

Enhanced Trauma Program Commitment at a Level I Trauma Center

Effect on the Process and Outcome of Care

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Hypothesis: With advances in surgical care, the occurrences of major adverse outcomes have become a rare event. The effect of a surgical service can be more comprehensively evaluated by following the Donabedian model, looking at the triad of structure, process, and outcome. It is hypothesized that the implementation of a focused program commitment at a trauma center is associated with improvements in process of care and patient outcomes.

Design: Evaluation of prospectively collected information in a trauma registry for the 3-year periods immediately before (1995-1997) and after (1999-2001) the implementation (in 1998) of the full-time trauma service.

Setting: Level I university-affiliated trauma center.

Patients: Patients meeting criteria for major trauma.

Intervention: The implementation of a full-time trauma service, featuring 24-hour in-house attending coverage, dedicated trauma admitting unit, regular trauma core curriculum, regular multidisciplinary quality assurance meetings, and state designation for level I status.

Main Outcome Measures: Process of care measures, including time in the emergency department (ED) and trauma "bypass" hours (ie, time spent in the trauma resuscitation area). Outcome measures, including lengths

of stay, overall mortality and mortality, excluding ED deaths.

Results: The total number of patients with major trauma increased from 2240 (1995-1997) to 2513 (1999-2001). The average time in the ED for patients going to the operating room, intensive care unit, and observation wards all decreased significantly (84 vs 52 minutes, 197 vs 118 minutes, and 300 vs 140 minutes, respectively; all with $P < .01$). The number of hours that the trauma center was closed owing to ED overcrowding also decreased significantly, from 56 to 2.7 hours per month ($P < .01$). After excluding ED deaths, there was a trend on bivariate analyses toward lower overall mortality rates (4.5% vs 3.4%, $P = .07$) and mortality rates among patients with severe head injury (23.8% vs 17.2%, $P = .07$). On further analyses with multiple logistic regression, controlling for age, Injury Severity Score, Abbreviated Injury Score (for a head injury), and admission blood pressure, the later period is associated with a 31% decrease in overall odds of death ($P = .047$) and a 42% decrease in odds of death among patients with severe head injury (an Abbreviated Injury Score, ≥ 3 ; $P = .03$).

Conclusion: The implementation of a full-time trauma service is associated with improved timeliness of triage and therapeutic interventions and improved patient outcomes.

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SEVERAL STUDIES have analyzed the affect of hospital commitment to quality care to a dedicated trauma service. Specifically, there have been conflicting reports on the effect of initiating a 24-hour in-house presence of trauma attending physicians. Some have suggested improved outcomes,¹⁻³ others have demonstrated no difference,⁴⁻⁷ and still others have suggested that the question be posed in a different way.⁸

Advances in trauma care have made mortality progressively less common

among critically injured patients surviving to leave the emergency department (ED). Therefore, it may be useful to apply a Donabedian model to the analysis of quality of care.⁹ This model stipulates that the quality of care is assessed by evaluating the following 3 components: structure, process, and outcome. The purpose of this study was to evaluate the effect of the commitment to a dedicated trauma program that features 24-hour in-house attending physician coverage (structure) at a university-affiliated level I trauma center on the process and outcome of care.

Table 1. Structural Changes to the Trauma Service at The Johns Hopkins Hospital, Baltimore, Md

Change	1995-1997*	1999-2001*
In-house trauma faculty	No	Yes
No. of full-time trauma faculty	3	5
Dedicated trauma admitting unit	No	Yes
No. of written trauma protocols	0	16
Regular trauma core curriculum for nurses	Yes	Yes
Regular trauma core curriculum for physicians and medical students	No	Yes
Trauma QA	Yes	Yes
Regular multidisciplinary trauma QA	No	Yes
Multidisciplinary research, injury prevention, and outreach program	No	Yes
State level I designation	No	Yes

Abbreviation: QA, quality assurance.

*The 3-year periods immediately before (1995-1997) and after (1999-2001) the implementation (in 1998) of a full-time level I trauma center.

METHODS

In 1998, a commitment was made to develop a dedicated trauma program worthy of level I trauma center designation at The Johns Hopkins Hospital, Baltimore, Md.¹⁰ In-house attending physician presence 24 hours a day was one of several structural changes that was implemented (**Table 1**). Designation from the State of Maryland was obtained in August 1998 and comparisons in process and outcome of care are made for the 3-year periods immediately before (1995-1997) and after (1999-2001) implementation of the enhanced trauma program.

The analysis focused on patients with major trauma, who were most likely to be affected by the structural changes of the trauma service. **Table 2** lists the criteria for the major trauma category requiring immediate response from the in-house trauma team (ie, trauma attending physician, chief and junior residents in surgery, attending and resident in anesthesiology, and respiratory therapist, and general operating room nurse and nursing shift coordinators) by telephone.

The analysis is based on data in the in-house prospectively collected registry from 1995 through 2001. The registry is managed by Collector software from Tri-Analytics (Bel Air, Md). Statistical analysis was performed in Intercooled Stata Version 6.0 (Stata Corporation, College Station, Tex). Comparisons of proportions were performed using χ^2 tests, and comparisons of means were performed using 2-tailed *t* tests. Adjusted odds were calculated using multiple logistic regressions. The comparison began with bivariate analyses on all patients who had major trauma and then with bivariate and multiple logistic regression analyses on the subset of patients surviving to leave the ED.

RESULTS

Over the period studied, the total number of patients with major trauma increased from 2240 to 2513, had a significantly greater frequency of blunt mechanism of injury, and was less male predominant (**Table 3**). There was a significant improvement in triage time for all patients leaving the ED (**Table 4**). There was about a 40% decrease in the triage time for patients going to the operating room or to the intensive care unit. There was an even more dramatic improvement in triage time for patients being admitted to the hospital for observation. This

Table 2. Criteria for Major Trauma at The Johns Hopkins Hospital, Baltimore, Md

Variable	Standard
Physiological criteria	SBP < 90 mm Hg; pulse rate, > 120/min or < 50/min; respirations, > 30/min or < 10/min
Mechanism criteria	GSW or STW to head, neck, or torso; certain blunt trauma (fall > 15 ft, assault, pedestrian struck, motor vehicle collision)
Other criteria	Head trauma; obvious major vascular injury; open fracture; burns
	Any traumatic pneumothorax; any traumatic amputation or de-gloving injury; any displaced pelvic fracture

Abbreviations: GSW, gunshot wound; SPB, systolic blood pressure; STW, stab wound.

Table 3. Demographic Information of Patients Who Were Treated for Major Trauma at The Johns Hopkins Hospital, Baltimore, Md*

Variable	3-Year Period		P Value†
	1995-1997‡ (n = 2240)	1999-2001‡ (n = 2513)	
Male sex	1895 (84.6)	2044 (81.3)	.01
Age, y	30.9	31.6	.10
Mechanism of injury			
GSW	864 (38.6)	667 (26.6)	<.01
Blunt trauma	842 (37.6)	1232 (49.0)	<.01
ISS score, >15	506 (22.6)	501 (19.9)	.03
AIS score, ≥3	273 (12.2)	314 (12.5)	.75
SBP, <90 mm Hg	179 (8.0)	211 (8.4)	.61
Direct admission from ED to OR	495 (22.1)	446 (17.8)	<.01

Abbreviations: AIS, Abbreviated Injury Severity (for head injuries); ED, emergency department; GSW, gunshot wound; ISS, Injury Severity Score; OR, operating room; SBP, systolic blood pressure.

*Data are given as the number (percentage) of patients unless otherwise indicated.

†The 3-year periods immediately before (1995-1997) and after (1999-2001) the implementation (in 1998) of a full-time level I trauma center.

‡Boldfaced *P* values indicate statistical significance.

improved triage was associated with a substantial decrease in the number of hours per month that the trauma center was closed owing to unavailable beds in the ED trauma resuscitation area (trauma "bypass").

There was also a significant decrease in the lengths of hospital stay, from an average of 4.3 to 3.8 days (*P* = .03) (**Table 5**). On bivariate analyses, there was no significant difference in mortality overall, or among patients with an Injury Severity Score exceeding 15, or with severe head injury (Abbreviated Injury Score, ≥3). There was, however, lower mortality among patients with blunt trauma (7.2% vs 5.0%, *P* = .03) and patients without hypotension (4.1% vs 2.2%, *P* < .01) in the later period. While gunshot wounds (GSW) decreased in frequency over the study period, they became more lethal (14.2% vs 19.3%, *P* < .01). Most of the patients with fatal GSWs (86 [66.7%] of 129 patients) were either dead on arrival or died shortly after ED admission.

Table 4. Analysis of Process of Care for Patients Who Were Treated for Major Trauma at The Johns Hopkins Hospital, Baltimore, Md*

Variable	3-Year Period	
	1995-1997†	1999-2001†
Time in ED	238 (n = 2213)	126 (n = 2501)
Time to OR	84 (n = 494)	52 (n = 446)
Time to ICU	197 (n = 193)	118 (n = 193)
Time to observation ward	300 (n = 675)	140 (n = 1413)
Trauma center by pass hours	56 h	2.7 h

Abbreviations: ED, emergency department; ICU, intensive care unit; OR, operating room.

*Data are given as the number of minutes unless otherwise indicated. The *P* value for all of the variables was statistically significant at .01.

†The 3-year periods immediately before (1995-1997) and after (1999-2001) the implementation (in 1998) of a full-time level I trauma center.

Table 6. Analysis of Outcome of Patients Who Were Treated for Major Trauma at The Johns Hopkins Hospital, Baltimore, Md, After Excluding Deaths in the Emergency Department*

Variable	3-Year Period		<i>P</i> Value‡
	1995-1997†	1999-2001†	
Deaths			
All	96/2138 (4.5)	82/2392 (3.4)	.07
Cases with an ISS >15	88/433 (20.3)	74/410 (18.1)	.40
Cases with an ISS <15	8/1705 (0.5)	8/1982 (0.4)	.77
Cases with an SBP <90	27/92 (29.4)	37/95 (39.0)	.17
Cases with an SBP ≥90	69/2046 (3.4)	45/2297 (2.0)	<.01
Cases with an AIS score, ≥3	57/240 (23.8)	46/268 (17.2)	.07
Cases with an AIS score, 1 or 2	39/1898 (2.1)	36/2124 (1.7)	.40
Cases with blunt trauma	42/823 (5.1)	34/1205 (2.8)	<.01
Cases with GSW	47/788 (6.0)	43/581 (7.4)	.29

Abbreviations: AIS, Abbreviated Injury Severity (for head injuries); GSW, gunshot wound; ICU, intensive care unit; ISS, Injury Severity Score; SBP, systolic blood pressure.

*Data are given as the number of persons/total number of persons (percentage).

†The 3-year periods immediately before (1995-1997) and after (1999-2001) the implementation (in 1998) of full-time level I trauma center.

‡Boldfaced *P* values indicate statistical significance.

A slightly different picture emerged in mortality data after excluding ED deaths (**Table 6**). While the improvement in mortality of patients with blunt trauma persisted (5.1% vs 2.8%, *P* < .01), the differences in mortality rates among patients with GSWs surviving to leave the ED became nonsignificant (6.0% vs 7.4%, *P* = .29). A trend toward improvement in overall mortality rates (4.5% vs 3.4%, *P* = .07) and in the mortality rates among patients with severe head trauma (23.8% vs 17.2%, *P* = .07) did not quite achieve statistical significance. On multiple logistic regression analyses, controlling for age, Injury Severity Score, Abbreviated Injury Severity score, and admission blood pressure, the later period is associated with a 31% decrease in overall odds of death (*P* = .047) and a 42% decrease in odds of death among patients with severe head injury (Abbreviated Injury Severity score, >3, *P* = .03).

Table 5. Analysis of Outcome of Patients Who Were Treated for Major Trauma at The Johns Hopkins Hospital, Baltimore, Md*

Variable	3-Year Period		<i>P</i> Value‡
	1995-1997†	1999-2001†	
Length of hospital stay, d	4.3 (n = 2219)	3.8 (n = 2509)	.03
ICU length of stay, d	4.0 (n = 560)	4.6 (n = 481)	.09
Deaths			
All	198/2240 (8.8)	203/2513 (8.1)	.35
Cases with an ISS >15	161/506 (31.8)	165/501 (32.9)	.71
Cases with an ISS <15	37/1734 (2.1)	38/2012 (1.9)	.59
Cases with an SBP <90	114/179 (63.7)	153/211 (72.5)	.06
Cases with an SBP ≥90	84/2061 (4.1)	50/2302 (2.2)	<.01
Cases with an AIS score, ≥3	90/273 (33.0)	92/314 (29.3)	.34
Cases with an AIS score, 1 or 2	108/1967 (5.5)	111/2199 (5.1)	.52
Cases with blunt trauma	61/842 (7.2)	61/1232 (5.0)	.03
Cases with GSW	123/864 (14.2)	129/667 (19.3)	<.01

Abbreviations: AIS, Abbreviated Injury Severity (for head injuries); GSW, gunshot wound; ICU, intensive care unit; ISS, Injury Severity Score; SBP, systolic blood pressure.

*Data are given as the number of persons/total number of persons (percentage) unless otherwise indicated.

†The 3-year periods immediately before (1995-1997) and after (1999-2001) the implementation (in 1998) of a full-time level I trauma center.

‡Boldfaced *P* values indicate statistical significance.

Time in the ED was not independently associated with outcomes. For patients going to the operating room or the intensive care unit, after adjusting for injury severity, systolic blood pressure, and Abbreviated Injury Severity score, length of time in the ED was not significantly associated with the odds of death (*P* = .09). Restricting the analysis to severely injured patients only (Injury Severity Score, >15; systolic blood pressure, <90 mm Hg; or Abbreviated Injury Severity score, ≥3), the variables remained nonsignificant.

COMMENT

There have been several studies analyzing the effect of commitment of resources to a dedicated trauma service. Cohen et al⁶ reported that there was no significant change in actual mortality, despite a significant increase in the severity of injuries after the implementation of a dedicated trauma program at their hospital. Demetriades et al² described a significant decrease in mortality and a trend toward fewer permanent disabilities after the implementation of dedicated trauma service at the Los Angeles County Hospital—University of Southern California Medical Center.

The term “in-house attending” is probably best viewed in this study as a surrogate for several structural changes implemented on the trauma service (Table 1). The specific implementation of the in-house attending trauma surgeon has been the subject of debate in the literature. Luchette et al³ compared the outcome of patients of 4 attending trauma surgeons at a university-affiliated, urban, level I trauma center, 2 of whom were taking calls in-house, and the other 2 who were taking calls from home. They found that the in-house trauma

attending significantly reduced the costs of care; reduced the elapsed time to diagnostic testing, therapeutic intervention and the operating room; and reduced patient mortality.³ Rogers et al¹ compared in-house vs on-call trauma attendings at 2 different university centers and found that the in-house trauma attendings were associated with lower odds of death and fewer errors in judgment. Demarest et al,⁵ however, reported no difference between 2 level I trauma centers in 2 different states, and further they found no difference between the in-house and on-call trauma attending system. Fulda et al⁷ made a similar comparison in a single level I trauma center and also found no significant difference in outcomes of patients. Thompson et al⁴ analyzed the same question at a rural level II trauma center and found that there was no significant survival advantage. Much of that literature has focused on patient outcomes. Porter and Ursic⁸ suggested that the question needs to be revised as to whether the trauma attendings direct the resuscitation, regardless of whether they come from home or are in house.

The Donabedian model focuses on structure, process, and outcome in the evaluation of the quality of health care. The objective of this study was to evaluate the implementation of a dedicated trauma program that features, among other things, 24-hour in-house attending coverage (structure, Table 1) on the process and outcome of care of trauma patients at a university-affiliated level I trauma center. The timeliness of triage and therapeutic interventions among trauma patients has significantly improved after the structural change (Table 4). The faster triage dramatically reduced the time on trauma bypass, which allowed the trauma team to serve a larger number of patients. The most significant improvement in outcomes was seen on multivariate analyses after excluding deaths in the ED, specifically in overall mortality and among patients with severe head injuries.

It is difficult to ascertain how much of the improved outcome was owing to the attending in house. The 5 full-time trauma attendings all received their general surgery³ and surgical critical care² training at university-affiliated level I trauma centers. They were between 1 and 10 years out of training during the second period studied. Given the improvements in overall mortality, in mortality among patients with blunt trauma, and among patients with severe head injuries, it is likely that attending supervision of multidisciplinary resuscitation and refinement of treatment protocols is as responsible as technical surgical proficiency for improved outcomes.

Given the numerous factors of improvement in the process and outcomes of care, the increased mortality of patients with GSWs (Table 5) seen on bivariate analysis deserves further comments. A greater lethality of weaponry is suggested by the fact that, over time, a greater proportion of all persons with a GSW (76 [8.8%] of 864 persons vs 86 [12.9%] of 664 persons, $P=.01$) arrived in extremis and were pronounced dead in the ED. Furthermore, of the 43 patients with fatal GSWs who had survived to leave the ED during the later period, 37 died in the first 24 hours, and 23 had a GSW to the head. These data have convinced us of the importance of a community outreach program in violence prevention.

The fact that time in the ED was unassociated with patient outcomes was not surprising. On the one hand, the greatest improvement in triage time was experienced by the group of patients who required neither intensive care unit admission nor admission directly to the operating room. Of course, this group had the greatest opportunity for improvement, as their triage time had averaged 5 hours before implementation of the trauma program. On the other hand, the constant attending presence is likely to affect ED time for the most critically injured subset of patients, regardless of destination. In short, patients who are most likely and least likely to die experienced more rapid triage, thus obliterating any correlation between ED time and outcome. Improved timeliness of care was unassociated in any improvement in outcome in a report by Dodek et al,¹¹ but faster triage is an important end point in and of itself in our statewide trauma system as it allows our level I trauma center to remain open longer.

Another interesting feature of the multidisciplinary trauma service emerged with time. The emergency medicine department was encouraged to activate the major trauma response for all patients with concerns for major mechanisms even if the criteria described in Table 2 were not met. This had the effect of including more patients in the later period with blunt trauma who ultimately did not achieve an Injury Severity Score exceeding 15 (Table 3). These patients are more likely to be female and less likely to require surgical interventions than patients with a GSW. Nevertheless, the improvement in outcome was seen on multivariate analyses even after controlling for injury severity.

CONCLUSION

The implementation of a dedicated trauma service is associated with improved timeliness of triage, therapeutic interventions, and patient outcomes.

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DISCUSSION

George C. Velmahos, MD, Los Angeles, Calif: Dr Cornwell and colleagues add this elegant study to the literature that describes the benefits of developing a well-rounded trauma program. The authors correctly emphasize that we should monitor not only patient outcomes but also the process of care as an indicator of the effectiveness of a trauma program. Following the implementation of a dedicated trauma program, The Johns Hopkins Hospital was designated as a level I trauma center and realized statistically and clinically significant improvements in patient triage and outcomes.

Trauma patients were transferred to areas of definitive care faster and more efficiently, the numbers of bypass hours were reduced, and in this way the local community better served. Even more, the new trauma program produced the ultimate benefit, which is a decrease in mortality of specific trauma subgroups.

I have 4 questions for the authors, and the first one relates to their initial hypothesis. The authors claimed that the most important bearer of positive changes in their new trauma program was the in-house, around-the-clock commitment of trauma attendings. This is certainly my own bias also. But how could you provide hard proof to the skeptics that among many changes this was the major or at least one of the major factors for the improvement seen at your trauma center.

A frequently measured outcome to evaluate the effectiveness of trauma centers is the incidence of preventable deaths. Did you observe any changes in the number or causes of preventable deaths in your hospital?

The cost-effectiveness of organized trauma centers is relatively unexplored. Do you offer a better quality of care by spending more or less money? Do you think that cost-effectiveness should be an important end point to justify trauma center existence and survivability?

A question on the field of injury prevention, in which the principal author is considered a national authority. Many reports suggest that organized injury prevention can actually save more lives than organized pre- or in-hospital trauma care. Do you have any data from your own injury prevention program and the benefits it produced for the local community?

I really enjoyed this paper. Dr Cornwell and his group re-taught us an important lesson that is often forgotten. If you invest the commitment and resources, you will definitely reap the appropriate benefits.

Richard J. Mullins, MD, Portland, Ore: Trauma services have for decades depended on protocol-driven resuscitation in the ED where residents worked up patients according to guidelines. Dr Cornwell, when the gray-haired professors are down there in the Trauma Bay guiding the resuscitation, are you making sure that your residents comply with these protocols or, Dr Cornwell, are you cutting to the chase on the key issues saying "this is the way we are going to do it because I can see how we need to focus on this issue."

David Wisner, MD, Sacramento, Calif: I have 2 questions. One is that I noticed that you went from 3 full-time trauma attendings to 5 full-time attendings with the change. Could you talk a little bit about what the change meant in terms of call frequency per individual surgeon and, perhaps more importantly, what did it mean for the surgical volume that each individual surgeon saw before and after the change?

Also, could you talk a little bit about the non-Delta or the noncritical trauma patients maybe as a measure of how the other changes besides attending presence affected your outcome measures? Do you have any data on the patients who were not critically injured in terms of length of stay in the ED, mortality rate, etc?

Gill Cryer, MD, Los Angeles: Dr Cornwell, I really enjoyed this paper and it is a very important topic, particularly for you, and I would encourage you to change your title. Rather than showing that there is an increased survival benefit to in-house attendings, what you really showed is that there is a survival benefit from an increase in leadership. It was the leadership change and a commitment to endorsing the American College of Surgeons' resource document requirements, that really led to the benefit to your patients, and you should be proud of it. I would also ask a question which was not clear to me in your data: in the American College of Surgeons Committee on Trauma Resource Document, they require that attendings be present for a certain subset of patients, those patients who have hypotension, those patients who have a Glasgow Coma Scale score of less than 8, and then those patients who have a GSW or a penetrating injury to the torso. In your data analysis, could you show a difference in that specific subset of patients in the period when you did not have attendings present and the period that you did?

James J. Peck, MD, Portland: Hippocrates stated, "He who wishes to be a surgeon should go to war." Trauma has been an important part of Eddie Cornwell's and my training and my training at LA County-USC Medical Center. It focused our education. Diagnoses needed to be made. Therapeutic options needed to be evaluated. Operating could involve almost any organ system: blood vessels, viscera, solid organs, or the brain. It was fertile soil for the training of a surgeon. The ideas of Halsted and Blalock at The Johns Hopkins Hospital of using wards of indigent patients for the maturation of surgeons has become unacceptable in our society. Is this changing the way we educated our surgeons? Is the decision making not being made by the resident himself but being made by the in-house attending? Essentially, all patients are "entitled" to be private patients. They have trauma care by fully qualified trauma surgeons. Are we putting the surgeons of the future on the firing line? In other words, a lot of good judgment usually requires experience and bad judgment. Is this the best way to educate the surgeons of the future?

John C. Mayberry, MD, Portland: My question is similar to the one of Dr Peck's. How many patients per day or critically ill patients per day or procedures per day does it make sense to have an in-house trauma attending, and also, for the resident's sake, how many patients per day does it make sense to have the resident in-house? In many trauma centers who see mostly patients with blunt trauma, sometimes the resident is chewing up a lot of hours and not getting much educational benefit. This may not be true in Baltimore, but in other trauma centers that the resident may not be getting much educational benefit by spending the night in the hospital.

John T. Owings, MD, Sacramento, Calif: Eddie, Your title suggests that it is the in-house trauma attending commitment. My question very simply is: do you believe it is the in-house trauma attending or do you believe it is the commitment? Many centers have gone to a mandatory trauma attending response time to the ED. In the last years and decades we have demon-

strated that the American public does not care whose bed the President of the United States sleeps in, so should they care any more whose bed their trauma attending sleeps in as long as they show up to the resuscitation? So your own personal opinion: do you favor specifically having a trauma attending sleeping in the hospital over having a mandatory attendance in the ED-within say 10 or 15 minutes?

Dr Cornwell: I would like to thank Dr Velmahos for his kind comments and insightful questions and all of the discussants for some very excellent insightful questions. I will try to take them in the order in which they were given.

George, I cannot say that we have hard evidence; so it is my bias that the attending commitment be in house. This will vary from institution to institution. In our case, consider that even with the increase in blunt trauma, 18% of our patients are going directly to the operating room (this also considers Dr Mayberry's question). This means that between 1 in 5 and 1 in 6 patients with trauma team activations are going directly to the operating room. Now 2500 trauma activations in 3 years is about 830 a year, so you are looking at between 2 and 3 patients a day. So every other night, there is a patient who is going to come in and go directly to the operating room. These are the very patients with whom there was more timely therapeutic intervention once the in-house attending commitment was implemented. In addition, we like USC and other institutions, practice selective management of GSWs to the abdomen, something that requires serial examinations and requires an experienced examiner. This is something I would not practice without an attending in house.

Now this is going to vary from institution to institution (and this goes also to John Owing's question). No attending is going to live in the East Baltimore community where The Johns Hopkins Hospital is located, and 80% of our patients come from within a 5-mile radius of the hospital vs some other trauma centers in the western part of our state where attendings can literally be in house within 5 minutes. Their evaluation is going to be different than ours. I have been to Annapolis 6 times in the last 3 months actually testifying in support of the Trauma System Funding Act. We paint the picture: that in the State of Maryland, trauma centers have very different looks and level IIs vs level IIIs have different requirements. That also explains the variety of conclusions that you see in the literature relative to effect on quality of care.

Dr Velmahos' second question was regarding preventable deaths. We did not include that in the presentation because it is really an apples-and-oranges comparison. During the first 3-year period, there were fully 45 deaths of the 248 total deaths that had poor or missing documentation as to the peer-review conclusion of preventability. What we do know is that there were a total of 28 preventable or potentially preventable deaths of the 203 that were evaluated from 1995-1997 (ie, 19%) vs 11 preventable or potentially preventable from 1999-2001 (ie, 5%). It is statistically different but you cannot really say a lot about that when data elements on 45 deaths are missing. What we can say is that of the preventable deaths during the first period, the single most common citation was delay in getting the patient to the operating room. There was no patient who died during the second period where therapeutic delay contributed to a preventable death. As the Optimal Resources Manual of the American College of Surgeons says, the best way of demonstrating the commitment in our clinical setting is having the attending in house.

Third, the issue of cost of care: regardless of what I think, politicians have made it clear. They are spending taxpayer dollars, and we have to demonstrate some cost-effectiveness. We did in fact show a decreased length of stay, and in the Health Services Cost Review Commission format (for the State of Mary-

land) of establishing hospital reimbursement, that actually translates to better reimbursement for hospital charges, although not professional fees.

Thank you, George, for your comments about injury prevention. I would not trivialize the issue of violence prevention by saying that in 3 years we showed a major impact. We do have an American Trauma Society supported grant for this complex issue. In a city where only 7% of eighth graders in public schools are reading at their grade level and more of them are dropping out of high school than are graduating; and with the highest percentage of babies born to unwed mothers of any large city in the country, Baltimore has a crisis in the absence of nonviolent male role models. What I can say is that one of our projects involves bringing kids to witness the effects of violence. We are evaluating short-term attitude changes, and hopefully next year we will be able to come back and show you some difference in the attitudes relating to violence and conflict intervention. We also have underway a project using a validated readiness-to-change interview tool. It shows that despite having a life-threatening event, young trauma survivors who are consuming alcohol and other drugs on board, still have no readiness to change when intervention is done in the hospital. True violence prevention cannot really be done in the hospital. It is like trying to give swimming lessons from the bottom of the pool.

Rich Mullins, thank you for your comments about ATLS. We do have multiple protocols, some that correlate with ATLS and some that do not. We adhere to them, if they are evidence-based such as the head injury guidelines. We have 16 protocols that we adhere to, and in head injury we have shown an improved outcome.

Dave Wisner asked about the "non-Delta" patients. While there was actually an improved outcome among non-hypotensive Delta patients, there are a large number of the non-Delta patients that got out of the ED and got to the trauma admitting unit more quickly. Ninety-nine percent of those patients are surviving, so we cannot show outcome changes. The major effect there would be process of care improvement that allowed us to stop being closed so much and treat more patients, perhaps some of the critically injured patients who really needed us.

Gill Cryer also asked about the attending presence and outcome. There was an improvement in mortality on multivariate analysis among major head injuries. The attending presence vs commitment is going to be a function of the institution and your patient mix.

Jim Peck asked about bad judgments, decreasing those errors. In an age of simulated patient care and patient models, I think we are just going to have to use our simulated patient models to help us acquire good judgment which came from experience which came from bad judgment.

Finally, the issue of the previous system when we had fewer trauma surgeons: the junior attendings and the residents took care of trauma patients in the earlier period, not in house. The junior attending would come in house for operations and they covered every other night, day and night. We took away their daytime responsibility. These are busy surgeons performing a lot of general surgery. We have full-time trauma attendings taking all of the day-time call. Trauma attendings take anywhere from 4 to 6 nights a month. There are 1 or 2 attendings who are not full time on the service who will take a few nights a month and get paid for each night that they take. "Pass-on" rounds occur every morning between the attending coming on call and the attending coming off call; the patients' care will be passed on if they are in that period of evaluation. So with that, it is still a significant in-house commitment. We are committed to it because we think it improves both process and outcome.