PAPER

Influence of Resident Involvement on Trauma Care Outcomes

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Hypothesis: Discrepancies exist in complications and outcomes at teaching trauma centers (TTCs) vs nonteaching TCs (NTCs).

Design: Retrospective review of the National Trauma Data Bank research data sets (January 1, 2007, through December 31, 2008).

Setting: Level II TCs.

Patients: Patients at TTCs were compared with patients at NTCs using demographic, clinical, and outcome data. Regression modeling was used to adjust for confounding factors to determine the effect of house staff presence on failure to rescue, defined as mortality after an in-house complication.

Main Outcome Measures: The primary outcome measures were major complications, in-hospital mortality, and failure to rescue.

Results: In total, 162 687 patients were available for analysis, 36 713 of whom (22.6%) were admitted to NTCs. Compared with patients admitted to TTCs, patients admitted to NTCs were older (52.8 vs 50.7 years), had more severe head injuries (8.3% vs 7.8%), and were more likely to undergo immediate operation (15.0% vs 13.2%) or ICU admission (28.1% vs 22.8%) ($P < .01$ for all). The mean Injury Severity Scores were similar between the groups (10.1 for patients admitted to NTCs vs 10.4 for patients admitted to TTCs, $P < .01$). Compared with patients admitted to TTCs, patients admitted to NTCs experienced fewer complications (adjusted odds ratio [aOR], 0.63; $P < .01$), had a lower adjusted mortality rate (aOR, 0.87; $P = .01$), and were less likely to experience failure to rescue (aOR, 0.81; $P = .01$).

Conclusions: Admission to level II TTCs is associated with an increased risk for major complications and a higher rate of failure to rescue compared with admission to level II NTCs. Further investigation of the differences in care provided by level II TTCs vs NTCs may identify areas for improvement in residency training and processes of care.

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The training of surgical residents as pioneered by Halsted used an immersive learning model that included frequent call, long duty hours, and a focus on continuity of patient care. This involved a gradual process of increasing clinical independence and decreasing supervision based on the level of the trainee, as well as ongoing competence review. The time-honored training paradigm continued uninterrupted for decades, until the Institute of Medicine published its renowned report "*To Err Is Human: Building a Safer Health System*,"[1] which drew considerable attention to the practice of medicine and the number of "preventable" errors that occur as a result of the current health care system. In particular, resident participation in perioperative patient care represented an area of interest for improving patient safety[2] because of the perception that significant errors were occurring at the hands of overworked residents.[3,4]

See Invited Critique at end of article

In 2003, the Accreditation Council for Graduate Medical Education[5] implemented the 80-hour workweek in response to growing political and public pressure, despite the absence of solid evidence to support this reduction in work hours. Since then, the results of several studies,[6-9] including single-institution and large registry investigations, have suggested that surgical and trauma outcomes are unaffected by reductions in resident work hours. However, concerns

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remain about diminished continuity of care. These worries are particularly relevant in the trauma setting, in which care plans can change rapidly owing to the complexity of injuries and the coordination of multiple consulting teams that required for successful outcomes. Critics of reduced resident work hours also cite the increased frequency of patient hand offs as a major drawback to the new system.[10] These factors may affect outcomes, particularly in the setting of traumatic injury, after which patients follow unpredictable clinical courses.[11]

One benchmark of a hospital's quality of care is failure to rescue (FTR), defined as mortality after an in-house complication.[12,13] Failure to rescue has been demonstrated among surgical and trauma patients in previous investigations.[14-16] However, to our knowledge, no study to date has examined the influence of teaching center status or resident involvement on FTR outcomes. We undertook the present investigation to determine whether differences exist between teaching trauma centers (TTCs) and nonteaching TCs (NTCs) with regard to major complication rates and FTR outcomes in the restricted work hour era. We hypothesized that discrepancies exist in this measure between TTCs and NTCs.

METHODS

A retrospective review was performed of the National Trauma Data Bank (NTDB) research data sets for the admission years January 1, 2007, through December 31, 2008. The NTDB is maintained by the American College of Surgeons Committee on Trauma and is the largest repository of data about inpatients with traumatic injury in the United States.

The analysis included all patients with traumatic injury older than 14 years who were admitted to level II TCs between January 1, 2007, and December 31, 2008. The teaching status of TCs was identified as a TTC, including university and community centers, or an NTC, as defined in the NTDB Dictionary (http://www .ntdsdictionary .org /dataElements /datasetDictionary .html). Patients were excluded from the study if they died in the emergency department, were dead on arrival to the emergency department, had a hospital length of stay (LOS) of less than 24 hours, or had an Abbreviated Injury Score of 6 for any body region (ie, nonsurvivable injury) or if they were admitted to any non–level II TC. This final exclusion criterion reflects an attempt to minimize selection bias on the basis of variable access to resources and institutional expertise among TCs with lower-level designations. In addition, all level I TCs have in-house general surgery residents to meet criteria standards of the American College of Surgeons Committee on Trauma.

Patients who met study inclusion criteria were dichotomized by the teaching status of their admitting TC (TTCs vs NTCs) and were compared on the basis of the following: sex, age, race/ethnicity, insurance status, mechanism of injury, Injury Severity Score, admission systolic blood pressure, Abbreviated Injury Score for the head, disposition from the emergency department, characteristics of the admitting TC, and major in-hospital complications, including pneumonia, cardiac arrest, acute renal failure, pulmonary embolus, in-hospital mortality, deep vein thrombosis, organ space infection, and acute respiratory distress syndrome. All the listed complications were defined using the NTDB Dictionary.

Descriptive statistics were summarized using raw percentages, means, medians, and SDs. The Pearson product moment χ^2 test was used to compare differences in proportions for categorical variables. An independent-samples t test or analysis of variance was used to compare differences in means for continuous variables. Our primary outcome measures were major complications, in-hospital mortality, and FTR, defined as mortality occurring in patients with an identified complication. Secondary outcome measures included hospital LOS, days of ventilator use, and intensive care unit (ICU) LOS. To account for confounding factors that could affect outcomes, multivariate logistic regression models were used to adjust for baseline differences between the 2 study groups. All the variables with $P<.05$ were entered into the models to determine adjusted odds ratios (aORs) and 95% CIs. All the statistical analyses were performed using commercially available software (SPSS for Macintosh, version 18.0; SPSS Inc). This study was reviewed by the institutional review board of the Cedars-Sinai Medical Center and was deemed exempt from requiring approval.

RESULTS

In total, 162 687 patients (14.3% of the entire 2007-2008 NTDB research data set populations) met study inclusion criteria; they had a mean age of 51.2 years, a mean Injury Severity Score of 10.3, and in-hospital mortality of 2.8% (**Table 1**). Of these, 36 713 (22.6%) were admitted to NTCs. Compared with patients admitted to TTCs, patients admitted to NTCs were older, less likely to have penetrating injuries, more predominantly of white race/ethnicity and with some form of insurance, and more likely to undergo immediate operative intervention (15.0% vs 13.2%) or ICU admission (28.1% vs 22.8%) ($P<.01$ for both). Overall, patients in the 2 study groups were clinically well matched for admission vital signs, overall injury burden on presentation, and percentage of severe head injuries, despite the noted statistical significance of differences. Unadjusted rates for the presence of any complication (5.4% among patients admitted to TTCs vs 4.2% among patients admitted to NTCs, $P<.01$) and defined major in-hospital complications were higher among patients treated at TTCs, as were the incidence of FTR (15.8% among patients admitted to TTCs vs 13.3% among patients admitted to NTCs, $P=.02$) and in-hospital mortality (2.8% among patients admitted to TTCs vs 2.5% among patients admitted to NTCs, $P=.01$).

The characteristics of the admitting TCs are summarized in **Table 2**. Overall, the level II TCs included in our study were midsize (mean number of adult beds, 351.0), with a mean of 6.1 trauma surgeons sharing call responsibilities. Compared with the average NTC, the average TTC in our study had fewer adult beds (339.2 vs 390.9, $P<.01$). Although the number of trauma surgeons in the call pool was similar between TTCs and NTCs (mean, 6.2 vs 6.0, $P<.01$), a higher proportion of NTCs had fewer than 5 core trauma surgeons taking call (30.2% vs 14.1%, $P<.01$).

Table 3 gives the aORs for any complication and for major defined complications at NTCs vs TTCs after controlling for demographic, clinical, and institutional factors. Patients at NTCs were less likely to develop any postinjury complication (aOR, 0.63; 95% CI, 0.59-0.67) and individual complications except for deep vein thrombosis and myocardial infarction. The adjusted odds for the occurrence of any complication or failure to rescue are shown in the **Figure**. Notably, the development of any postinjury complication was found to be a strong

Table 1. Patient Demographics, Disposition From the Emergency Department, Complications, and Outcomes

Variable	Overall (N = 162 687)	Teaching Trauma Center (n = 125 974)	Nonteaching Trauma Center (n = 36 713)	*P* Value
Patient Demographics				
Male sex, %	60.5	61.0	58.8	<.01
Age				
Mean (SD), y	51.2 (23.4)	50.7 (23.4)	52.8 (23.6)	<.01
Median, y	49.0	49.0	52.0	
>55 y, %	41.7	40.7	45.2	<.01
Penetrating injury, %	7.3	7.8	5.7	<.01
Admission systolic blood pressure				
Mean (SD), mm Hg	139.5 (26.8)	139.4 (27.0)	139.9 (26.4)	<.01
Median, mm Hg	138.0	138.0	138.0	
<90 mm Hg, %	2.3	2.4	2.1	<.01
Admission Glasgow Coma Scale score				
Mean (SD)	14.1 (2.8)	14.1 (2.8)	14.1 (2.8)	.56
Median	15.0	15.0	15.0	
Abbreviated Injury Score for the head				
Mean (SD)	0.8 (1.3)	0.8 (1.3)	0.8 (1.4)	.05
Median	0.0	0.0	0.0	
≥4, %	7.9	7.8	8.3	<.01
Injury Severity Score				
Mean (SD)	10.3 (8.6)	10.4 (8.6)	10.1 (8.6)	<.01
Median	9.0	9.0	9.0	
>25, %	6.1	6.2	5.7	<.01
Race/ethnicity, %				
White	78.0	76.2	84.5	<.01
African American	9.6	10.5	6.3	<.01
Asian	2.0	1.9	2.0	.85
Hawaiian or Pacific Islander	0.2	0.3	0.1	<.01
American Indian	1.1	1.0	1.5	<.01
Other	9.1	10.1	5.5	<.01
Insurance status, %				
Private	48.1	48.3	47.4	<.01
Medicaid	7.6	7.4	8.3	.09
Medicare	29.1	28.7	30.6	.57
Uninsured	15.2	15.7	13.7	<.01
Disposition From the Emergency Department				
Intensive care unit, %	24.0	22.8	28.1	<.01
Operating room, %	13.6	13.2	15.0	<.01
Complications				
Major in-hospital complication, %				
Acute renal failure	0.7	0.8	0.3	<.01
Acute respiratory distress syndrome	1.3	1.5	0.7	<.01
Cardiac arrest	0.3	0.3	0.3	.26
Deep vein thrombosis	0.8	0.8	0.9	<.01
Myocardial infarction	0.3	0.3	0.3	.95
Organ space infection	0.3	0.3	0.2	<.01
Pneumonia	2.4	2.5	2.1	<.01
Pulmonary embolus	0.3	0.3	0.2	<.01
Any complication, %	5.1	5.4	4.2	<.01
Outcomes				
Intensive care unit LOS, d				
Mean (SD)	2.7 (6.0)	2.6 (6.1)	2.9 (5.7)	<.01
Median	1.0	0.0	1.0	
Hospital LOS, d				
Mean (SD)	6.5 (8.3)	6.6 (8.5)	6.5 (7.6)	.03
Median	4.0	4.0	5.0	
Ventilator use, d				
Mean (SD)	1.3 (4.9)	1.4 (5.0)	1.2 (4.5)	<.01
Median	0.0	0.0	0.0	
Failure to rescue, %	15.3	15.8	13.3	.02
In-hospital mortality, %	2.8	2.8	2.5	.01

Abbreviation: LOS, length of stay.

Table 2. Characteristics of the Trauma Centers[a]

Variable	Overall (N = 162 687)	Teaching Trauma Centers (n = 125 974)	Nonteaching Trauma Centers (n = 36 713)
Adult beds			
Mean (SD)	351.0 (169.1)	339.2 (164.7)	390.9 (177.5)
Median	323.0	317.0	336.0
<250, %	26.5	28.4	19.4
Intensive care unit beds			
Mean (SD)	24.0 (14.4)	23.9 (4.6)	24.6 (4.0)
Median	20.0	20.0	22.0
<16, %	26.2	24.5	32.5
Trauma surgeons in the call pool			
Mean (SD)	6.1 (2.1)	6.2 (1.9)	6.0 (2.7)
Median	6.0	6.0	6.0
<5, %	17.4	14.1	30.2

[a] $P < .01$ for all comparisons.

Table 3. Adjusted Odds for the Occurrence of Complications at Nonteaching Trauma Centers Compared With Teaching Trauma Centers

Complication	Adjusted Odds Ratio (95% CI)[a]	*P* Value
Deep vein thrombosis	1.09 (0.96-1.24)	.19
Myocardial infarction	0.92 (0.74-1.15)	.48
Cardiac arrest	0.79 (0.63-0.98)	.04
Failure to rescue	0.81 (0.68-0.96)	.01
Pneumonia	0.71 (0.65-0.77)	<.01
Pulmonary embolus	0.65 (0.51-0.83)	<.01
Any complication	0.63 (0.59-0.67)	<.01
Organ space infection	0.54 (0.41-0.71)	<.01
Acute respiratory distress syndrome	0.40 (0.35-0.46)	<.01
Acute renal failure	0.28 (0.23-0.34)	<.01

[a] Logistic regression variables included the following: sex, race/ethnicity, insurance status, mechanism of injury, age older than 55 years, Injury Severity Score higher than 25, Abbreviated Injury Score of 4 or higher for the head, admission systolic blood pressure of less than 90 mm Hg, disposition from the emergency department to the intensive care unit or to the operating room, and teaching center status and whether the trauma center has fewer than 250 adult beds, fewer than 16 intensive care unit beds, and fewer than 5 trauma surgeons in the call pool.

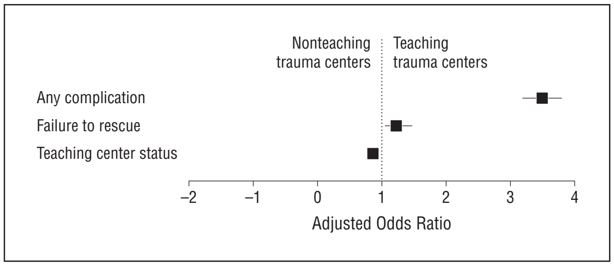

Figure. Adjusted odds of mortality at level II teaching trauma centers vs nonteaching trauma centers after adjusting for the following: sex, race/ethnicity, insurance status, mechanism of injury, age older than 55 years, Injury Severity Score higher than 25, Abbreviated Injury Score of 4 or higher for the head, admission systolic blood pressure of less than 90 mm Hg, disposition from the emergency department to the intensive care unit or to the operating room, and teaching center status and whether the trauma center has fewer than 250 adult beds, fewer than 16 intensive care unit beds, and fewer than 5 trauma surgeons in the call pool.

predictor of increased mortality (aOR, 3.5; 95% CI, 3.19-3.82) after controlling for confounding variables. Compared with patients admitted to TTCs, patients admitted to NTCs had a lower adjusted rate of FTR (aOR, 0.81; 95% CI, 0.68-0.96) and a lower adjusted mortality rate (aOR, 0.87; 95% CI, 0.81-0.95) ($P = .01$ for both).

Table 4 gives the mean differences between TTCs and NTCs for our secondary outcome measures. Hospital LOS was significantly longer at TTCs vs at NTCs (mean difference, 0.16 days; $P = .001$), as were days of ventilator use (mean difference, 0.12 days; $P = .01$), likely reflective of the higher incidence of complications. After adjusting for baseline differences, no statistically significant difference in ICU LOS was observed between the 2 study groups.

COMMENT

The quality of surgical care offered at teaching hospitals is thought to be high on the basis of access to advanced technology, participation in biomedical research, experience with rare diseases and patients with complex conditions.[17] However, in this large retrospective study of the current NTDB research data sets, we demonstrate that patients admitted to level II TTCs have associated increased risks for FTR, major postinjury complications, and subsequent death compared with patients admitted to level II NTCs. To date, this study is the first of its kind to address TTC status as a predictor of FTR in the 80-hour workweek era. Our results raise the question whether resident involvement in trauma care may be associated with worse patient outcomes at level II TCs, which contradicts the findings of previously published investigations.

Earlier studies[18,19] examined the "July effect," the theory that the seasonal variations in resident surgical and perioperative skills may affect surgical outcomes. Although many of these investigations are from single centers, they have shown similar outcomes throughout the academic year in various surgical specialties,[20-23] including patients with traumatic injury.[20,21] Similarly, 2 large registry studies[8,9] demonstrated congruent findings with respect to differences in mortality rates.

However, Salim et al[11] demonstrated increases in total, preventable, and nonpreventable complications in a 2-year period after the institution of the 80-hour workweek at a large urban TC that was heavily dependent on house

Table 4. Adjusted Mean Differences in Secondary Outcomes by Teaching Center Status[a]

Variable	Teaching Trauma Centers	Nonteaching Trauma Centers	Difference (95% CI)	*P* Value
Hospital LOS, mean, d	6.54	6.38	−0.16 (−0.26 to 0.07)	.001
Intensive care unit LOS, mean, d	2.69	2.76	0.07 (−0.02 to 0.17)	.14
Ventilator use, mean, d	1.40	1.28	−0.12 (−0.22 to −0.03)	.01

Abbreviation: LOS, length of stay.
[a]Linear regression variables included the occurrence of any complication and the following: sex, race/ethnicity, insurance status, mechanism of injury, age older than 55 years, Injury Severity Score higher than 25, Abbreviated Injury Score of 4 or higher for the head, admission systolic blood pressure of less than 90 mm Hg, disposition from the emergency department to the intensive care unit or to the operating room, and teaching center status and whether the trauma center has fewer than 250 adult beds, fewer than 16 intensive care unit beds, and fewer than 5 trauma surgeons in the call pool.

staff services. We demonstrate similar findings in the present study and, most important, show that the development of postinjury complications was associated with more than a 3.5-fold increased risk for mortality. The phenomenon known as FTR[12] has been cited as a distinguishing characteristic between TCs with low mortality rates vs high mortality rates[16] and should be examined in the context of teaching vs nonteaching institutions given our observed differences in outcomes.

We were unable to establish an exact cause of our findings because of the retrospective nature of our study. However, it is important to speculate why these differences occurred so that they may be investigated prospectively.

A major criticism of the duty hour restrictions is the increased number of hand offs required for continuing patient care. One institution found that the work hour changes increased the number of hand offs by 40%, with residents taking 300 hand offs per month.[22] This increase in patient care transition can be particularly hazardous when information is not conveyed correctly or is forgotten.[23-26] Alarming survey findings from medical and surgical residents at Massachusetts General Hospital, Boston, disclosed that almost 60% of their patients had been harmed by a poor hand off, with an estimated 12% experiencing "major" harm and almost 1 major harmful incident occurring per day.[27] Some institutions recognized this potentially hazardous issue and implemented electronic methods for hand offs, with promising results.[28,29] Although this seems to be a step in the right direction, many institutions still do not incorporate best-practice recommendations into their system of hand offs.[27] The overall resident experience with critically ill patients may also be diminishing as a result of the duty hour restrictions. A decline in operative volume has been demonstrated as a result of the 80-hour workweek.[30] Just as certain numbers of cases are required to become technically proficient, a certain amount of experience is needed to recognize acutely ill patients, as well as impending complications before physiological decompensation. This is particularly challenging in the field of trauma because current teaching has focused on nonoperative strategies. Recognizing when nonoperative management has failed or is inappropriate is often the result of experience.

A reason for the possible discrepancy seen between our study findings and the results of previous investigations looking at trauma residents is the undeniable generational changes that have occurred in the field of medicine.[31,32] Most physicians graduating from medical schools are more focused on family and quality of life than on career.[27] This pattern may have been unrecognized early after the implementation of the Accreditation Council for Graduate Medical Education restrictions because of the persistence of previous surgical culture and mentality. However, because our study reviewed outcomes 5 years after the implementation of the duty hour restrictions, this could have allowed for alteration of this mind-set and establishment of the concept of shift work and hand offs.

Surgical educators are also responsible for the discrepancy seen between TTCs and NTCs. While the influence of attending surgeon involvement in trauma resuscitations and care has been debated and thought to be negligible,[33-35] other studies[36-38] have documented significant positive effects of attending involvement on trauma resuscitations, including fewer errors in judgment, decreased times for resuscitation and transport, greater adherence to evidence-based guidelines, and shorter intervals to diagnostic and therapeutic interventions. Although the judgment and performance of unsupervised senior residents may be adequate for the care of most acutely injured patients, undoubtedly a handful of patients will benefit from attending surgeon presence to prevent inadequate resuscitation, underappreciation of injury severity, and delays in definitive management. Support for this concept comes from our observation herein that NTCs deliver more aggressive initial care than TTCs in the form of higher rates of immediate operative intervention (15.0% vs 13.2%) and ICU admission (28.1% vs 22.8%) ($P < .01$ for both), as well as the narrow margin of difference for in-hospital mortality. The vigilance for attending supervision should not end after resuscitation or operation because ICU management has an important role in patient outcomes. Early detection and anticipation of complications are vital to prevent FTR. Higher adjusted complication rates at TTCs (Table 3), a trend toward shorter ICU LOS among patients with similar injury severity (Table 4), and increased rates of FTR (Figure) imply that patients at TTCs may be transferred out of the ICU prematurely, representing an area for potential performance improvement at TTCs.

Although much of our article focuses on the influences of resident involvement and attending surgeon oversight, we would be remiss if we failed to acknowledge other potential confounders that could account for the morbidity and mortality discrepancies seen between TTCs and NTCs. Previous investigations have shown that patients with traumatic injury admitted to American College of Surgeons–designated level II TCs have worse outcomes, including higher mortality rates and increased morbidity, compared with those admitted to level I TCs for various injuries.[39] This is generally thought to result from level 1 TCs having more resources readily available to mobilize an immediate response to those patients initially seen in extremis from hemorrhagic shock,[40] as well the access to multiple subspecialties and adjunctive therapies that are readily available in level 1 TCs. However, considerable differences among TCs also exist in key resource areas, such as research and academic productivity, evidence of attending fellowship training in trauma, and dedicated operating rooms and operating room staff who are familiar with trauma procedures and instrumentation, which could account for some of the variability seen in outcomes.[41] Finally, best-practice guidelines derived from evidence-based protocols have been developed and implemented successfully for multiple clinical problems (such as prevention of ventilator-related pneumonia and prophylaxis and treatment of deep vein thrombosis) and are associated with improved outcomes.[42,43] Because these complications were less likely to occur at NTCs, perhaps these centers had higher adherence to guideline implementation, and this accounted in part for the observed differences.

It is important to acknowledge several limitations of our study. As with any retrospective study, we were unable to establish direct cause and effect but report only associations between the variables examined. Multiple limitations are inherent in using the NTDB as a source. The NTDB is a convenience sample of information voluntarily reported by TCs, with basic issues about the quality of data reported, level of detail provided, and number of variables available, although improvements have been noted with the more recent data sets. Significant numbers of hospitals contributing data to the NTDB do not code any complications,[44,45] and because the NTDB does not audit hospital data, it is impossible for us to know whether data about complications are distributed evenly or accurately between TTCs and NTCs. This could lead to underestimation or overestimation of the effect that complications have on in-hospital mortality. It is also impossible to determine the exact cause of death from the NTDB. Some patients may not have succumbed to their reported complications. Another limitation involves the definition of TTCs in our study. While each TTC trains resident physicians, we were unable to distinguish TTCs that train general surgery residents from those that train only nonsurgical residents. Differences may exist in the outcomes of patients with traumatic injury based on the type of residents involved in their care. In addition, our study examined only level II TCs, and the results may not be applicable to other TCs. It also would have been informative to investigate the effects of the use of physician extenders, the performance of call responsibilities in-house vs from at home, and the presence of critical care or trauma training programs in our analysis if the NTDB had made these variables available.

In summary, our study shows that patients admitted to level II TTCs are at increased risk for major postinjury complications, higher rates of FTR, and greater in-hospital mortality compared with patients admitted to level II NTCs. These findings perhaps add weight to the criticism that resident involvement in postinjury care is potentially hazardous in the 80-hour workweek era.[2,46] The exact causes of our discrepancy in outcomes between TTCs and NTCs should be examined in future prospective studies. In the interim, the results herein should encourage those who participate in surgical education to search for areas of potential performance improvement when reviewing complications and mortality rates in trauma care involving house staff.

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INVITED CRITIQUE

Failure to Rescue From Residents?

As surgeons and educators, we often do not hesitate to present our achievements or "superior" results and rarely put as much effort into airing our shortcomings. So, when an esteemed group from one of our top teaching hospitals presents data that say we may not be doing as well as our nonteaching center colleagues, we should listen, but should we believe it? In this issue of the *Archives of Surgery*, Bukur and colleagues[1] at Cedars-Sinai Medical Center, Los Angeles, California, have written an interesting and thought-provoking analysis of nationwide outcomes from level II trauma centers. Although the subject of the article is the influence of resident involvement in trauma care, their data look at a much broader and complex question, the differences between outcomes at teaching vs nonteaching centers.

Among the most concerning of the authors' findings is that there seems to be an increase in complications, mortality, and "failure to rescue" events at teaching centers compared with their nonteaching counterparts. Using standard multivariate regression techniques, this finding appears to persist after controlling for major baseline differences between the 2 study groups. However, accepting this result as being truly representative requires an assumption that the underlying model is robust and reliable and includes the major variables that may affect these observed differences. Unfortunately, a complete listing of all the factors that could influence these