Invited Commentary: The Effect of Trauma Center Verification on Outcomes of Traumatic Brain Injury Patients Undergoing Interfacility Transfer

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When an injured patient presents to a non-trauma hospital, and a provider determines that the needs of the patient exceed the capabilities of the hospital, she faces a critical decision: where to send the patient? Hospital referral patterns may be predetermined by inter-facility transfer agreements, but they may also be informed by evidence regarding hospital outcomes. For example, a limited amount of evidence suggests that patients with traumatic brain injuries (TBIs) have improved survival when treated at ACS Level I trauma centers compared with ACS Level II trauma centers.[1, 2] While those studies favor the transfer of TBI patients to ACS Level I trauma centers, the amount and quality of evidence supporting that decision is quite limited. One of the studies cited above uses data that predates current ACS trauma center verification criteria, while the other uses data that is limited to a single state.

Given this paucity of evidence and the lack of a distinction between clinically relevant resources at ACS Levels I and II trauma centers,[3] the authors of this study postulated that these two types of trauma centers actually achieve equivalent clinical outcomes for TBI patients. To test their hypothesis, the authors used nationally representative data to develop a risk-adjusted model for in-patient mortality of TBI patients who underwent inter-facility transfer. Then, they tested for a mortality difference between ACS Level I and Level II trauma centers.

The finding that no statistically significant difference existed between types of trauma centers is provocative and has potentially consequential policy implications for trauma systems. First, the findings of this study challenge previous studies that found that ACS Level I trauma centers impart a survival benefit over Level II trauma centers. The negative findings of this study may, in fact, reflect that trauma systems are generally functioning as intended: mortality has been optimized by the selective referral of more severely injured patients to ACS Level I trauma centers, while patients with less complex injuries are selectively transferred to ACS Level II trauma centers. Mortality, however, is a blunt measure of healthcare quality. It is worth noting that Level II trauma centers appeared in this study to have a greater rate of unadjusted complications compared with Level I trauma centers, and significant differences in other study outcomes appeared to exist as well (Table 2). Unfortunately, the study does not report adjusted differences in those outcomes.

Given the findings of this study, it is reasonable to infer that ACS Level II trauma centers provide a safe alternative to ACS Level I trauma centers for the management of patients with isolated TBIs. As the authors suggest, EMS providers managing those patients should not necessarily bypass ACS Level II facilities while performing an inter-facility transfer, given that their local knowledge supports the literature. Increased utilization of ACS Level II centers for the care of patients with isolated TBIs has the potential to increase access to care and may allow patients to remain closer to their families and/or support communities. Furthermore, these policy implications are particularly timely, given that many hospitals are experiencing unprecedented capacity strain secondary to the COVID-19 pandemic. As leaders of Level I trauma programs seek preserve capacity for the more severely injured patients and avoid diversion status, they may explore coordinating with ACS Level II trauma centers to direct isolated TBI patients to those facilities. Unfortunately, virtually all hospitals are experiencing some form of capacity strain currently, not just ACS Level I trauma centers, and it is unclear whether ACS Level II trauma centers can safely accommodate increased trauma volume.

Of course, the findings of this study should be interpreted in the context of its limitations. As mentioned above, the full range of outcomes are not reported in a risk-

adjusted manner, so one cannot draw a fuller understanding of how trauma quality compares between the different types of trauma centers beyond in-hospital mortality. Also, the rationale for certain statistical methods is not fully explained (e.g., transforming continuous variables like systolic blood pressure into dichotomous variables) and would seem to compromise the statistical power of the analyses. The ACS risk-adjustment methods are well described, and deviation from those methods should be justified.[4] Further, it is curious that GCS was not included in the multivariable model, given its prevalence in existing neurotrauma literature and high prognostic value. Since the study cohorts were likely influenced by selection biases of the referring hospitals, a propensity score matched approach to the analyses may have yielded results that better account for those unmeasured biases. Finally, the study is constrained by the data itself, since the authors were unable to account for variations in pre-trauma center care and trauma center proximity that may have resulted in delays in therapy and influenced patient outcomes.[5] Despite these limitations, the risk-adjusted mortality model produced a C-statistic of 0.83, reflecting a sound predictive model, so the results of the analyses and their policy implications warrant consideration.

The authors seek to attribute their findings to changes in the guidelines for ACS trauma center verification, stating that the previous literature that demonstrated differences in outcomes between ACS Level I and Level II trauma centers used data that predated the publication of the most recent ACS trauma center verification requirements. However, we submit that other study designs (e.g., difference-in-difference) would be more appropriate to examine the association between changes in health policy and clinical outcomes.[6] For that reason, as well as the fact that more recent data suggest that differences persist between outcomes at ACS Level I and Level II trauma centers,[1] attribution of this study's findings to changes in policy are unwarranted.

In short, the effective coordination of care between non-trauma hospitals and trauma centers is a cornerstone of the trauma system of care, and appropriate trauma center selection should be informed by one's local knowledge and the best available evidence. This study represents a substantive contribution to prevailing knowledge

regarding the safety of inter-facility transfer to ACS Level I and Level II trauma centers for patients with isolated TBIs.

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