

## **Hospital 30-Day, All-Cause, Risk-Standardized Readmission Rate (RSRR) Following Sepsis Hospitalization**

### **Evidence: Peer-Reviewed Original Research (Search Strategy) & Empiric Evidence**

#### *Peer-reviewed Systematic Review*

### **Hospital readmission after surviving sepsis: A systematic review of readmission reasons and meta-analysis of readmission rates<sup>1</sup>**

Sepsis survivors face significant long-term health challenges, including reduced quality of life, physical and cognitive impairments, and high rates of chronic health issues. They also utilize more healthcare resources compared to patients hospitalized for other conditions and frequently experience subsequent hospital readmissions. These readmissions not only impact patients' quality of life but also impose substantial financial burdens on both patients and healthcare systems. Notably, many readmissions among sepsis survivors are potentially preventable.

#### *Economic Burden of Sepsis Readmissions*

According to the authors the estimated annual cost of 30-day readmissions for sepsis is twice the cost of readmissions for congestive heart failure and more than three times the cost of readmissions for acute myocardial infarction.

#### *Study Objective*

Given the heterogeneous nature of sepsis survivors, distinct subgroups may have different risks for readmission due to various conditions. To better understand these patterns, the authors aimed to:

1. Identify common diagnoses leading to hospital readmission.
2. Provide insights into survivor morbidity risks.
3. Facilitate the development of targeted interventions to reduce hospital readmissions.

#### *Methodology*

This systematic review and meta-analysis included 51 studies. The authors conducted quality and certainty of evidence assessments using:

1. A modified Newcastle Ottawa Scale (NOS) for cohort study evaluation.
2. The Grading of Recommendations, Assessment, Development, and Evaluations (GRADE) framework to assess the certainty of evidence in systematic reviews of prognosis.

#### *Key quality assessment findings*

- 88.3% of studies scored 3 or more out of 5 on NOS.
- 66.7% of studies had good representativeness of the exposed cohort.
- 94.1% of studies had robust ascertainment of exposure.

#### *In the outcome section*

- 80.4% had a strong assessment of outcome.
- 90.2% had an adequate follow-up period.

- 70.6% demonstrated a low risk of survivorship bias.

#### *Findings*

- Most studies in the systematic review focused on adult populations and used International Classification of Diseases (ICD) codes to identify both index sepsis admissions and subsequent readmissions. Most studies defined index sepsis admissions as the first sepsis hospitalization that occurred within the study period with any following admissions classified as readmission. The most common readmission diagnoses are sepsis and infection. Other readmission diagnoses included heart failure, cardiovascular disease, biliary sepsis, and non-infectious diagnoses.

### Peer-reviewed Original Research Search Strategy

To inform the development of the sepsis readmission measure, we conducted a literature review to inform definition of the sepsis measure cohort, with particular attention to the inclusion and exclusion criteria used to delineate sepsis populations in published literature, and to identify risk adjustment variables that could inform the development of a risk model. We also performed an environmental scan to identify and evaluate current claims-based sepsis quality measures. This approach ensures that the sepsis readmission measure is grounded in the most current and relevant research and avoids duplication, thereby enhancing its accuracy and applicability in clinical settings.

### *Environmental Scan Methods*

Our environmental scan consisted of two components:

1. An online scan of both pre-specified websites and a web search based on CORE's subject matter and clinical expertise input to identify sepsis outcome measures to inform the cohort definition.
2. Discussions with clinical consultants and measurement experts to identify additional relevant studies and measures.

To identify relevant measures, we searched the sites listed below.

**Table 1: Sites and Professional Societies Included in the Environmental Scan**

Site description
Agency for Healthcare Research and Quality (AHRQ)
American College of Chest Physicians (CHEST)
American College of Emergency Physicians (ACEP)
American Hospital Association (AHA)
Association of American Medical Colleges (AAMC)
Battelle Partnership for Quality Management (PQM)
California Quality Measures
CDC (Hospital Sepsis Core Elements: 2023, Hospital Toolkit for Adult Sepsis Surveillance)
CMS Measure Inventory Tool (CMIT)
Council of Medical Specialty Societies (CMSS)
Healthcare Infection Society (HIS)
Infectious Disease Society of America (IDSA)
International Sepsis Forum (ISF)
Massachusetts Sepsis Consortium
Michigan Hospital Medicine Safety Consortium (HMS)
National Committee for Quality Assurance (NCQA)
National Quality Forum (NQF)
New York State health Department Quality Measures
PSI90 (CMS)
Sepsis Alliance Institute
Society for Academic Emergency Medicine (SAEM)
Society of Critical Care Medicine (SCCM)
The Joint Commission (TJC)

### *Measure Exclusion Criteria and Abstraction*

We excluded measures that focused only on the pediatric population and pregnant persons. We also excluded measures for which no relevant information on the measure's specifications could be identified.

For all identified measures we abstracted the following variables for each item identified within the environmental scan: Measure, Developer/Steward, Measure Description, Care Setting; Attribution, Type, Data Source, Numerator, Denominator, and Cohort Exclusions. We included measures that were retired or had their endorsement removed because their specifications are still potentially relevant for this project.

### *Literature Search Methods*

We conducted a search for relevant peer-reviewed publications that would help inform the Sepsis Readmission cohort selection and identify risk variables for the risk model. A summary of the literature search and methodology follows, with a full search string in [Table 2](#) and [Literature Review References](#) at the end of this document.

We developed a list of potential search terms and met with the Yale University Medical Librarian on August 16th, 2023, to refine the list of search terms. We then conducted a search of the Ovid Medline database using the keyword "sepsis" and included more general terminology such as "septic," "bacteremia," and "septicemia." We refined our search by looking at studies examining "patient readmission," "hospitalizations," and "risk assessment." We combined controlled vocabulary (MeSH terms) and free-text keywords, utilizing proximity operators to capture closely related terms. The resulting studies were evaluated to identify studies or measures that addressed the objectives of this project. The LR focused on cohort definitions and risk adjustment variables for a claims-based adult sepsis measure.

### *Study Inclusions*

We included studies that fulfilled the following criteria:

- Studies with a focus on sepsis and patient readmission, rehospitalization, or risk assessment
- Studies where the outcome of interest included readmission rates, mortality, or length of hospital stay
- Meta-analysis and empirical studies including observational, experimental, and prospective and retrospective studies

### *Study Exclusions*

We excluded studies for the following reasons:

- Studies published in a language other than English
- Studies focused on drug, device, surgical, or behavioral interventions
- Review articles or case report/series with no data reported
- Wrong population, focused on pediatrics, obstetrics, etc.
- Wrong outcome (e.g., not sepsis outcome, interventions to reduce mortality and/or readmission, association between sepsis and mortality, etc.)
- Comment letter, editorial, or opinion pieces
- Articles looking at trends over time but failing to address risk adjustment

### Empirical Evidence

Research indicates that 30-day readmission rates following sepsis hospitalization range from 17% to 26%, contributing to substantial excess costs.<sup>2</sup> Readmissions adversely affect patient outcomes and impose a significant financial burden on patients and the healthcare system. Readmissions among sepsis survivors are often preventable, highlighting the need for targeted interventions to reduce sepsis-related morbidity and improve post-discharge outcomes.<sup>3</sup> Unnecessary readmissions can pose risks of iatrogenic infections, medication errors, muscle weakening, delirium, and pressure injuries such as decubitus ulcers. For sepsis survivors, unnecessary readmissions can increase the risk of infection, mortality, intensive care unit admissions, long-term complications including cognitive impairment, functional disability, and psychiatric problems, and increased healthcare utilization, which all lead to poor quality of life.<sup>4</sup> Sepsis and infection are the most common causes for hospital readmission after the index sepsis hospitalization.<sup>5,6,7</sup> Sepsis is also a main reason why patients are readmitted to the hospital following hospitalizations for other conditions or procedures and has been reported to be associated with higher costs compared to other conditions selected for CMS reporting.<sup>8</sup>

Given that there are currently no existing sepsis readmission measures, there is a clear gap in tracking, capturing, and reporting on hospital sepsis readmissions. The Logic Model (see below) shows how the sepsis readmission measure can be used to improve the quality of clinical care and care transitions, which can influence patient health outcomes and readmission risk. The sepsis readmission measure will encourage hospitals to prioritize patient safety during all aspects of care. Specifically, the sepsis readmission measure can 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. Hospital-specific readmission rates can be influenced by care processes, and there is considerable variation in readmission rates among hospitals<sup>9</sup>, suggesting that hospitals can improve outcomes through better management strategies. For example, interventions such as care coordination with post-discharge clinical teams, collaboration with primary care providers and community-based programs, home visits, telephone or telemedicine follow-ups, patient and family education about signs or symptoms of unresolved or recurrent infection and side effects of medications, instructions on what to do should these complications arise, medication reconciliation, discharge planning and a mechanism by which the team can close the loop on items introduced at discharge. Telemonitoring has also been identified as effective strategies for reducing hospital readmissions. These approaches enhance the care of the peripherally inserted central catheter (PICC line) or port-a-cath in the case of prolonged intravenous antibiotics administration. They will also improve care transitions, improve patient engagement, and ensure continuity of care, ultimately mitigating the risk of readmission.<sup>10</sup> One 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.<sup>11</sup>

**Table 2: Ovid Medline Search Criteria and Results**

<b>Criterion #</b>	<b>Criterion Description</b>	<b>Results</b>
1	Exploded search for Sepsis <b>[exp *Sepsis/]</b>	146073
2	The words 'sepsis' or 'septic' or 'bacteremia' or 'septicemia' in word text (abstract or title) or key word <b>[(sepsis or septic or bacteremia* or septicemia*).ti,kf.]</b>	92051
3	1 or 2	175848
4	The phrase 'patient readmission' <b>[patient readmission/]</b>	23720
5	The word beginning with 'rehospitaliz' in text word or key word <b>[rehospitaliz*.tw,kf.]</b>	7967
6	The words 'after' or 'post' within one word of 'hospital' or 'discharge' in text word or key word <b>[((after or post*) adj1 (hospital* or discharge*)).tw,kf.]</b>	81123
7	The words 'patient', '30-day' or 'thirty-day' within one word of 'readmission' or 'readmit' in text word or key word <b>[((patient* or 30-day* or thirty-day*) adj1 (readmission or readmit*)).tw,kf.]</b>	8009
8	4 or 5 or 6 or 7	108028
9	3 and 8	1522
10	The word 'excess' within three words of 'day', 'in-acute', or 'in-hospital' <b>[(excess* adj3 (day* or in-acute or in-hospital)).tw,kf.]</b>	6115
11	EDAC as text word (abstract or title) <b>[EDAC.ti,ab.]</b>	307
12	The words 'patient', '30-day' or 'thirty-day' within one word of 'readmission' or 'readmit' in text word or key word <b>[((patient* or 30-day* or thirty-day*) adj1 (readmission or readmit*)).tw,kf.]</b>	8009
13	The phrase 'patient readmission' <b>[patient readmission/]</b>	23720
14	Exploded search for <b>[exp Emergency Service, Hospital/]</b>	103101
15	The word 'emergency' within one word of 'service', 'room', 'department', or 'medicine' or the word 'observation' within one word of 'patient', 'stay', 'unit', or 'hospital' <b>[((Emergency adj1 (service* or room* or department* or medicine*)) or (observation* adj2 (patient* or stay* or unit* or hospital*))).tw,kf.]</b>	196227
16	10 or 11 or 12 or 13 or 14 or 15	263885
17	9 and 16	494
18	Exploded search for Risk Assessment <b>[exp risk assessment/]</b>	316844
19	The word 'risk' within three words of 'score', 'model', 'predict', 'assess', or 'algorithm' <b>[(risk* adj3 (score* or model* or predict* or assess* or algorithm*)).tw,kf.]</b>	337745
20	18 or 19	578676
21	17 and 20	46

**Figure 1. Logic Model for the Sepsis Readmission Measure**

*The Sepsis Readmission measure assesses readmission within 30 days of discharge from an inpatient hospitalization for sepsis. This measure is intended to capture the quality of care during index hospitalization and through discharge transitions provided to patients hospitalized for an eligible sepsis condition by measuring risk standardized rates of unplanned readmissions at any time during the 30 days post-discharge. CMS will report the measure for patients who are 65 years or older, are enrolled in Medicare fee-for-service (FFS) or Medicare Advantage (MA) and are hospitalized in non-federal short-term acute care hospitals. The outcome for the measure is adjusted to account for age and comorbidities and counts unplanned readmissions within 30 days of discharge from an eligible index hospitalization of sepsis. Planned readmissions, which are generally not a signal of quality of care, are not considered readmissions in the measure outcome. Performance on the sepsis readmission measure will be released once every year, with data from the previous 12 months.*

Inputs	Activities	Outputs	Outcomes	Impacts
<ul style="list-style-type: none"> <li>Electronic health records (EHR dashboards)</li> <li>Quality improvement (QI) infrastructure</li> <li>Hospital specific reports</li> <li>Capacity to measure patient context and identify patients at high risk for readmission</li> <li>Development of patient education materials</li> <li>Development of staff training materials.</li> <li>Hospital-wide infection control mechanisms</li> </ul>	<ul style="list-style-type: none"> <li>QI committee to evaluate dashboard and develop QI projects</li> <li>Policies around adoption of and adherence to clinical guidelines</li> <li>Improved timing of care delivery</li> <li>Antibiotic stewardship committee</li> <li>Sepsis guideline implementation in ED and critical care units</li> <li>Care coordination with clinical teams</li> <li>Implementation of a structured peridischarge collaboration plan with primary care providers, specialists, and community-based programs</li> <li>Adoption of transition of care procedures to improve safe discharge</li> </ul>	<ul style="list-style-type: none"> <li>Improved communication between patients, family and care givers, and post-discharge care teams</li> <li>Building trust between patients and the clinical care staff team</li> <li>Improve attendance at ambulatory post-discharge appointments</li> <li>Increasing education for self-monitoring of signs of unresolved infections or recurrent infections</li> <li>Providing patient workflows to get care for signs and symptoms: post hospital visits, urgent care, calling PCP/Infectious disease specialists</li> <li>Support and education about completion of course of antibiotics and medication reconciliation</li> <li>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.</li> <li>Consideration of the acute clinical intervention in the context of primary health problems and comorbid conditions</li> </ul>	<p><b>Short-term</b></p> <ul style="list-style-type: none"> <li>Adherence to treatment regimen</li> <li>Reduced utilization of emergency department services</li> <li>Improved knowledge about condition and better recognition of symptoms</li> <li>Reduction in iatrogenic infections</li> </ul> <p><b>Intermediate term</b></p> <ul style="list-style-type: none"> <li>Reduced healthcare utilization</li> <li>Improved relationship between care teams and patients, family, and caregivers</li> </ul> <p><b>Long-term</b></p> <ul style="list-style-type: none"> <li>Reduced inpatient readmission</li> <li>Improved patient satisfaction</li> <li>Reduced mortality</li> </ul>	<ul style="list-style-type: none"> <li>Reduced patient readmissions</li> <li>Reduced risk of hospital-acquired infections</li> <li>Better patient quality of life</li> <li>Lower overall health system cost</li> <li>Decreased morbidity and mortality</li> </ul>

Inputs	Activities	Outputs	Outcomes	Impacts
	<ul style="list-style-type: none"> <li>Build structure for feedback to responsible parties.</li> </ul>	<ul style="list-style-type: none"> <li>Discharge planning</li> <li>Telemonitoring</li> </ul>		

Feedback Mechanisms
<ul style="list-style-type: none"> <li>Real-time provider dashboards tracking sepsis-related acute care visits and complications.</li> <li>Utility of the hospital specific report for hospital performance on the sepsis readmission measure and benchmarking hospitals performance against national measure performance.</li> <li>Patient-reported outcomes on self-management confidence and outpatient care experience.</li> <li>Regular case review meetings with care teams to refine discharge protocols.</li> <li>QI mechanisms</li> </ul>
Assumptions
<ul style="list-style-type: none"> <li>Hospitals have access to structured EHR data for tracking sepsis-related hospital stays.</li> <li>Post-discharge interventions (case management, telemonitoring) are available and feasible.</li> <li>Patients have the ability and willingness to engage in self-management programs.</li> <li>Resource availability (staff, infrastructure, and time) to implement bundled or multifaceted interventions that address gaps in the transition process.</li> <li>Hospitals have established relationships with primary care providers and the community to further enhance the coordinating care transitions processes</li> <li>Provider buy-in for standardized discharge planning, follow-up protocols, and care transition interventions.</li> <li>QI infrastructure</li> <li>Resources for training of staff</li> </ul>
External Factors
<ul style="list-style-type: none"> <li>Policy and reimbursement models for sepsis care transitions (e.g., CMS, private payers).</li> <li>Socioeconomic determinants affecting patient follow-up (e.g., transportation, health literacy).</li> <li>Provider shortages, particularly infectious disease specialists and PCPs.</li> <li>Staff shortages: nursing</li> </ul>

**Summary:** The Sepsis Readmission measure focuses on improving post-discharge care for Medicare beneficiaries hospitalized for sepsis. The sepsis readmission measure, as outlined above, could lead to improvements in initial diagnosis and management of sepsis, care coordination, discharge planning, sepsis mortality post-discharge, and longer-term health outcomes such as quality of life.



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