VIEWPOINT

The Importance of Shifting Sepsis Quality Measures From Processes to Outcomes

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Sepsis continues to be a leading cause of death and disability worldwide. In the US alone, more than a quarter million adults hospitalized with sepsis die each year. Clinicians, patients, regulators, and quality improvement advocates recognize the necessity of doing more to prevent sepsis and improve sepsis outcomes.

One of the highest-profile measures designed to improve sepsis outcomes is the Centers for Medicare & Medicaid Services (CMS) Severe Sepsis/Septic Shock Early Management Bundle (SEP-1). SEP-1 requires hospitals to report adherence to a strictly defined initial management bundle that includes obtaining blood cultures, measuring lactate, and administering broad-spectrum antibiotics within 3 hours of a patient meeting sepsis criteria, infusing at least 30 mL/kg of intravenous crystalloids for hypotension or hyperlactatemia, and rechecking lactate and initiating vasopressors within 6 hours for refractory shock. It is an all-or-nothing bundle; hospitals receive credit only if all components are performed or contraindications documented. SEP-1 is currently a pay-for-reporting measure, but CMS recently proposed changing it to a pay-for-performance measure.

SEP-1 was launched in 2015 with high expectations that it would improve outcomes for patients with sepsis. Unfortunately, it has not done so. Four large, rigorous, multicenter time-series analyses now document the disappointing real-world impact of SEP-1 across hundreds of US hospitals.[1-4] Broad-spectrum antibiotic use has increased since SEP-1 went into effect, but SEP-1 has not lowered mortality rates.

The first study included 111 hospitals and reported that broad-spectrum antibiotic use increased by 0.4% per month after SEP-1 was implemented.[1] The second study included 114 hospitals and reported a 25% increase in anti–methicillin-resistant *Staphylococcus aureus* antibiotic use in patients with possible sepsis between 2013 and 2017 (from 19.8% to 26.3%) and a 45% increase in antipseudomonal antibiotic use (from 27.7% to 40.5%) but no change in the combined outcome of hospital death or discharge to hospice (from 20.3% to 20.4%; odds ratio, 1.00; 95% CI, 0.97-1.04).[2] University of Pittsburgh Medical Center investigators reported similar trends among 11 affiliated hospitals.[3] The fourth study, including 26 hospitals, reported that (1) antibacterial use increased by 24% between 2014 and 2016 and (2) overall hospital mortality rates were decreasing before SEP-1 but the trend leveled off after SEP-1 went into effect.[4]

The only studies that claim a benefit from SEP-1 are a subset of those comparing outcomes among patients who received SEP-1–compliant vs noncompliant care (ie, all components of the SEP-1 bundle were or were not performed).[5] These studies are unreliable, however, because the patients who receive care that is not compliant with SEP-1 are very different from those who receive care that is compliant with SEP-1: they tend to have more severe illness and more ambiguous clinical presentations, and are more likely to have shock (and thus require clinicians to complete more steps to be compliant with SEP-1). This was evident in an analysis of 245 740 patients that reported SEP-1 compliance was associated with lower mortality rates than SEP-1 noncompliance (21.8% vs 27.5%); despite propensity matching, patients who received noncompliant care were more likely to have hyperlactatemia (17.3% vs 9.4%) and septic shock (25% vs 15.1%).[5] When the investigators focused exclusively on patients with septic shock (a more apples-to-apples comparison), mortality rates were similar for SEP-1–compliant vs noncompliant care (38% vs 35%; $P = .33$). Similarly, studies with more robust risk adjustment report no differences in mortality rates for SEP-1–compliant vs noncompliant care.[6]

There are many possible explanations for SEP-1's failure to improve outcomes. The antibiotic and fluid components of the bundle are controversial because the measure does not account for the complexity of diagnosing sepsis, selecting an appropriate initial antibiotic regimen, and the heterogeneity of sepsis patients, presentations, and credible management strategies.[6] Approximately one-third of patients treated for sepsis in emergency departments and intensive care units are found to have nonbacterial infections or noninfectious mimicking conditions.[7] These patients are at risk of the adverse effects of broad-spectrum antibacterial therapy without their potential benefits. Similarly, not all patients with hypotension require or are able to tolerate 30 mL/kg of fluids (eg, patients with heart failure and fluid overload, patients with tenuous respiratory status, and some patients with kidney disease).

The term *sepsis* encompasses a very wide range of patient populations, infectious precipitants, primary sites of infection, secondary organ dysfunctions, and severity of illness. It is inappropriate to require clinicians to treat all these patients in a single, rigid, uniform fashion. The COVID-19 pandemic helped reaffirm the fallacy that all patients with possible sepsis require immediate broad-spectrum antibiotics and aggressive fluid resuscitation. About one-third of individuals hospitalized for COVID-19 meet international consensus criteria for sepsis (infection leading to organ dysfunction), but only a small minority have concurrent bacterial infection or require aggressive fluid resuscitation. The common practice early in the pandemic of treating all COVID-19 patients with antibiotics typically offered no benefits but selected for multidrug-resistant bacteria and, ironically, may have increased these patients' future risk of sepsis by disrupting the microbiome.[8]

One may wonder why SEP-1 has not been able to reproduce the mortality reductions reported by New York State and other sepsis quality improvement initiatives using similar bundles.[9] New York State's sepsis regulations, however, allow hospitals more flexibility in bundle design, report compliance with 3- and 6-hour bundle components separately, require hospitals to actively educate staff, and track sepsis outcomes in addition to processes of care.[3] More broadly, determining the true impact of bundles is challenging because they focus on increasing sepsis recognition as well as care. This typically leads to more sepsis diagnoses, inclusion of patients with milder syndromes, and, thus, a decrease in net sepsis mortality rates that could reflect labeling more patients with sepsis, improvements in care, or both.[10] A strength of the SEP-1 time-series analyses cited previously[2,3] is that these analyses used consistent clinical indicators to identify possible sepsis (obtaining clinical cultures, administering antibiotics, and signs of organ dysfunction) rather than physician diagnoses, thus sidestepping the risk of ascertainment bias associated with analyses that use sepsis registries or diagnosis codes to track sepsis rates and outcomes.

The broader limitation of SEP-1 is that it focuses exclusively on the initial hours of care and lacks incentives to optimize subsequent care. Patients with sepsis are often hospitalized for long periods. Their clinical courses can include intensive care admission, mechanical ventilation, invasive catheters, sedation, catecholamines, and antibiotics for secondary infections. Such patients are at very high risk of nosocomial complications, including acute lung injury, health care–associated infections, delirium, deconditioning, and pressure ulcers. These risks are reflected in the Surviving Sepsis Campaign guidelines that describe at length both the initial resuscitation of patients with sepsis and strategies to minimize subsequent complications. SEP-1's focus on initial management alone ignores the enormous importance of optimizing every aspect of care for patients with sepsis from first contact through hospital discharge and, given the long-term adverse sequelae of sepsis, postdischarge care for sepsis survivors.

We believe the solution to SEP-1's failure to improve patient outcomes is to change the focus of sepsis quality metrics from processes to outcomes, particularly short-term mortality. This will shift the emphasis to what matters most to patients and clinicians. It will sidestep some of SEP-1's potentially deleterious incentives and allow clinicians to tailor care to patients' variable syndromes, underlying conditions, precipitating pathogens, and potential complications. Hospitals can still opt to embrace early management bundles, but focusing on outcomes will incentivize hospitals to address the full continuum of sepsis care and not just limited aspects of the initial resuscitation.

Moreover, shifting from processes to outcomes will encourage more innovation in areas that are more likely to improve outcomes. Examples include adopting emerging technologies that accelerate identification of infecting organisms and antimicrobial susceptibilities, implementing tools to predict impending sepsis, partnering with emergency medical services to provide antibiotics for the sickest patients before they reach the hospital, improving not just time-to-antibiotic orders but also timely antibiotic delivery and redosing, achieving effective antibiotic concentrations, ensuring expeditious and thorough source control, tailoring treatment to specific syndromes and pathogens, setting appropriate antibiotic courses and stopping unnecessary antibiotics to minimize selection for resistant pathogens, preventing health care–associated infections, avoiding delirium, and providing effective restorative care for sepsis survivors both before and after discharge.

CMS is well underway with developing a new sepsis mortality measure that will hopefully replace SEP-1. The new measure is designed to be collected electronically, a promising step forward that has the potential to allow hospitals to shift the substantial resources they currently devote to measuring SEP-1 manually toward optimizing care. Important details, including precise criteria for defining sepsis and how to perform risk adjustment for hospital-to-hospital comparisons, remain in development. However, the forthcoming measure's focus on outcomes is what matters most. The proposal by CMS to entrench SEP-1 by making it a pay-for-reporting measure, in contrast, is a step backward.

SEP-1 helped usher in a new era of accountability and focus on sepsis care, but data from hundreds of hospitals now show that it has not met its core goal of improving outcomes. It is time to shift the focus of sepsis quality metrics from narrowly defined, controversial, and constraining process measures to patient-centered outcomes, with all the attendant breadth of opportunity and responsibility that this entails.

ARTICLE INFORMATION

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REFERENCES

1. Pakyz AL, Orndahl CM, Johns A, et al. Impact of the Centers for Medicare and Medicaid Services sepsis core measure on antibiotic use. *Clin Infect Dis*. 2021;72(4):556-565. doi:10.1093/cid/ciaa456

2. Rhee C, Yu T, Wang R, et al. Association between implementation of the Severe Sepsis and Septic Shock Early Management Bundle performance measure and outcomes in patients with suspected sepsis in US hospitals. *JAMA Netw Open*. 2021;4(12):e2138596. doi:10.1001/jamanetworkopen.2021.38596

3. Barbash IJ, Davis BS, Yabes JG, et al. Treatment patterns and clinical outcomes after the introduction of the Medicare sepsis performance measure (SEP-1). *Ann Intern Med*. 2021;174(7):927-935. doi:10.7326/M20-5043

4. Anderson DJ, Moehring RW, Parish A, et al. The impact of Centers for Medicare & Medicaid Services SEP-1 core measure implementation on antibacterial utilization. *Clin Infect Dis*. 2022;75(3):503-511. doi:10.1093/cid/ciab937

5. Townsend SR, Phillips GS, Duseja R, et al. Effects of compliance with the early management bundle (SEP-1) on mortality changes among Medicare beneficiaries with sepsis. *Chest*. 2022;161(2):392-406. doi:10.1016/j.chest.2021.07.2167

6. Baghdadi JD, Brook RH, Uslan DZ, et al. Association of a care bundle for early sepsis management with mortality among patients with hospital-onset or community-onset sepsis. *JAMA Intern Med*. 2020;180(5):707-716. doi:10.1001/jamainternmed.2020.0183

7. Klein Klouwenberg PM, Cremer OL, van Vught LA, et al. Likelihood of infection in patients with presumed sepsis at the time of intensive care unit admission. *Crit Care*. 2015;19(1):319. doi:10.1186/s13054-015-1035-1

8. Baggs J, Jernigan JA, Halpin AL, et al. Risk of subsequent sepsis within 90 days after a hospital stay by type of antibiotic exposure. *Clin Infect Dis*. 2018;66(7):1004-1012. doi:10.1093/cid/cix947

9. Kahn JM, Davis BS, Yabes JG, et al. Association between state-mandated protocolized sepsis care and in-hospital mortality among adults with sepsis. *JAMA*. 2019;322(3):240-250. doi:10.1001/jama.2019.9021

10. Rhee C, Dantes R, Epstein L, et al. Incidence and trends of sepsis in US hospitals using clinical vs claims data, 2009-2014. *JAMA*. 2017;318(13):1241-1249. doi:10.1001/jama.2017.13836