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# Can trauma surgeons keep up? A prospective cohort study comparing outcomes between patients with traumatic brain injury cared for in a trauma versus neuroscience intensive care unit

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## ABSTRACT

**Background** Although many patients with traumatic brain injury (TBI) are admitted to trauma intensive care units (ICUs), some question whether outcomes would improve if their care was provided in neurocritical care units. We sought to compare characteristics and outcomes of patients with TBI admitted to and cared for in a trauma versus neuroscience ICU.

**Methods** We conducted a prospective cohort study of adult (≥18 years of age) blunt trauma patients with TBI admitted to a trauma versus neuroscience ICU between May 2015 and December 2016. We used multivariable logistic regression to estimate an adjusted odds ratio (OR) comparing 30-day mortality between cohorts.

**Results** In total, 548 patients were included in the study, including 207 (38%) who were admitted to the trauma ICU and 341 (62%) to the neuroscience ICU. When compared with neuroscience ICU admissions, patients admitted to the trauma ICU were more likely to have sustained their injuries from a high-speed mechanism (71% vs. 34%) and had a higher Injury Severity Score (ISS) (median 25 vs. 16) despite a similar head Abbreviated Injury Scale score (3 vs. 3, p=0.47) (all p<0.05). Trauma ICU patients also had a lower initial Glasgow Coma Scale score (5 vs. 15) and systolic blood pressure (128 mm Hg vs. 136 mm Hg) and were more likely to have fixed or unequal pupils at admission (13% vs. 8%) (all p<0.05). After adjusting for age, ISS, a high-speed mechanism of injury, fixed or unequal pupils at admission, and field intubation, the odds of 30-day mortality was 70% lower among patients admitted to the trauma versus neuroscience ICU (adjusted OR=0.30, 95% CI 0.11 to 0.82).

**Conclusions** Despite a higher injury burden and worse neurological examination and hemodynamics at presentation, patients admitted to the trauma ICU had a lower adjusted 30-day mortality. This finding may relate to improved care of associated injuries in trauma versus neuroscience ICUs.

**Level of evidence** Prospective comparative study, level II.

## BACKGROUND

Throughout North America, variation exists in the structure, process, and culture of intensive care units (ICUs) providing care to patients with severe traumatic brain injury (TBI).[1] Affected patients may be admitted to a trauma/surgical, general, or neuroscience ICU after severe TBI where a trauma surgeon/surgical intensivist, general intensivist, or neurointensivist directs their care.[1] Studies have previously reported that variation in the process of providing care for severe TBI may be associated with differences in patient outcomes,[2–4] highlighting opportunities for research to examine the effectiveness of different approaches.[1]

Some have recently questioned whether outcomes of patients with severe TBI would improve if their care was provided in dedicated neurocritical care units staffed by specially trained physicians, nurses, and allied health professionals.[5] Proponents of this model argue that training clinicians to be experts in both critical care and neurologic disorders may allow for an enhanced focus on neuroprotection, secondary neurologic injury prevention, and non-neurologic complications of brain injury management.[5] Some support for this argument was reported by a systematic review and meta-analysis of 11 cohort studies,[6–17] which observed that care in a neurologic versus non-neurologic ICU was associated with improved mortality and functional outcomes among patients with largely non-traumatic causes of severe acute brain injury.[5]

However, there presently exist little data on whether the provision of care in a dedicated neurocritical care unit may offer benefit over that provided in a trauma ICU for patients with severe TBI.[6 9 10 18] At present and historically, most patients with TBI in the USA are and have been cared for in trauma/surgical ICUs.[1] This is likely because these patients frequently have associated injuries,[1] whose management may benefit from the expertise of a trauma surgeon/surgical intensivist. Further, studies have suggested that adherence to guidelines created by trauma surgery experts and management of patients with multiple injuries with severe TBI in a trauma instead of neuroscience ICU is associated with improved mortality.[19–21]

In this study, we sought to prospectively compare the characteristics and outcomes of patients with TBI admitted to and cared for in a trauma versus neuroscience ICU at a major American trauma center. Our hypothesis was that patients admitted to the trauma ICU would have a higher associated mortality despite a similar TBI severity when compared with those admitted to the neurologic

ICU because of a higher overall burden of injury secondary to associated injuries.

## METHODS

### Design and setting

This prospective cohort study was conducted at the Red Duke Trauma Institute at Memorial Hermann Hospital in Houston, TX, USA. The Memorial Hermann Hospital is an urban, high-volume (the hospital admits >7000 injured patients per year) American College of Surgeons-verified level 1 trauma center that serves as the primary teaching hospital for the University of Texas Houston McGovern Medical School (UT Health) and is one of only two adult level 1 trauma centers in Houston. It is reported according to the Strengthening the Reporting of Observational Studies in Epidemiology statement.[22]

### Participants

Between May 2015 and December 2016, we assessed all injured adults (those ≥18 years of age) who met criteria for trauma team activation. We included blunt trauma patients with computed tomography (CT) evidence of acute TBI at the time of admission to hospital, including subarachnoid hemorrhage (SAH), subdural hematoma (SDH), epidural hematoma, intraparenchymal hematoma, or diffuse axonal injury (DAI). We excluded those who did not receive a head CT at the time of admission or who were <18 years of age, pregnant or incarcerated before admission, or died before being admitted to the trauma or neuroscience ICU.

### Data sources

Immediately after patient arrival, dedicated research personnel collected data on patient demographics, comorbidities, and preinjury anticoagulant use; mechanism of injury; vital signs; and neurological examination and head CT findings. After admission, they prospectively collected daily data regarding interventions (endotracheal intubation, craniotomy, craniectomy, intracranial pressure (ICP) monitor/external ventricular drain (EVD) insertion, tracheostomy, and percutaneous endoscopic gastrostomy or surgical gastrostomy tube placement) and patient outcomes from patient medical records. We collected data on the Abbreviated Injury Scale (AIS) and Injury Severity Score (ISS) of injured patients from the institutional trauma registry.

### Exposure variables

We stratified patients according to whether they were admitted to the trauma or neuroscience ICU. The Red Duke Trauma Institute Shock Trauma ICU is a 25-bed closed unit in which critically injured patients are principally cared for under the direction of a general surgeon who is fellowship trained in trauma surgery/surgical critical care. In contrast, the Mischer Neuroscience Institute at Memorial Hermann houses a 32-bed closed neuroscience ICU in which patients with a variety of life-threatening neurological conditions, including TBI, are cared for under the direction of a neurointensivist with accredited neurocritical care training.

Admission to the trauma versus neuroscience ICU at Memorial Hermann is based on several factors. Those with multisystem injuries involving more than one operative subspecialty (eg, neurosurgery, plastic surgery, orthopedics, and so on) are generally managed in the trauma ICU. In contrast, patients with single system injuries or multisystem injuries with minor, generally non-operative, non-neurological injuries are most often admitted to the neuroscience ICU. However, both units are considered capable of admitting and caring for patients with TBI. Therefore, the ICU that patients with TBI are admitted to is ultimately driven by bed availability in either unit.

### Processes of care in the trauma versus neuroscience ICU

During the study period, the trauma and neuroscience ICU used several unit-specific guidelines or protocols for providing care to patients with severe TBI. Both units initiated post-TBI seizure prophylaxis (adherence exceeded 95%) and early (<48 hours after admission) enteral nutrition (adherence was 96% in the trauma ICU and 85% in the neuroscience ICU) while maintaining blood glucose >60 and <200 mg/dL (adherence was 94% in the trauma ICU and 87% in the neuroscience ICU). The transfusion strategy in the trauma ICU was to maintain hemoglobin ≥7.0 g/dL (adherence was >90%). Although there was no defined transfusion threshold or hemoglobin target in the neuroscience ICU, the standard was to maintain hemoglobin ≥9.0 g/dL (adherence not captured). Both ICUs used 0.9% NaCl maintenance fluid for patients with severe TBI when they had not been fitted with an ICP monitor or EVD and 3% NaCl as a maintenance fluid (at 30 mL/hour) when they had been fitted with one of these devices. Both units provided hypertonic saline therapy for raised ICP (including 23.4% NaCl boluses for sustained ICP 'spikes' >25 mm Hg) until the plasma [Na+] was >160 mEq/L (at which time they were transitioned to 0.9% NaCl solution as a maintenance fluid). Neither ICU routinely used albumin therapy. Corticosteroids were not given to patients with TBI or spinal cord injury in either of the study ICUs except in cases of overwhelming sepsis and escalating doses of vasopressors (adherence not captured). For patients requiring mechanical ventilation, both units maintained partial pressure of arterial oxygen >60 mm Hg and partial pressure of arterial carbon dioxide between 38 and 45 mm Hg (adherence was 87% in the trauma ICU and 88% in the neuroscience ICU). Finally, both units had the neurosurgery service insert ICP monitoring devices in patients with: (1) a Glasgow Coma Scale (GCS) score <8, (2) CT findings indicative of elevated ICP (eg, a herniation syndrome on CT head), and (3) an abnormal brain CT where a neurological examination would not be possible to obtain for prolonged periods of time due to the use of general anesthesia or neuromuscular blocking agents. The adherence rates for use of this last guideline in the trauma and neuroscience ICU were 80% and 75%, respectively.

### Outcome variables

The primary outcome was 30-day mortality. Secondary outcomes included discharge destination (home or a rehabilitation facility), discharge Glasgow Coma Scale (GCS) and extended Glasgow Outcome Scale (GOSE) scores, development of brain death, and in-hospital complications, including venous thromboembolic events (deep venous thrombosis or pulmonary embolus), pneumonia, sepsis or septic shock, and urinary tract infection (UTI). The GOSE is a validated global scale for functional outcome after brain injury that includes eight ordinal categories, including: (1) death, (2) vegetative state, (3) lower severe disability, (4) upper severe disability, (5) lower moderate disability, (6) upper moderate disability, (7) lower good recovery, and (8) upper good recovery.[23 24]

### Statistical analyses

We summarized dichotomous data using percentages and continuous data using medians (with interquartile ranges (IQRs)). These statistics were compared using Fisher's exact test and Wilcoxon rank-sum test, respectively.

We used multivariable logistic regression to estimate an adjusted OR (and surrounding 95% confidence interval (CI)) comparing the primary outcome of 30-day mortality between patients admitted to the trauma versus neuroscience ICU. This was done using the technique of purposeful selection of covariates described by Hosmer and Lemeshow.[25] We first selected potentially clinically important independent variables, including age, gender, a high-speed mechanism of injury (motor vehicle or motorcycle crash or automobile-pedestrian collision), patient injury severity (ISS and AIS score), initial vital signs and GCS and head AIS scores, and requirement for emergent craniotomy, ICP monitor/EVD placement, or field endotracheal intubation.[26] These variables were then entered into a stepwise logistic regression model that selected five significant covariates that were associated with mortality, including age, a high-speed mechanism of injury, ISS, fixed/unequal pupils at admission, and field endotracheal intubation. These selected variables were then entered into a final multivariable logistic regression analysis evaluating these five variables and whether patients were admitted to the trauma versus neuroscience ICU. Finally, as a sensitivity analysis, we also compared the odds of 30-day mortality between patients admitted to the trauma versus neuroscience ICU after adjusting for age, a high-speed mechanism of injury, ISS and GCS score, fixed or unequal pupils at admission, and need for craniotomy.

We considered two-sided p values $<0.05$ significant. Stata MP V.13.1 (StataCorp, College Station, TX) was used for statistical analyses.

## RESULTS

### Participants

In total, 548 patients were included in the study. Of these, 207 (38%) were admitted to the trauma and 341 (62%) to the neuroscience ICU. The overall median age of the patients was 51 (IQR 32–69) years, 70% were males, and 48% were injured by a high-speed mechanism, resulting in a median ISS of 18 (IQR 12–27) and head AIS score of 3 (IQR 3–4).

### Characteristics of the patients admitted to the trauma versus neuroscience ICU

Baseline characteristics of the patients stratified by admitting ICU are presented in table 1. Patients admitted to the trauma ICU were younger and less likely to have comorbidities or a history of preinjury anticoagulant use than those admitted to the neuroscience ICU ($p<0.05$ for all comparisons). They were also more likely to have sustained their injuries as a result of a high-speed mechanism and have a higher ISS when compared with neuroscience ICU admissions ($p<0.05$ for both comparisons). Despite this, there was no difference in median head AIS scores between patients admitted to the trauma versus neuroscience ICU.

Table 2 describes the presenting physiology and neurological examination findings of the patients stratified by admitting ICU. Patients admitted to the trauma ICU had a lower median initial GCS motor score and overall GCS score. Their initial systolic blood pressure was also lower than those admitted to the neuroscience ICU ($p<0.001$ for all comparisons). Finally, those patients admitted to the trauma instead of neuroscience ICU were more likely to have already been intubated in the field and have fixed or unequal pupils at the time of admission to ICU ($p<0.05$ for both comparisons).

Table 3 provides a comparison of the head CT findings of the patients stratified by admitting ICU. The most common injuries identified on the admission head CT across the entire study population included SAH (71%), SDH (63%), and parenchymal contusions (36%). Twelve percent of the study patients had evidence of herniation at admission. Although there was no difference in the frequency of herniation between those admitted to the trauma versus neuroscience ICU ($p=0.13$), patients admitted to the trauma ICU were more likely to have SAH and DAI and less likely to have parenchymal contusions than those admitted to the neuroscience ICU ($p<0.05$ for all comparisons).

### Interventions performed and outcomes of the patients admitted to the trauma versus neuroscience ICU

Table 4 presents complications, interventions performed, and outcomes of the patients by admitting ICU. Those admitted to the trauma ICU were less likely to undergo craniotomy or craniectomy, but more likely to receive an ICP monitor/EVD

**Table 1** Baseline demographics of the patients

| Characteristic | Neuroscience ICU (n=341) | Trauma ICU (n=207) | P value |
|---|---|---|---|
| Median age, years (IQR) | 57 (34, 73) | 44 (28, 61) | <0.001 |
| Male gender | 68% | 73% | 0.252 |
| High-speed mechanism | 34% | 71% | <0.001 |
| Transfer | 46% | 19% | <0.001 |
| Comorbidities | 22% | 13% | 0.007 |
| Preinjury anticoagulant use | 7% | 2% | 0.010 |
| Median head AIS score (IQR) | 3 (2, 4) | 3 (3, 4) | 0.471 |
| Median ISS (IQR) | 16 (10, 24) | 25 (17, 34) | <0.001 |

AIS, Abbreviated Injury Scale; ICU, intensive care unit; ISS, Injury Severity Score.

**Table 2** Presenting history, physiology, and neurological examination findings

| Characteristic | Neuroscience ICU (n=341) | Trauma ICU (n=207) | P value |
|---|---|---|---|
| Intubated in field | 27% | 46% | <0.001 |
| Fixed/unequal pupils at admission | 8% | 13% | 0.105 |
| Median initial GCS motor examination | 6 (1, 6) | 3 (1, 6) | <0.001 |
| Median initial GCS total examination | 14 (3, 15) | 5 (3, 15) | <0.001 |
| Median initial SBP (IQR) | 136 (120, 156) | 128 (108, 145) | <0.001 |
| Intubated in ED | 14% | 13% | 0.683 |

ED, emergency department; GCS, Glasgow Coma Scale; ICU, intensive care unit; SBP, systolic blood pressure.

**Table 3** Initial head CT findings

| Characteristic | Neuroscience ICU (n=341) | Trauma ICU (n=207) | P value |
|---|---|---|---|
| SAH | 66% | 78% | 0.002 |
| SDH | 61% | 65% | 0.273 |
| EDH | 12% | 10% | 0.394 |
| IPH | 14% | 12% | 0.459 |
| Contusion | 39% | 29% | 0.016 |
| DAI | 1% | 6% | 0.018 |
| Herniation | 13% | 9% | 0.130 |

DAI, diffuse axonal injury; EDH, epidural hematoma; ICU, intensive care unit; IPH, intraparenchymal hematoma; SAH, subarachnoid hemorrhage; SDH, subdural hematoma.

Table 4 Complications, interventions, and outcomes

| Characteristic | Neuroscience ICU (n=341) | Trauma ICU (n=207) | P value |
|---|---|---|---|
| Progression from initial CT | 20% | 28% | 0.063 |
| Witnessed seizure | 3% | 1% | 0.268 |
| Craniotomy/craniectomy | 19% | 9% | 0.002 |
| ICP monitor/EVD placement | 17% | 28% | 0.003 |
| VTE event | 3% | 5% | 0.159 |
| Sepsis/septic shock | 1% | 3% | 0.073 |
| Pneumonia | 11% | 18% | 0.034 |
| UTI | 7% | 8% | 0.762 |
| Tracheostomy | 11% | 19% | 0.008 |
| PEG/surgical feeding tube | 15% | 20% | 0.141 |
| If alive, discharged to home | 62% | 52% | 0.033 |
| If alive, discharged to home or rehab | 74% | 70% | 0.361 |
| Discharge GCS | 15 (13, 15) | 15 (6, 15) | 0.109 |
| Discharge GOSE | 4 (3, 5) | 4 (2, 5) | 0.365 |
| Brain death | 11% | 20% | 0.007 |
| Death | 12% | 23% | 0.001 |

EVD, external ventricular drain; GCS, Glasgow Coma Scale; GOSE, Extended Glasgow Outcome Scale; ICP, intracranial pressure; ICU, intensive care unit; PEG, percutaneous endoscopic gastrostomy; UTI, urinary tract infection; VTE, venous thromboembolic event.

($p<0.005$ for both comparisons). These patients were also more likely to receive a tracheostomy ($p=0.008$). Of the patients who survived 7 days after their initial severe TBI, 59% who were admitted to the trauma ICU had at least three CT scans of the brain as compared with 51% who were admitted to the trauma ICU ($p=0.08$). Among this population of patients, there was no difference between patients admitted to the trauma (9%) versus neuroscience (8%) ICU in the percentage of MRI brain scans ordered ($p=0.52$).

The median length of stay for the patients admitted to the trauma ICU was 9 (IQR 4–20) days whereas that for those admitted to the neuroscience ICU was 5 (IQR 2–10) days ($p<0.001$). The median hospital-free days (days alive and not hospitalized up to 30 days after the index injury) in the patients admitted to the trauma ICU was 13 (IQR 0–24) days versus 24 (IQR 11–27) days among those admitted to the neuroscience ICU ($p<0.001$).

The unadjusted risk of death among patients admitted to the trauma ICU was higher than that for those admitted to the neuroscience ICU (23% vs. 12%, $p=0.001$). However, multivariable logistic regression adjusting for age, ISS, a high-speed mechanism of injury, fixed or unequal pupils at admission, and field endotracheal intubation identified that the adjusted odds of 30-day mortality was approximately 70% lower among patients admitted to the trauma versus neuroscience ICU (adjusted OR=0.30, 95% CI 0.11 to 0.82) (table 5). This relationship persisted (although the CI surrounding the point estimate increased and included the null value of 1 at its upper limit) in a sensitivity analysis adjusting instead for age, a high-speed mechanism of injury, ISS and GCS score, fixed or unequal pupils at admission, and need for craniotomy (adjusted OR for 30-day mortality=0.37; 95% CI 0.14 to 1.00).

Among those who died, both 'do no resuscitate' status leading to comfort care (14% vs. 7%) and brain death (20% vs. 11%) were more likely to occur in the trauma versus neuroscience ICU ($p<0.05$ for both comparisons). Of those who survived, patients

Table 5 Results of a multivariable logistic regression model predicting 30-day mortality in patients with traumatic brain injury admitted to the intensive care unit

| Predictor variable | OR | 95% CI | P value |
|---|---|---|---|
| Admitted to the trauma vs. neuroscience ICU | 0.30 | 0.11 to 0.82 | 0.019 |
| Age (years) | 1.01 | 0.98 to 1.03 | 0.268 |
| ISS score | 1.12 | 1.07 to 1.18 | <0.001 |
| High-speed mechanism of injury | 0.96 | 0.35 to 2.69 | 0.942 |
| Field intubation | 4.99 | 1.91 to 12.99 | 0.001 |
| Fixed or unequal admission pupils | 2.87 | 1.10 to 7.49 | 0.031 |

ICU, intensive care unit; ISS, Injury Severity Score.

admitted to the trauma ICU were less likely to be discharged to home than those admitted to the neuroscience ICU (52% vs. 62%, $p=0.03$). However, there was no difference in median discharge GCS or discharge GOSE scores between the two groups. Although the risk of pneumonia was more common among patients admitted to the trauma versus neuroscience ICU, there were no differences in the risk of UTIs, venous thromboembolic complications, or sepsis between the two cohorts.

## DISCUSSION

To our knowledge, this is the first prospective study to compare the characteristics and outcomes of patients with TBI admitted to and cared for in a trauma versus neuroscience ICU in North America. We observed that patients admitted to the trauma ICU were younger and had less comorbidities, but were more severely injured than those admitted to the neuroscience ICU. Those admitted to the trauma ICU were also more likely to present with a history of field endotracheal intubation, lower systolic blood pressures, and worse neurological examination findings (ie, lower GCS motor and overall GCS scores and a higher incidence of fixed or unequal pupils). However, despite a higher overall injury burden and worse neurological examination and hemodynamics at presentation, trauma ICU patients had a lower adjusted 30-day mortality.

Similar to the findings of this study, the American Association for the Surgery of Trauma (AAST) recently reported data retrospectively collected from 37 different American ICUs, which suggested that patients admitted to a trauma instead of neuroscience ICU were less likely to have isolated TBI and more likely to have significant associated injuries and a higher overall ISS.[21] Lombardo *et al* also noted that trauma ICU patients had lower presenting systolic blood pressures and a worse neurological examination at presentation.[21] Findings from our study and theirs suggest that although those admitted to a trauma ICU have similar TBI severity, they may be at higher risk of secondary brain injury (potentially as a result of a higher incidence of associated injuries and worse initial physiology). The higher risk of secondary brain injury may secondarily predispose them to worse unadjusted outcomes. In support of this, patients admitted to our trauma ICU had a lower risk of being discharged home alive and a higher risk of both brain death and death from any cause.

However, despite a higher overall injury burden and worse neurological examination at presentation, patients admitted to our trauma ICU had a lower adjusted 30-day mortality than those admitted to the neuroscience ICU despite no difference in discharge GCS or GOSE scores between these cohorts. In the multicenter AAST study described above, Lombardo *et al* noted that whereas survival was equivalent between different ICUs for patients with isolated TBI, adjusted mortality was lower in polytrauma patients with TBI (ie, those who suffered multiple other associated injuries in addition to their TBI) who were specifically admitted to a trauma ICU.[21] Interestingly, the survival benefit appeared to increase in a graded fashion in favor of admission to a trauma ICU as the overall ISS score of the patient increased.[21] Our study and theirs therefore together suggest that admission of TBI patients with multiple other injuries to a trauma instead of neuroscience ICU may be associated with improved injured patient outcomes.

Although reasons for the above are largely unknown, we hypothesize that they may be the result of differences in processes of care for severe TBI in the trauma versus neuroscience ICU or the management of associated injuries by ICU staff personnel. This may include withholding of care in cases with perceived poor prognosis for acceptable functional recovery in the neuroscience versus trauma ICU. Further, we observed that patients admitted to the trauma instead of neuroscience ICU were less likely to undergo craniotomy or craniectomy and more likely to be fitted with an ICP monitor/EVD. Studies have previously suggested that variation in the timing and frequency of use of these interventions are associated with differences in reported outcomes across institutions caring for patients with severe TBI.[2–4 27] Further, as those admitted to the trauma ICU are frequently more injured, trauma surgeons, specially trained trauma nurses, and allied healthcare providers with specialized trauma training may improve outcomes through more evidence-based and guideline-directed management of this population and their concomitant injuries. In support of this, in addition to creating and validating guidelines for management of TBI in adults and children,[28–30] trauma surgeons and professional trauma organizations have long been involved in the development and implementation of guidelines for management of all types of neurological and non-neurological injuries.

This study has several limitations. First, although this is the first prospective study to our knowledge to compare the characteristics and outcomes of patients with TBI admitted to the trauma versus neuroscience ICU, the study was non-randomized and results are derived from a single center. Second, although most patients with isolated TBI are cared for in the neuroscience ICU whereas patients with TBI with multisystem injuries are admitted to the trauma ICU, lack of bed availability in one of the two ICUs often 'trumps' triage decisions and is not uncommon at our hospital. Even though there were clear differences in populations between the ICUs in this study, this may have led to somewhat of a mix of isolated TBI and TBI/associated multisystem injury patients across the two ICUs. Third, in our trauma ICU, the culture exists that we aggressively document do-not-resuscitate status. The documenting of this status in the trauma ICU as opposed to non-documentation of do-not-resuscitate status in favor of comfort care status in the neuroscience ICU may explain some of our outcome associations. Finally, although we observed differences in outcomes between the two ICUs, we are unsure exactly which structures or processes of care produced these outcome differences between the two units. We are also unsure as to what extent our findings may be due to residual confounding (secondary to insufficient adjustment for potentially confounding variables between groups). As a result of the above, our findings must be confirmed by future prospective studies (designed using propensity scores or cluster randomization) before they are used to inform care.

## CONCLUSION

In this prospective cohort study, we observed that although the severity of brain injury was similar between those admitted to the trauma versus neuroscience ICU, patients admitted to the trauma ICU were more severely injured overall, had a lower arrival GCS score and systolic blood pressure, and had a higher incidence of fixed or unequal pupils. However, despite a higher overall injury burden and worse neurological examination and hemodynamics at presentation, trauma ICU patients had a lower adjusted 30-day mortality. Although reasons for this finding are largely unknown, they may be the result of differences in processes of care for patients with severe TBI in the trauma versus neuroscience ICU or management of associated injuries by trauma ICU staff. These findings warrant and should be confirmed by an appropriately designed prospective multicenter study and perhaps even a randomized controlled trial.

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