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Difficulties in Retrospectively Characterizing Sepsis in Patients With Trauma

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The severely injured patient with trauma who is in a catabolic state, combating the lethal triad of death (hypothermia, acidosis, and coagulopathy), has undergone a life-saving damage control operation, is nearing physiological exhaustion, and will be susceptible to infection. The constellation of hemodynamic instability, end-organ failure, and tissue hypoxia are recognizable septic shock symptoms in the patient without trauma; however, when confounded by the posttraumatic setting, the assumption of sepsis and immunologic incompetency must take priority within the clinical differential. The physical examination findings defining the systemic inflammatory response syndrome are early criteria in the continuum leading to sepsis and septic shock.[1] Identification of sepsis related to an infectious process and the subsequent appropriate interventions may result in favorable patient outcomes. Missing these findings may lead to an extended hospitalization, increased ventilatory requirements and morbidity, and potentially death. Methods to accurately account for this patient population and to understand an institution's disease burden may lead to comparable interfacility metrics, justification for an increased number of patient beds and staff, or validation for additional funding.

By interrogating their institutional electronic medical record (EMR), the National Trauma Data Bank (NTDB), and patients' *International Classification* of *Diseases* (*ICD*) codes, Stern et al[2] investigated 3 methods to identify patients with sepsis. Sepsis was defined by the 2016 Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) consensus guidelines.[1] Their EMR was queried using the Centers for Disease Control and Prevention sepsis surveillance guidelines with the additional criteria of (1) tissue culture ordered within 48 hours of a new intravenous antibiotic, (2) a course of antibiotics for a minimum of 4 consecutive days or until death or hospital discharge, and (3) an increase in the Sequential Organ Failure Assessment score over a 6-day period centered around the culture date. The Angus method (ie, examination of a patient's *ICD* codes for infection and organ dysfunction, severe sepsis, or severe sepsis with shock) was used.[3] Last, the NTDB was reviewed for a source of infection with bacteremia and physiological derangements. There were 3194 patients who met study inclusion criteria. Using the 3 metrics, sepsis (EMR data, 23%; NTDB, 4%; Angus method, 17%) and in-hospital mortality (EMR data, 23%; NTDB, 36%; Angus method, 21%) were identified.

The methods used highlighted several limitations of automated sepsis identification, medical billing transcription, and populating large databases. First, the physiology of a patient with trauma may mimic sepsis but may not meet standardized criteria. For example, a significant traumatic brain injury may result in episodic neurostorming (paroxysmal autonomic instability). These patients with fever and tachycardia may trigger a sepsis protocol involving a bacteremia evaluation and the initiation of antibiotics. Their presentation, however, is more accurately addressed with β-receptor blockade, patient repositioning, and electrolyte correction. Similarly, postoperative leukocytosis and transient febrile states are expected findings due to the recent physiological insults of a patient with trauma. A vigilant health care professional unfamiliar with postoperative patients with trauma may initiate a sepsis evaluation. These examples will be documented within the medical record as a sepsis evaluation. The strict interrogation of a patients' EMR, abstracting culture data and antibiotic initiation, will record these findings as a patient with sepsis when these are expected physiological derangements.

Second, analogous to the aforementioned, the retrospective analysis by Stern et al[2] was contingent on the accuracy of large databases and the translation of clinical information into a coding

structure that may not comprehensively capture a patient's clinical status. This clinical status is best diagnosed by performance of a bedside physical examination. Combining the physical examination, biochemical results, and radiographic findings may lead to real-time definitive diagnoses, immediate interventions, and improved outcomes. In 2001, Rivers et al[4] proposed early goal-directed therapy (EGDT) as a clinical protocol to reduce severe sepsis, septic shock, and in-hospital mortality. This prospective study used real-time clinical data to randomize patients into the standard therapy vs EGDT groups. The study demonstrated a significant in-hospital mortality difference between standard therapy and EGDT (46.5% vs 30.5%; *P* = .009). This landmark study resulted in a paradigm shift in critical care that has become common practice. More recent investigations (ARISE [Australasian Resuscitation in Sepsis Evaluation], PROMISE [Protocolised Management in Sepsis], and PROCESS [Protocolized Care for Early Septic Shock]),[5-7] which used a similar inclusion criterion and care pathways—EGDT vs standard of care—did not demonstrate a clinical statistical difference between the 2 pathways. This is not surprising. Given the maturation of critical care protocols, the institution of early antibiotic stewardship, maintenance of the biochemical profiles, and other ancillary interventions for the critically ill patient, the baseline standard of care has advanced, resulting in significantly improved outcomes compared with the comparison group in the study by Rivers et al.[4]

The findings by Stern et al[2] also demonstrate that our reliance on the EMR and large self-reporting electronic databases has become ubiquitous. The dependence on mobile computers and handheld tablets during patient rounds has increased patient data generation to potentially untenable levels. These technological advancements have cultivated industries to translate medical terminology into the billable context. This complicated and evolving process, which began in 1909 with *ICD-1*, has been periodically refined and upgraded, increasing its granularity and specificity, resulting in *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* (*ICD-10*), the latest iteration. This leads to a third limitation. Continued *ICD* code refinement has potentially led to apathy and fatigue. For example, nuanced definitions have helped classify and differentiate between postprocedural sepsis (*ICD-10* code T81.4) and sepsis with organ dysfunction (*ICD-10* code R65.20). These are distinctly different billing codes, although the patient presentation could be categorized by both. The bedside clinicians' interpretation, coding technicians' translation, and subsequent *ICD-10* code selection is a multifactorial equation with multiple solutions. To resolve this problem, some institutions have required their physicians to assume the coding burden. Although this eliminates a second party's interpretation of the EMR, comprehensive coding may be limited by an individual's clinical burden and workflow prioritization. Another solution is to virtually decrease the geographic distance between the clinician and coder by increasing the communication between the medical and coding teams. This bidirectional approach may educate both groups, targeting specific words and phrases needed to code and bill appropriately.

Finally, Stern et al[2] performed a retrospective investigation. There are numerous proprietary algorithms that can interrogate an EMR, providing real-time analysis identifying patients who may present with early sepsis. This artificial intelligence approach is agnostic of clinicians' personal or professional influences, producing a repeatable solution and a higher level of precision. This approach may be the next tool in developing a clinical sepsis metric. Stern et al[2] have accurately demonstrated several flaws within the current system, which may lead to an additional evaluation of the coding and data abstraction process.

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