Figures and Tables Supplemental Attachment]).

Calibration

Higher deciles of the predicted outcomes are associated with higher observed outcomes, which show a good calibration of the model. The predictive ability of the model shows a wide range between the lowest decile and highest decile, indicating the ability to distinguish high-risk subjects from low-risk subjects (Figure 5 [see Figures and Tables Supplemental Attachment]).

5.4.7 Final Approach to Address Risk Factors

Statistical risk adjustment model with risk factors

6.1.1 Current Status

Not in use

6.1.2 Current or Planned Use(s)

Public Reporting, Payment Program

6.2.1 Actions of Measured Entities to Improve Performance

Thirty-day hospital readmissions following an index hospitalization often stem from ineffective initial treatment, poor discharge planning, and insufficient post-discharge follow-up and care transitions. Evaluating hospital performance using the Sepsis Readmission measure provides valuable feedback, enabling hospitals to enhance quality across the entire care continuum. Research has demonstrated that transitional care interventions, which address both pre-discharge and post-discharge factors, can significantly reduce hospital readmissions and improve continuity of care for sepsis patients. (Kash et al., 2018, Burke et al., 2013) For example, interventions such as care coordination with clinical teams, collaboration with primary care providers and community-based programs, home visits, telephone follow-ups, patient and family education, medication reconciliation, discharge planning, and telemonitoring have been identified as effective strategies for reducing hospital readmissions as illustrated by the Logic Model. These approaches enhance care transitions, improve patient engagement, and ensure continuity of care, ultimately mitigating the risk of readmission. (Kash et al., 2018) Reducing readmission rates after hospitalization for sepsis requires a multidisciplinary approach that effectively integrates interventions across the care continuum. A study examining the relationship between 20 evidence-based transitional care processes and readmission rates across 10 facilities within a single health system found that facilities that consistently implemented a higher number of recommended transitional care processes experienced lower readmission rates.(Pugh et al., 2021) Another study found that the combination of early home health nursing and at least 1 outpatient physician visit in the first week after hospital discharge reduced the risk of 30-day hospital readmission among sepsis survivors. (Deb et al., 2019) Additionally, another study conducted within a single healthcare system found that implementing a post-sepsis bundle of care was associated with an 88% reduction in the odds of 90-day readmission. The post-sepsis bundle of care included medication optimization, early identification and management of new functional, cognitive, or mental health impairments, close monitoring for exacerbation of comorbid conditions after discharge, and palliative care when appropriate. (Taylor et al., 2022)

Prescott (2018) highlights additional strategies for preventing and reducing hospital readmissions among sepsis survivors including implementing the ABCDEF Bundle (Prescott & Angus, 2018), a set of evidence-based practices designed to minimize the risk of iatrogenic complications, which can contribute to increased readmission risk. This includes performing medication reconciliation to ensure that long-term medications are not overlooked, while short-term medications prescribed during hospitalization are appropriately discontinued to prevent unnecessary long-term use. Adjusting medication dosing is important because sepsis survivors often experience physiological changes such as muscle atrophy and weight loss, which may necessitate dose modifications to prevent adverse effects.

Given that infection, either new or recurrent, is the leading cause of sepsis-related readmission, Prescott (2018) notes that hospitals should implement targeted strategies to reduce the risk of hospital-acquired infections and infection-related readmissions including optimizing antibiotic use

by discontinuing or narrowing antibiotics as soon as clinically appropriate during the initial hospitalization, ensuring patients are up to date on vaccinations to protect against preventable infections, and educating and counseling patients on their elevated risk for recurrent sepsis, while empowering them to recognize early symptoms and seek timely medical care.

Educating patients education about their disease, the expected clinical course, and how to recognize concerning symptoms are other important factors that significantly lower the risk of readmission. Patients can better manage their illness and their care if they are counselled on their risk for recurrent sepsis and taught how to identify signs or symptoms of infection, who to contact with questions, and when to seek follow-up care. Prescott (2018) notes resources for educating patients including education handouts on post-sepsis symptoms (Marra et al., 2017), post-intensive care syndrome, videos about recovery after hospitalization for sepsis. (Prescott, 2018)

Finally, to support quality improvement, CMS shares reports with measured entities that include measure results benchmarked against the state and nation (hospital-specific reports [HSRs]). These reports include, among other details, the principal diagnosis code associated with the readmission, which allows hospitals to tie their quality improvement efforts to the specific reasons for rehospitalization that are occurring. CMS gives hospitals 30 days to preview their results and submit questions before public reporting on the data catalog on Data.cms.gov (also known as the Provider Data Catalog) and Medicare.gov (also known as Care Compare) websites.

References:

Kash B, Baek J, Cheon O, Coleman N, Jones S. Successful hospital readmission reduction initiatives: Top five strategies to consider implementing today. Journal of Hospital Administration. 10/21 2018;7:16. doi:10.5430/jha.v7n6p16

Burke RE, Kripalani S, Vasilevskis EE, Schnipper JL. Moving beyond readmission penalties: Creating an ideal process to improve transitional care. Journal of Hospital Medicine. 2013;8(2):102-109. doi:https://doi.org/10.1002/jhm.1990

Pugh J, Penney LS, Noël PH, et al. Evidence based processes to prevent readmissions: more is better, a ten-site observational study. BMC Health Services Research. 2021/03/01 2021;21(1):189. doi:10.1186/s12913-021-06193-x

Deb P, Murtaugh CM, Bowles KH, et al. Does Early Follow-Up Improve the Outcomes of Sepsis Survivors Discharged to Home Health Care? Medical Care. 2019;57(8):633-640. doi:10.1097/mlr.0000000000001152

Taylor SP, Murphy S, Rios A, et al. Effect of a Multicomponent Sepsis Transition and Recovery Program on Mortality and Readmissions After Sepsis: The Improving Morbidity During Post-Acute Care Transitions for Sepsis Randomized Clinical Trial*. Critical Care Medicine. 2022;50(3):469-479. doi:10.1097/ccm.0000000000005300

Prescott HC. Preventing Chronic Critical Illness and Rehospitalization: A Focus on Sepsis. Critical Care Clinics. 2018;34(4):501-513. doi:10.1016/j.ccc.2018.06.002

Prescott HC, Angus DC. Postsepsis Morbidity. JAMA. 2018;319(1):91-91.

doi:10.1001/jama.2017.19809

Marra A, Ely EW, Pandharipande PP, Patel MB. The ABCDEF Bundle in Critical Care. Critical Care Clinics. 2017;33(2):225-243. doi:10.1016/j.ccc.2016.12.005

6.2.5a Potential Unintended Consequences

Unintentional consequences of the measures use will be important to monitor after implementation. For example, might hospitals change coding practices to 'game the system', which could increase costs and confusion associated with sepsis management. Additionally, changes in care settings post-index hospitalization such providing services during prolonged emergency department visits or observation unit stays would mask within 30 days returns to the hospital by sepsis survivors. These consequences may ultimately lead to increased patient morbidity and mortality. However, the Sepsis Readmission measure is designed to provide actionable feedback to healthcare providers, prompting a critical evaluation of both system- and staff-level processes that can be improved upon or implemented to enhance patient care during the initial hospitalization and post-discharge period. Implementation of this measure may incentivize in-hospital quality improvements, such as early detection and prompt treatment of sepsis, as well as comprehensive and effective discharge planning and post-discharge interventions.

Changes in coding practices

Implementation of the Sepsis Readmission measure may unintentionally lead to changes in coding practices. Some hospitals may use the codes indicating higher sepsis severity more frequently than others to improve measure score after adjustment. However, this may not be a concern for this measure given CMS' coding guidelines for sepsis. Specifically, coding guidelines specifically require that if severe sepsis is present on admission, sepsis should be assigned as principal diagnosis followed by the appropriate code for severe sepsis, septic shock, or localized infection. (Centers for Medicare & Medicaid Services, 2024) CORE examined hospital coding variation of sepsis using A41.9 (Sepsis, unspecified). Most sepsis cases are coded using this code and per the CMS April 2024 coding guidelines, providers are encouraged to use this code if the type of infection or causal organism is not further specified. The results showed no significant variation in the use of A41.9 (Sepsis, unspecified) across hospitals suggesting that hospital performance on the measure is likely not biased and differential sepsis coding will not impact the comparability of outcomes across hospitals.

Changes in care setting (shifting care to ED or observation units)

The Sepsis Readmission measure captures unplanned inpatient readmissions within 30 days following discharge from an index hospitalization for sepsis. It does not include emergency department (ED) visits or observation stays, which may unintentionally incentivize hospitals to reclassify return visits to avoid readmissions being counted in the measure. Evidence from studies on the HRRP shows that, while inpatient readmissions declined, the total number of hospital revisits within 30 days (including ED visits and observation stays) actually increased for HRRP-targeted conditions. This raises concern that hospitals may alter practices in response to the Sepsis Readmission measure. For instance, one study found an increase in ED treat-and-release

visits from 2.8% in 2010 to 5.4% in 2014, although the findings were not nationally representative. (Meyer et al., 2018) The literature is mixed with some data supporting that the HRRP did not result in material increases in ED visits or observation stays.

Mortality

Following implementation of HRRP, studies reported that the program was associated with a reduction in 30-day readmission rates, however, there were concerns that the program led to an increase in 30-day mortality after hospital discharge for HRRP-related conditions. Subsequent studies have refuted such claims by showing that changes in 30-day readmission rates were weakly correlated with changes in mortality after discharge.

Sepsis is associated with high rate of mortality, so the competing risk of death was carefully considered during measure development. Notably, the measure cohort already excludes patients who are discharged to hospice after their index sepsis hospitalization. Patients who are readmitted and later die within 30 days after discharge are considered as readmissions in the measure. However, patients who die after discharge index hospitalization without being readmitted are coded as not readmitted. This could create potential bias when interpreting readmission rates across hospitals with varying within 30 days post-discharge mortality rates. Hospitals with higher post-discharge mortality could appear to have better readmission rates simply because patients who die shortly after discharge (and are not readmitted) are no longer at risk of readmission. Therefore, it will be important to monitor post-discharge mortality after measure implementation.

To explore if this was an issue even before measure implementation and potentially account for it in the measure specification, we analyzed the association between hospital-level within 30 days post-discharge mortality and readmission rates by grouping hospitals into deciles based on their post-discharge mortality rates. This approach allowed us to explore whether hospitals with higher post-discharge mortality rates had lower readmission rates, which could indicate bias in the readmission measure. We also calculated Pearson's correlation to determine the strength and direction of the association of post-discharge mortality and readmission rates across hospitals. The results showed that the median readmission rates were relatively consistent across the mortality decile groups and there was no correlation between mortality and readmission rates across hospitals confirming that readmission rates are not disproportionately lower among hospitals with higher post-discharge mortality rates. The unweighted Pearson correlation coefficient between mortality rate and readmission rate was 0.005 (p=0.784, 95% CI [-0.032, 0.042]) and the weighted (by hospital volume) correlation between mortality rate and readmission rate was 0.011 (p=0.578, 95%CI [-0.027,0.048]). While these results show no correlation between post-discharge mortality and readmission, CMS should continue to track and monitor the measure to ensure it does not lead to worse outcomes or obscure underlying care quality concerns.

References

Centers for Medicare & Medicaid Services. ICD-10-CM Official Guidelines for Coding and Reporting.; 2024. https://www.cms.gov/files/document/fy-2024-icd-10-cm-coding-guidelines-…

Meyer N, Harhay MO, Small DS, et al. Temporal Trends in Incidence, Sepsis-Related Mortality, and Hospital-Based Acute Care After Sepsis. Crit Care Med. Mar 2018;46(3):354-360.

doi:10.1097/ccm.0000000000002872

Developer POC email

Lisa.Suter@yale.edu

Measure Developer POC

Lisa Suter
Yale/YNHH Center for Outcomes Research and Evaluation (CORE)
New Haven, CT
United States

The measure developer is different from the measure steward

Yes

Steward Address

Raquel Myers
Windsor Mill , MD
United States

Steward Organization

Centers for Medicare & Medicaid Services

Steward Organization URL

https://www.cms.gov

Steward POC email

Raquel.Myers@cms.hhs.gov