

## Clinical Science

# Nontrauma surgeons can safely take call at an academic, rural level I trauma center



Nathan Louras, M.D.<sup>a</sup>, John Fortune, M.D., F.A.C.S.<sup>a</sup>,  
Turner Osler, M.D., F.A.C.S.<sup>a</sup>, Neil Hyman, M.D., F.A.C.S.<sup>b,\*</sup>

<sup>a</sup>Department of Surgery, University of Vermont College of Medicine, Burlington, VT, USA; <sup>b</sup>Department of Surgery, University of Chicago Medicine, 5841 S Maryland Avenue, Chicago, IL 60637, USA

**KEYWORDS:**

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**Abstract**

**BACKGROUND:** Care protocols can facilitate effective management of injured patients across a spectrum of providers. It is uncertain whether patient care is compromised when a full time trauma surgeon is not on call in the rural setting, where manpower may be a challenge.

**METHODS:** A retrospective cohort study was performed at an academic medical center with a level I trauma center. Patients admitted to the trauma service from 2007 to 2012 were compared with respect to mortality, missed injuries, delay in diagnosis, and length of stay based on whether they were admitted to the trauma service when a full-time trauma surgeon was on call.

**RESULTS:** A total of 2,571 injured patients were admitted during the study period; 1,621 directly to the trauma service. Of those, 1,415 patients were initially seen by a trauma surgeon (group A) and 206 by a nontrauma surgeon (group B). Demographics were similar except that the trauma attending patients were somewhat older (44.7 vs 39.4 years,  $P = .002$ ). There was no difference in the mean injury severity score (17.0 vs 16.0,  $P = .13$ ) or Glasgow Coma Scale (12.7 vs 12.3,  $P = .7$ ) between the 2 groups. There were 128 deaths; mortality rate in group A was 7.9% versus 7.7% for group B ( $P = .54$ ). There was no difference in the incidence of delayed diagnosis or missed injuries (3.0 vs 3.4%,  $P = .8$ ; .4 vs .9%,  $P = .27$ , respectively). The mean length of stay was shorter (7.9 vs 6.3,  $P = .016$ ) in group B.

**CONCLUSIONS:** There was no increase in mortality, delayed diagnosis, or missed injuries when nontrauma surgeons took call. Systems of care and algorithms can be developed that provide staffing flexibility yet maintain safe and effective care to trauma patients in the rural setting.

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Trauma centers were developed with the intent of improving the safety and effectiveness of care for injured patients. Many studies have looked at the effect of an established trauma team and/or systems on mortality.<sup>1-4</sup> A dedicated trauma service can improve the cost and quality

of care, especially in areas of higher population density.<sup>5-7</sup> Academic medical centers often use protocol-based management schemes to help coordinate care across a broad spectrum of services and health care providers.<sup>8,9</sup> Improvements in patient outcomes have been reported when the on-call attending can respond within 15 minutes of an alert and provides direct supervision in the resuscitation room.<sup>10-12</sup>

However, the necessity of around the clock coverage by full-time dedicated trauma surgeons has been questioned, especially when carefully constructed processes of care have been delineated. Haut et al<sup>13</sup> found no difference in

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\* Corresponding author. Tel.: 773-834-7126; fax: 773-834-1995.

E-mail address: [nhyman@surgery.bsd.uchicago.edu](mailto:nhyman@surgery.bsd.uchicago.edu)

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mortality between an experienced trauma director and a 1st year general surgery attending after the implementation of a structured trauma system including algorithms, protocols, and guidelines for patient management. In urban centers, where penetrating injuries are more common, the benefits of the immediate availability of a trauma surgeon seem clear and intuitive. However, in rural settings where blunt trauma overwhelmingly predominates, much of care is driven by standardized protocols developed and regularly reinforced by the trauma attendings.<sup>14,15</sup> As such, the immediate availability of a specialized trauma surgeon at all times may be less critical.

The purpose of this study was to determine if the quality of care suffered in a rural environment when nontrauma surgeons took call for the trauma service.

**Methods**

The medical records of all patients admitted by the trauma service of Fletcher Allen Health Care (FAHC), the teaching hospital of the University of Vermont College of Medicine from January 1, 2007 through December 31, 2012 were retrospectively reviewed. FAHC is a level I trauma center located in Burlington, Vermont, with a population of approximately 42,000 people, but serves a much larger geographic area of rural Vermont and upstate New York. Generally speaking, a trauma attending is always available from 7 AM to 5 PM on weekdays, and they take trauma call most of the nights and weekends; however, there is not always 24-hour attending coverage by full-time trauma surgeons. Attending call may be taken from home if the commute is 15 minutes or less.

An alert system has been set up for severely injured patients so that the attending may be present when they arrive based on specific prehospital transport criteria (Table 1). The presence of the attending was documented and timed based on a sign-in sheet and audited on a regular basis. All admissions to the trauma service were discussed with the attending on call.

Nontrauma surgeons supplement the call schedule as needed; there were a total of 7 full-time trauma attendings involved with trauma service night call during the study period and 5 surgeons who took call at the discretion of the trauma service. Four were experienced general surgeons, and 1 was a thoracic surgeon; all had been on staff at FAHC for more than 10 years.

Irrespective of the on-call attending physician, patients were always seen, evaluated, and admitted directly to the trauma service, which is covered at all times by the surgical house staff assigned to the team as well as a group of dedicated physician assistants. The morning after admission, patients are seen and transferred to the care of an attending from the trauma service. Broad-based spectrum of care algorithms has been established (eg, a solid organ protocol).

Patients were excluded if they were seen by the trauma service but admitted to another service such as neurosurgery or orthopedics. The patients were then divided into 2 groups: patients admitted when a trauma attending was on-call (group A) and patients admitted when a nontrauma attending was on-call (group B). The 2 groups were evaluated for age, injury severity score (ISS), and Glasgow Coma Scale (GCS). The primary outcomes of interest were mortality, length of stay, delays in diagnosis, and missed

**Table 1** Criteria for immediate on-site trauma surgeon presence

Red trauma alert criteria	
Adult criteria	Pediatric criteria (<14 years of age)
GCS <8 with a mechanism attributed to trauma	GCS <8 with a mechanism attributed to trauma
Hypotension (SBP <90 mm Hg)	Age-specific hypotension <60 mm Hg in term neonates (0–28 d), <70 mm Hg in infants (1–12 mo), <70 mm Hg + (2 times the age in years) in children (1–10 years), <90 mm Hg in children ≤ 10 years
Airway difficulty secondary to trauma, respiratory compromise (10 < RR > 30 bpm)	Airway difficulty secondary to trauma or intubation at the scene
Amputation proximal to the wrist or ankle	Amputation proximal to the wrist or ankle
Penetrating injury to the chest, neck, or abdomen	Penetrating injury to the chest, neck, or abdomen
Receiving blood before admission to <i>maintain</i> vital signs	Receiving blood before admission to <i>maintain</i> vital signs
Helicopter transport from the scene without communication of vital signs	Spinal cord injury from the scene (only) Helicopter transport from the scene without communication of vital signs
Emergency physician’s discretion	

Activation: Activation demands response of the trauma team.  
 Trauma attending response: Trauma attending must be present in the trauma bay within 15 minutes of patient arrival.  
 Patient responsibility: ED attending is responsible for the care of the patient (working collaboratively with the chief surgical resident), until the arrival of the trauma attending.  
 Pregnant patients greater than 20 weeks gestation: Page OB team on beepers 181, 708, 4095, and 0457.  
 ED = Emergency Department; GCS = Glasgow Coma Scale; OB = Obstetrics; RR = respiratory rate; SBP = systolic blood pressure.

injuries. Patients who underwent a trauma laparotomy underwent a secondary analysis to assess the utilization of blood products. Outcomes were compared using univariate analysis (Kruskal-Wallis or an unpaired *t* test, as appropriate) and multivariate analysis.

## Results

A total of 2,571 trauma patients were admitted during the study period. Of those, 950 patients who were evaluated by the trauma service but admitted to another service (most commonly orthopedics or neurosurgery) were excluded, leaving 1,621 patients for analysis. There were 1,415 patients initially seen by a trauma attending on-call (group A) and 206 that were seen by a nontrauma attending on-call (group B).

Patient characteristics in the 2 groups are presented in Table 2. Patients in group B were younger (44.7 vs 39.4,  $P < .002$ ) and had a shorter length of stay (7.8 vs 6.3,  $P < .02$ ). There was no difference in the mean ISS (17.0 vs 16.0,  $P = .1$ ) or mean GCS (12.7 vs 12.3,  $P = .7$ ) between the groups.

There were a total of 128 deaths after admission. Of those, 112 (88%) patients were initially seen by one of the trauma attendings and 16 (12%) were initially seen by one of the nontrauma attendings on-call; the unadjusted mortality rate was 7.9 versus 7.7% for groups A and B, respectively ( $P = .54$ ). On multivariate analysis controlling for age, ISS, and GCS, the odds ratio for trauma attending was 1.05 (95% confidence interval, .51 to 2.54;  $P < .73$ ) in a reliable logistic regression model nearly identical (area under receiver operating characteristic curve = .95, Hosmer-Lemeshow statistic 10.03 [ $P > .26$ ]).

There were a total of 8 missed injuries; 6 occurred in group A and 2 in group B (.4% vs .9% of patients, respectively,  $P = .27$ ). There were 50 instances of a delay in diagnosis; 43 occurred in group A and 7 in group B (3.0% and 3.4%, respectively,  $P = .8$ ). A total of 149 patients had a trauma laparotomy; 123 were performed by a trauma attending and 26 by a nontrauma attending. Seventy-five of the 123 operated group A patients and 15 of the 26 group B patients received at least 1 blood transfusion (61.0 vs 57.7%,  $P = .8$ ; Fisher exact test) The mean number of

transfusions per case was also similar (2.3 vs 1.8 units,  $P = .9$ ; Kruskal-Wallis test).

## Comments

We found no difference in missed injuries, delay in diagnosis or patient mortality between trauma and non-trauma surgeons who took night and/or weekend call at a rural level I trauma center associated with an academic medical center. The GCS and ISS were quite similar in the 2 groups, suggesting that the groups truly are comparable. Our multivariate model had good discrimination based on the ROC value and was well calibrated, leading to a high degree of confidence in the observed findings.<sup>16</sup>

The length of stay was longer for trauma attendings compared to nontrauma attendings but this appears likely attributable to the subset of patients who stayed greater than 30 days. There were a total of 68 patients whose length of stay were greater than 30 days, 64 of whom were seen by a trauma attending and 4 by a nontrauma attending. Trauma attendings also cared for slightly older patients, and age has a direct impact on length of stay, especially for those undergoing any form of operative intervention.<sup>17</sup>

It must be emphasized that we do not wish to assert or imply that trauma surgeons do not add value to the care of our patients. Quite the contrary, we believe it is their expertise, organizational skills and leadership that has led to protocols and systems of care that are vital for the efficient management of patients. At academic centers with training programs, the trauma service is often led, managed, and staffed by rotating surgery house officers. Having well-trained residents has been shown to improve the efficiency of care delivered to patients.<sup>18</sup> Educating and training residents as well as other members of the care team, coordinating care among many services, mobilizing and procuring resources, and algorithm development and/or implantation are all critical aspects of trauma patient management.<sup>19,20</sup> We believe that our findings demonstrate that building this foundation in a trauma system is the cornerstone of making patient care safe and effective, irrespective of who is on call. This may be of particular value in an era of limited resources, when there are multiple

**Table 2** Patient characteristics

Group attributes	All patients	Group A	Group B	<i>P</i> value
Number of patients	1,621	1,415	206	—
Age	43.7 (42) [1–98]	44.7 (43) [1–98]	39.4 (36) [3–89]	<b>.002</b>
ISS	17.0 (14) [1–75]	17.0 (14) [1–75]	16.0 (14) [1–75]	.13
GCS	12.6 (15) [3–15]	12.7 (15) [3–15]	12.3 (15) [3–15]	.72
Number of injuries	6.3 (5) [1–24]	6.3 (5) [1–24]	6.1 (5) [1–24]	—
Mortality (%)	128 (100%)	112 (88%)	16 (12%)	.25
LOS	7.7 (4) [1–113]	7.8 (4) [1–113]	6.3 (4) [1–75]	<b>.02</b>

Data recorded as mean, (median), and [ranges]. The bold entries indicate statistical significance. GCS = Glasgow Coma Scale; ISS = injury severity score; LOS = Length of stay.

demands of all surgeons' time and there may not be enough volume to support specialty care all the time for every patient.

The study did have several limitations. There were relatively few deaths overall limiting the ability to draw overly broad conclusions about the potential benefit of having a well-trained, experienced trauma surgeon available in the setting of specific injuries or patient populations. Similarly, we do not necessarily believe that these findings can be generalized to institutions with a higher representation of penetrating trauma. Only 1 trauma laparotomy was performed by a nontrauma surgeon for a penetrating injury in this series. Although blood product utilization was similar in the patients requiring laparotomy, other measures pertaining to the quality of care of the trauma patient such as time to the operating room for acute laparotomy and/or thoracotomy or aspects of resource utilization and cost were not assessed. In addition, call was not designated in a random manner, and it may be that trauma surgeons assigned call outside their division on perceived "low risk" evenings or weekends.

## Conclusion

In conclusion, there was no difference in clinically significant outcomes between trauma and nontrauma attendings taking call at a rural level I trauma center. Trauma systems, protocols, and algorithms can be developed that allow nontrauma surgeons to provide equally safe and effective care.

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