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Unpacking regionalization of sepsis care using hospital capability assessments

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The theory of regionalized acute care seeks to align specific patients with hospitals that offer expertise and capabilities relevant to their care needs. Regionalized care systems for some conditions—trauma, stroke, and myocardial infarction, for example—have offered tangible improvements to patient outcomes by engaging pre-hospital first responders, emergency departments, and inpatient providers in the selection of admission and transfer destinations.^{1–3} Natural diagnoses to consider for future regionalization efforts are those with high morbidity and mortality, demonstrated evidence for high-complexity therapeutic management, and significant observed heterogeneity in treatments and outcomes across hospitals. Does the curse of sepsis fit the bill? As a candidate, certainly—morbid and deadly, requiring a multipronged approach to management, and with heterogeneity in nearly all aspects of its story from diagnosis to recovery.^{4,5}

In today's issue of *Critical Care Medicine*, Ofoma and colleagues⁶ examine the relationship between sepsis-related hospital capabilities—a potential determinant of transfer destination in a regionalized sepsis care system—and sepsis outcomes. To do this, they first developed and validated a novel sepsis-related hospital capability index using a principal component

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analysis of six sepsis-related hospital resource use characteristics: sepsis case volume, bed capacity, major diagnostic procedures, major therapeutic procedures, renal replacement therapy, and mechanical ventilation. Compared to sepsis case volume alone—the prevailing proxy for hospital capability for sepsis care—this sepsis-related hospital capability index explained more variation in hospital-level sepsis mortality and had stronger correlation with sepsis transfer rates across their derivation and validation cohorts. Patients admitted to hospitals with higher sepsis capability scores (i.e., hospitals that treated more sepsis and which performed additional diagnostic and therapeutic procedures) tended to admit septic patients with more acute organ dysfunction that ultimately experienced greater mortality. The authors conclude from these findings that the sepsis-related hospital capability index has validity for stratifying hospitals by their abilities to provide sepsis-related care and that sepsis care may already be (albeit partially and informally) regionalized. Notably, the authors identified similar mortality between low and high capability hospitals among patients with fewer organ failures. This may additionally mean that low-capability hospitals have become facile at achieving good outcomes for lower acuity sepsis patients.

The strengths of this study include its use of broad, statewide data for robust derivation and validation cohorts, its focus on the ever-important scourge of sepsis and the noble goal to create a more nuanced understand of hospital capability for this condition, and rigorous and well-presented analyses. Limitations—or at least unresolved nuances—of the study center around the novel sepsis-related hospital capability index and what it truly represents. The authors wanted a more complete measure of sepsis capability than offered by sepsis case volume alone, and so added as inputs bed capacity (e.g., total beds) and then sepsis-related diagnostics and therapeutics. Sepsis case volume and bed capacity remain straightforward—a hospital may have greater sepsis capability if it has more sepsis experience and more beds in which to care for patients with sepsis.

The relationship between sepsis-related diagnostics and therapeutics—procedures, renal replacement therapy, and mechanical ventilation— and implied capabilities are, in contrast, considerably more complicated. For example, the diagnostic and therapeutic procedure volumes used were derived from revenue and procedure coding. These observed volumes are certainly in part additional proxy measures of overall case volume that requires such diagnostic and therapeutic procedural volume, and representative of hospital experience with such procedures. But they also capture embedded among-hospital differences in utilization of such diagnostic and therapeutic procedures independent of case volume and characteristics—a well-documented phenomenon.^{7,8} Said another way, hospitals that are high-utilizers of procedures for sepsis evaluation and management, even adjusted for patient characteristics, will be characterized as having “high sepsis capabilities” in this domain, relative to low-utilizers. It is unclear how this might introduce bias or otherwise influence interpretation of the composite sepsis-related capability index.

The finding of higher adjusted mortality among patients admitted to the highest sepsis capability scoring hospitals, although only evident among patients with three or more acute dysfunctions in stratified analyses, appears to contradict the prevailing literature that hospitals with the highest sepsis case volume have the best outcomes.⁹ There are a few potential explanations for this. The first, offered by the authors, is that sepsis care may now

already be significantly regionalized, and that low-capability hospitals are achieving good outcomes for lower acuity sepsis patients. Assessing this interpretation rests to some degree on the success of the study's approach to risk adjustment across hospital capability strata—this interpretation would be more valid with less successful risk adjustment. Alternatively, if the inclusion of diagnostic and therapeutic procedural volume in the capability index captures significant procedural overuse under the guise of capability, what is labeled a “high capability” hospital stratum may indeed be enriched by those hospitals with wasteful and potentially complication-inducing procedural utilization, hence the poorer outcomes.

More broadly, this manuscript provides a fresh look under the hood of the largely informal U.S. critical care transfer network and of the transfer decisions that define it. In a 2004-2005 study, Iwashyna and colleagues applied tools from network analysis to map the critical care transfer network in the U.S.¹⁰ After constructing this map, the authors identified characteristics of more “central” hospitals—hospitals that received more critically ill transfer patients than they sent. They found that hospitals were loosely organized into networks, and that hospitals assuming a more central position in each network offered greater advanced diagnostic and therapeutic services, including cardiac catheterization and modern imaging. In the present study, Ofoma and colleagues similarly classified hospitals, relying in part on their experience with selected diagnostic and therapeutic procedures most pertinent to sepsis. Limitations stemming from procedural underuse or overuse notwithstanding, the authors found that sepsis-related clinical experience was more strongly negatively correlated with outward transfer rates—with “central”-like hospitals expected to have low outward transfer rates—than the number of sepsis cases alone.

Together with the earlier findings by Iwashyna, this finding supports the idea that patients, providers, or hospitals may be selecting transfer destinations by the availability of specialized *services* (e.g., percutaneous nephrostomy or mechanical ventilation) rather than general experience with a given *diagnosis*.¹¹ In effect, patients, providers, hospitals, or the market may be doing organically for sepsis-related diagnostic and therapeutic procedures—likely at limited scale—what many have advocated for mechanical ventilation,¹² specialized surgical care,¹³ and other complex procedures or interventions. Such *informal* regionalization, however, may fail to realize the maximal benefits of concentrated expertise and specialized care teams.¹⁴ It may also lead to disparities in who is offered more specialized care or potentiate losses of local procedural expertise that become important when transfer capabilities at receiving hospitals are overwhelmed.¹⁵

Future work should evaluate the extent to which organic transfer networks achieve some of the proposed benefits of regionalized care while avoiding potentially unintended consequences. In the interim, the authors provide a useful construct for those seeking to unpack and begin to optimize the critical care transfer network for sepsis and other critical illness syndromes.

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