

The State of Trauma: Chairman's Annual Report

January 2012

Introduction

Much has been achieved over the last year with regard to developing our state-wide trauma system. As we move into a new year, I thought a moment of reflection on our accomplishments and rationale for our vision would be appropriate. It is easy to lose focus when there are so many committees and partners working together to develop something as complex as a state-wide trauma system. Please consider this as a brief overview of our progress. Since we have several new Georgia Trauma Commission members, I have also incorporated some of the history of trauma regionalization into the discussion to show how we developed our current vision and plan.¹

Is trauma a public health issue?

Trauma continues to be the leading cause of death between the ages of 1 to 44. Overall injury is the 4th leading cause of death in the United States, but life-years lost are greater from injury than from the 3 other leading causes of death combined which are heart disease, cancer, and stroke. The average life-years lost per death from trauma is 36 compared with 12 years for heart disease and stroke combined and 16 years for cancer.²

Do trauma centers make a difference?

This evaluation started many years ago and has been answered in the affirmative with a landmark paper by MacKenzie published in the *New England Journal of Medicine* in 2006.³ In the late 1970's, in Orange County, California, West and colleagues compared the preventable death rate for trauma patients in San Francisco County (all trauma victims brought to a single trauma center) with Orange County (patients transported to the nearest of 31 different hospitals). The preventable death rate was 1% in San Francisco compared to 43% in Orange County. Of the trauma patients dying of causes other than brain injury, 73% were judged to be potentially preventable in Orange County compared to only 6% potentially preventable in San Francisco.⁴

Based on this information, Orange County implemented a regionalized system of trauma care in 1980. Using the American College of Surgeons Committee on Trauma (ACSCOT) criteria, five hospitals in the county were designated as trauma centers. A follow-up study by Cales comparing pre-implementation to post-implementation of the trauma system showed an approximate 50% reduction in the preventable death rate for trauma patients.⁵ Interestingly, 7 of the 9 preventable deaths occurring after trauma system implementation occurred in the non-designated hospitals. Overall, the designated trauma center preventable death rate was 4% compared to 54% for non-designated hospitals. Other parameters that were evaluated pre and post system development in these patients that died were the appropriate use of intravenous fluids and appropriate surgical intervention (a common practice and focus for designated trauma centers). After implementation of the trauma system, the appropriate use of intravenous fluids increased from 38% to 90% and the percentage of cases with appropriate surgical intervention increased from 6% to 76%.

In a similar study from San Diego, Shackford also showed dramatic results in decreasing the potentially preventable death rate by implementing a regionalized trauma system.⁶ After implementation of the trauma system, the preventable death rate dropped from 22% to 10%. A major advantage of this study was that they carefully assessed the errors that were made during resuscitation and noted that delays in initial evaluation of the patient decreased from 41% to 11%, delays in disposition of the patient decreased from 54% to 7%, and suboptimal care in the initial hospital phase decreased from 32% to 2%. In a follow-up study, Shackford noted that the frankly preventable death rate for the non-designated hospital was 4 times higher than the designated trauma center (8% versus 2%).⁷ The most common error leading to preventable deaths occurring in the non-designated hospital was an error in diagnosis. Errors in technique were the most common cause of preventable deaths in the trauma centers.

There are multiple other studies that could be referenced, but these are some of the most quoted and provide an excellent foundation showing the decrease in mortality due to trauma system development and the designation of hospitals as trauma centers based on ACSCOT standards. The most definitive study on this subject was from MacKenzie published in *The New England Journal of Medicine* in 2006.³ This was a large national study that examined the differences in mortality between 18 Level I trauma centers and 51 hospitals without trauma center

designation located in 14 states. Data was obtained from over 5,000 patients and was adjusted for differences in case mix. After adjustment, the overall risk of death was 25% lower at designated trauma centers when compared to non-designated hospitals.

Do trauma systems make a difference?

The literature is replete with multiple studies addressing this question. Mullins’s review using population based research to assess the effectiveness of trauma systems concluded that there was an approximately 15 to 20% reduction of risk of death among seriously injured trauma patients due to the implementation of a trauma system.⁸ The following table briefly summarizes many of the studies of trauma system effectiveness.

Table 1

Region	Authors	Year of Publication	Population Studied	Data Studied	Results
Illinois	Boyd et al. ¹⁵	1973	Rural and regional trauma system	MVC deaths	Reduced number of deaths
	Mullner and Goldberg ¹⁷	1978	Rural and regional trauma system	MVC injuries and deaths	Reduced death rate
Florida	Alexander et al.	1973	County EMS	MVC deaths	Lower death rates in counties with trauma centers
Nebraska	Ornato et al. ²²	1985	Statewide EMS MVC deaths	Death certificate	Reduced frequency of deaths
Salt Lake City	Clemmer et al. ²¹	1985	Urban region	Seriously injured patients transported	Reduced frequency of deaths
Pennsylvania and Maryland	Smith et al. ²³	1990	Rural and urban	Hospital discharge abstracts	Lower death rates
Los Angeles County	Kane et al. ²⁴	1992	Urban and rural	Regional registry on seriously injured	No statistically significant advantage
North Carolina	Rutledge et al. ²⁶	1992	Urban and rural statewide	Death certificates	Significantly lower death rate with trauma system
	Rutledge et al. ²⁶	1993	Urban and rural statewide	Hospital claims and death certificates	Significantly lower death rate with trauma system
Oregon	Mullins et al. ²⁷	1994	Urban	Hospital claims	Lower odds of death with trauma system
	Mullins et al. ²⁸	1996	Urban and rural	Hospital claims	Lower odds of death with trauma system
	Hulka et al. ³¹	1997	Urban and rural children	Hospital claims	Lower odds of death with trauma system; prevention effective
	Mullins et al. ³⁰	1998	Urban and rural, two states	Hospital claims	Lower odds of death with trauma system
San Diego and Vermont	Rogers et al. ³²	1997	Urban and rural	Death certificates and medical records	Lower death rates with trauma system

The strengths and weaknesses of each study are noted in this excellent review. The common theme throughout each study is that building infrastructure and providing care in an organized fashion through regionalization improves outcomes. In 2002, Abernathy published their excellent results of the

Birmingham Regional Emergency Medical System once again demonstrating that trauma regionalization saves lives.⁹ They developed their system in the Birmingham region by forming a Regional Trauma Advisory Committee with representation from all stake holders including EMS, physicians, trauma centers, and non-trauma center participating hospitals. They developed triage protocols to identify and then route the most severe trauma patients from the scene to the closest trauma centers striving to get the injured patient to definitive care as quickly as possible. This effort was coordinated by their Trauma Communications Center and data was analyzed on a regular basis. Through this extensive effort, they noted that mortality at one of the level I trauma centers decreased by 52% when the pre-system period was compared to the post-system period. When they performed subgroup analysis with specific injuries, they noted a significant decrease in mortality after system implementation for head injury, spleen/liver injury, and pelvic fractures. The length of stay also decreased from 19.5 to 16.5 days for the more severely injured patients. There were economic ramifications as well. Through better organized and timely care, the mean cost of care for these critically injured patients decreased from \$34,983 to \$29,795. Basically, they got the critically injured patients in a more timely fashion and were able to start appropriate resuscitation earlier.

What is the value of trauma center care?

As noted above, several studies have documented the effectiveness of regionalized trauma care and decreasing mortality. The National Study on the Costs and Outcomes of Trauma showed that risk of death is 25% lower when care is provided in a Level I trauma center compared to a non-designated hospital. The question that must be answered now is how cost effective is this care and is it comparable to other diseases? This question was answered by MacKenzie in an excellent review of over 5,000 major trauma patients enrolled in the National Study on Costs and Outcomes of Trauma.¹⁰ This study compared the costs of care for trauma patients treated in Level I trauma centers versus non-designated hospitals. Cost-effectiveness was estimated as the ratio of the difference in costs divided by the difference in life years gained. The incremental cost per life-year saved for treatment at trauma centers versus non-designated hospitals was estimated at \$36,319. To fully understand this data, one must ask the question “What is the value of a year of life?” Obviously, this is open to debate, but there are some standard numbers in the literature that are quoted for the development

of healthcare policies. Cutler lists benchmarks that range from \$50,000 to \$200,000 while Viscusi and Aldy estimate the value at \$200,000 per year of life remaining for a person aged 45 who is expected to live an additional 30 years.^{11,12} The British National Health Service uses an upper limit of \$50,000 when evaluating alternative healthcare therapies.¹³ It appears that \$50,000 to \$100,000 is a reasonable number to use for each life-year saved when comparing life-saving interventions. Although \$36,319 per life-year saved may appear to be expensive on initial evaluation, it is well within the range of other life-saving interventions. For example, the intervention of a prophylactic implantation of an implantable cardioverter defibrillator costs \$25,000 to \$51,000 per quality adjusted life-year (QALY) saved. Mechanical ventilation and continued aggressive care has the incremental cost of \$33,000 to \$147,000 per QALY saved, and renal dialysis results in an average of \$129,000 per QALY saved. Compared to these other therapies trauma care at a level I trauma center is well within the accepted healthcare financial limits of appropriate care.

Table 2: Cost-Effectiveness Ratios for Selected Life-Saving Interventions

Intervention	Comparator	Target Population	Incremental Cost-Effectiveness Ratios*
Prophylactic implantation of an implantable cardioverter defibrillator (ICD) ³⁵	Conventional treatment	Patients at risk of sudden death because of left ventricular systolic dysfunction	\$25–51 per QALY added (in thousands of US \$2005)
Administration of drotrecogin alfa (activated) ³⁴	Usual care	Adults with severe sepsis	\$34–70 per QALY added (in thousands of US \$2003)
Mechanical ventilation and continued aggressive care ³⁴	No mechanical ventilation or mechanical ventilation withheld	Adults with acute respiratory failure	\$33–147 per QALY added (in thousands of US \$2003)
Public access defibrillation (PAD) ³³	Standard emergency medical service agency	Persons in cardiac arrest	\$27–57 per QALY added (in thousands of US \$2003)
Reducing response time for cardiac arrest ³³	Existing emergency medical service agency	Persons in cardiac arrest	\$40–368 per QALY added (in thousands of US \$2003)
Renal dialysis, current practice ³²	Next least costly strategy	Persons with end-stage renal disease	Average of \$129 per QALY added (in thousands of US \$2003)

* Ranges in CERs reflect differences in specifics of the intervention, comparator, target population, and methods for estimating costs and effectiveness across studies.

Providing care for critically injured patients at a Level I trauma center is expensive. The benefit, however, of a 25% reduction in mortality and excellent cost-effective profile when compared to other healthcare therapies outweighs the cost. MacKenzie concluded that regionalization of trauma care is not only effective but is also cost effective. Additionally, she noted that “the higher incremental cost per life-year gained for less severely injured patients underscores the importance of designing these systems, so that they are inclusive and assure that patients are taken to the level of care commensurate with their needs. Although making sure the most severely injured are taken to a Level I

trauma center, triaging the less severely injured patients to a lower level of trauma care will result in lower overall costs and increased efficiency of the system overall.”¹⁰

This lays the perfect foundation for what the Commission has done so far which is to develop and maintain strong, committed trauma centers supported by participating non-designated hospitals working together through their Regional Trauma Advisory Committee (RTAC) to develop a regional trauma plan to insure that the right trauma patient gets to the right place at the right time.

The Vision: Where are we now?

The goal of a trauma system is to get the right trauma patient to the right place at the right time. Using the literature reviewed above and multiple site visits to other states, the Commission has developed a vision for a state-wide trauma system.¹ We have made tremendous progress over the past two years and many pieces of the system are already operational. Since diagnosis and treatment of the critically injured patient must start at the scene, we have adopted the Centers for Disease Control (CDC) Trauma Triage Guidelines to identify the critically injured patients that should be immediately transported from the scene to a trauma center. We have developed educational tool kits for the EMS providers to help promote the CDC triage criteria. EMS Region 5 (Macon area) and EMS Region 6 (Augusta area) have agreed to participate as the two pilot studies for trauma regionalization. Each region has formed a RTAC which consists of all 911 EMS providers, physicians, trauma centers, non-trauma center hospitals, and local government officials. The goal of the RTAC is to develop a regional plan that will insure that the critically injured trauma patient, once identified by the trauma triage criteria, will be transported to the appropriate trauma center for definitive care as soon as possible. Each region has developed their plan. Region 5 is currently operational as of January 1, 2012, and Region 6 will become operational January 31, 2012. Region 9 has formed a RTAC and is developing a plan, and Region 1 is currently forming a RTAC.

It is imperative that each region of the state identify their strengths and weaknesses in trauma care to develop a specific regional trauma plan. It has been the consensus of the Commission that one trauma plan will not work for every region of the state. The stakeholders in each region must take an active role as

they are local experts that must identify and develop solutions for trauma care specific to their region. The Commission has provided the general template for all regions to use through their pilot projects in Region 5 and Region 6. We look forward to all 10 regions developing their plan and participating in a state-wide trauma system.

This state-wide system with 10 regional plans will be coordinated by the Trauma Communications Center (TCC). It will have real time data on service lines for all hospitals in each region and will be able to provide this information to the EMS providers in the field. It will also monitor which trauma centers have resource limitations or are near full capacity. The TCC will also have the capability to advise the EMS providers in the field as to the closest and most appropriate facility for treatment. The TCC is not a dispatch center, will never force a transport decision; but will serve as a resource for the trauma system. The TCC is staffed 24/7 and became operational January 1, 2012. For the first time in our state's history all trauma centers and their capabilities as well as all of the participating non-designated hospitals in Region 5 and Region 6 will be connected. This will be a tremendous asset to the patients that need life-saving care and will shorten the time from injury to definitive care at a trauma center or participating hospital. By getting patients to definitive care sooner during the "golden hour" of trauma, our trauma system will be able to save more lives.

Putting the pieces in place: a brief list of accomplishments to date

Pre-hospital

- Training 1,000 first responders
- Developed and implemented an App for paramedics to use in the field to make care of the pediatric patient more efficient and safe (1st state in the country to develop this technology)
- Provided competitive grants to help rural ambulance services obtain new ambulances
- Automatic Vehicle Locator System for hundreds of ambulances that uses GPS technology to show where the closest ambulance is located in the event of a disaster

Trauma Centers

- Have maintained the current designated trauma centers with no designated trauma centers dropping out of the system since the Commission was formed
- Have increased or upgraded 9 designated trauma centers through the office of EMS and Trauma over the last four years. (Upgraded to level I: Atlanta Medical Center and Children’s Healthcare of Atlanta – Egleston; New level II centers: Athens Regional Medical Center and Wellstar Kennestone Hospital; Upgraded to level III centers: Taylor Regional Hospital and Walton Regional Medical Center; New level IV centers: Lower Oconee Community Hospital and Wills Memorial Hospital; Specialty center: Joseph M. Still Burn Center)
- Have provided sophisticated software that allows trauma centers and non-designated hospitals that are participating in trauma regionalization to better care for the critically injured pediatric patient. This not only makes their care more efficient but decreases medical errors.
- Have standardized the reporting of cost of readiness for all trauma centers (one of the few states in the nation to do this)
- Every other month Trauma Medical Director’s Conference call (this is the first time our trauma centers have been connected throughout the state at the Trauma Medical Director level).
- All trauma centers are now members and participating in the American College of Surgeons Trauma Quality Improvement Program (TQIP). This data registry allows trauma centers to monitor their outcome and to provide solutions for improvement (Georgia is the first state to implement this program in all trauma centers and is developing the state-wide reports that will ultimately be used by other states).

Trauma system regionalization

- EMS Regions 5 and 6 are the pilot study regions for our state.
- Both regions have formed Regional Trauma Advisory Committees (RTAC) composed of all 911 EMS providers in the region, designated trauma centers, non-designated participating hospitals, physicians, and local government.
- Through multiple meetings, these RTACs have developed regional trauma plans to get the right patient to the right place at the right time.

- The TCC became operational January 1, 2012, and will be the hub for real time data resource information sharing connecting all hospitals together (designated and non-designated) in these regions.
- Region 6 Trauma Plan became operational January 1, 2012, and Region 5 Trauma Plan will become operational January 31, 2012.
- Region 9 and Region 1 are starting to form their RTACs.
- We continue to recruit other regions to form their RTACs and come into the trauma system.

Next steps

We have made tremendous progress over the last four years. Even with limited funds, the Commission has continued to push forward with trauma system development. We now have two regions with regional trauma plans and a state-wide communications center. We must continue to support other regions as they form RTACs and develop their regional plans. Once developed, each regional plan will be added to the system and be supported by the Trauma Communications Center. By forming RTACs in each region, the Commission will be able to understand the unique needs specific for trauma care at the regional level. This will help the Commission decide what resources are needed to promote trauma care at the regional level ultimately strengthening the state-wide trauma system. Not only will this help to provide daily trauma care throughout the state, but we will also have the capacity to surge and have a coordinated state response if a major disaster occurs. We must continue to work with GEMA as we develop this system so that our coordinated response will be rapid and efficient in the event of a disaster. One example of our collaboration is the placement of Automatic Vehicle Locator Systems (AVLS) in hundreds of ambulances throughout the state. This will allow GEMA to identify the location of all ambulances throughout the state in the event of a disaster, thereby, allowing a more rapid and accurate deployment of ambulances during disaster management. Once the final phase of this project is complete this year, Georgia will become the leading state for having ambulances connected and ready for response through this type of infrastructure.

Now that we are developing a real plan with the appropriate infrastructure, we are to a point that we must develop methodology to evaluate outcomes for the system we have developed. We must look at all variables, which include mortality, morbidity, time from accident to definitive trauma care, and cost-

effectiveness. To this end, I recommend that we consult national and state experts in trauma care to develop this methodology and set the standard for us to study our results.

I would consider the development of RTACs and our Trauma Communications Center phase one of our trauma system development. Using CDC Trauma Triage Criteria, we have developed a system that will allow us to get the most critically injured patient from the scene of the accident to a designated trauma center in a rapid and efficient manner. Through our RTACs, we have developed an infrastructure that allows designated trauma centers and non-designated participating hospitals to work together on weaknesses in trauma care that are identified at the regional level.

The next phase of system development will be to promote timely and efficient trauma care for patients with mild to moderate injuries that may be treated at non-designated participating hospitals. Ben Hinson has suggested that we develop a “check list” for trauma care that could be used at each hospital to make sure that the most critical points in the early resuscitation of the patient are completed. This is an intriguing idea but is difficult to develop as there are so many variables and complexities with each trauma patient. The variables that must be addressed would include airway, breathing, circulation, and shock management. There is no national “check list” that I am aware of that would cover all of these complexities; however, the Advance Trauma Life Support (ATLS) course was designed to cover all these areas in a rapid “check list” fashion identifying life threatening injuries and providing life saving interventions immediately. This course was specifically designed to help physicians treat the trauma patient within the first hour of arrival to the emergency room. Therefore, I recommend that we start discussions about developing legislation that would require all physicians working in emergency rooms in Georgia to have successfully completed the ATLS course and maintain recertification every four years. Physicians that have completed a residency in Emergency Medicine would automatically qualify as ATLS is incorporated into their residency training. We should seek support from the American College of Emergency Physicians and from the Georgia Hospital Association.

The ATLS course is specifically aimed at a “check list” for physicians. There is another course from the ACS COT entitled Rural Trauma Team Development

course. This course is specifically designed for hospitals that are not designated trauma centers and provides a team approach with nurses, technicians, and physicians in the emergency room. It is designed specifically for the hospital that does not have significant resources for trauma care. The course is taught in the local emergency room and teaches the team approach to trauma utilizing the resources that are specific to each local emergency room. The course actually adapts to the resources that are available in each emergency room. By using these two courses, I think we could develop an appropriate “check list” that would help all hospitals provide more efficient and rapid trauma care.

In conclusion, based on the literature and recommendations by the ACS consultation visit we are heading in the right direction for the development of our state-wide trauma system. We are building infrastructure at the local level through RTAC development that will allow each region to identify their strengths and weaknesses. Each region will have a plan that is specific for their needs but will also be connected through the Trauma Communications Center so there will be no gaps in coverage. We must now develop outcome measures and develop methodology to study our system.

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