



Trauma Facility Study:

An Analysis of the Need for Additional Level I and Level II Trauma Facilities in Texas

Prepared By:
The American College of Surgeons
Committee on Trauma
Trauma Systems Evaluation and Planning Committee

In Partial Response To:
2009 SB 1: Article II, Rider 90 - Trauma Facility Study

Updated December 8, 2010

STATEMENT OF TASK

The Texas Department of State Health Services (DSHS), Office of EMS and Trauma Care Systems was directed by the 81st Texas legislature, Senate Bill 1, Rider 90 to conduct a study of the state's trauma facilities to assess the need for additional level I and level II trauma facilities in the state. The DSHS requested a trauma system consultation, conducted under the auspices of the American College of Surgeons Trauma System Consultation program (TSC) to fulfill the study requirement.

The specific question asked of the site visit team is: *Given the size of Texas, what is the recommended number and distribution of Level I and II trauma centers in the State? Particular consideration should be given to the Houston-Galveston area and to the role that level III trauma facilities play in Texas.* This report is a focused response to that specific question. It is augmented by a much more comprehensive report on the State of the Texas trauma system.

TEXAS TRAUMA SYSTEM HISTORY

Texas was an early state leader in trauma system development. The Texas legislature passed the Omnibus Rural Health Care Rescue Act in 1989, which directed the Bureau of Emergency Management of the Texas Department of Health to do the following:

- develop and implement a statewide emergency medical services (EMS) and trauma care system,
- create the Trauma Technical Advisory Committee,
- designate trauma facilities, and
- develop a trauma registry to monitor the system and provide statewide cost and epidemiological statistics.

No funding was provided for this endeavor at that time.

The Trauma Technical Advisory Committee met for the first time in 1990 and was charged with the development of a trauma registry, the medical and technical aspects of the trauma system, and recommendation of rules and regulations for the trauma system.

Rules for implementation of the trauma system were adopted by the Texas Board of Health in 1992. These rules divided the state into 22 trauma service areas (TSAs) and provided for the formation of a regional advisory council (RAC) in each region to develop and implement a regional trauma system plan. The rules also delineated the trauma facility designation process, and provided for the development of a state trauma registry.

In 1993, the first trauma facility was designated, the University Medical Center in Lubbock. As of 1995, the 22 trauma service area structure was in place with corresponding regional advisory councils. This structure was developed primarily

through the work of health professionals, largely on a volunteer basis. Funding for the RACs was initially appropriated in 1997.

Since 1997, funds appropriated for the trauma system have gradually increased to the current \$84 million appropriated for 2010. However, 97% of the funds are disbursed to eligible entities (hospitals, emergency medical service (EMS) providers, and RACs) that participate in the trauma system, leaving a minimal amount for the infrastructure support of the trauma system.

Today the Texas trauma system has 256 of its 583 acute care hospitals voluntarily participating as designated trauma centers. Sixteen hospitals have achieved level I designation and 8 hospitals have achieved level II designation following a vigorous verification review by the American College of Surgeons. These hospitals have committed extensive resources (e.g., skilled surgeons and nurses, dedicated operating suites, intensive care unit beds, and collection of data to monitor patient outcomes and quality of care) to ensure that all emergency and specialty care resources are available 24 hours a day, 7 days a week, for the most seriously injured Texas residents. The Texas trauma system has 45 level III trauma centers and 187 level IV trauma centers. See Figure 1.

METHODOLOGY

The primary objective of an American College of Surgeons trauma system consultation is to guide and help promote a sustainable effort in the graduated development of an inclusive and integrated system of trauma care for the State of Texas. The multi-disciplinary site visit team for this consultation included two trauma/general surgeons, an emergency physician, a state emergency medical services/trauma director, a trauma program manager, a rural trauma and prehospital specialist, and a public health and injury specialist. Prior to the visit, the site visit team reviewed the DSHS responses to the American College of Surgeon's Pre-Review Questionnaire prepared for the consultation. The site visit team also reviewed a number of related supporting documents provided by the DSHS and information available on state government websites.

The site visit team convened in Austin, Texas on May 18-21, 2010. During the visit, plenary sessions allowed the site visit team to engage in interactive dialogue with a large number of trauma system representatives. Interaction was focused on obtaining information that would help the site visit team to fully understand the current status of the Texas trauma system and to make recommendations for future development of the trauma system. The site visit team's independent recommendations are unbiased and based on the information provided prior to and during the site visit.

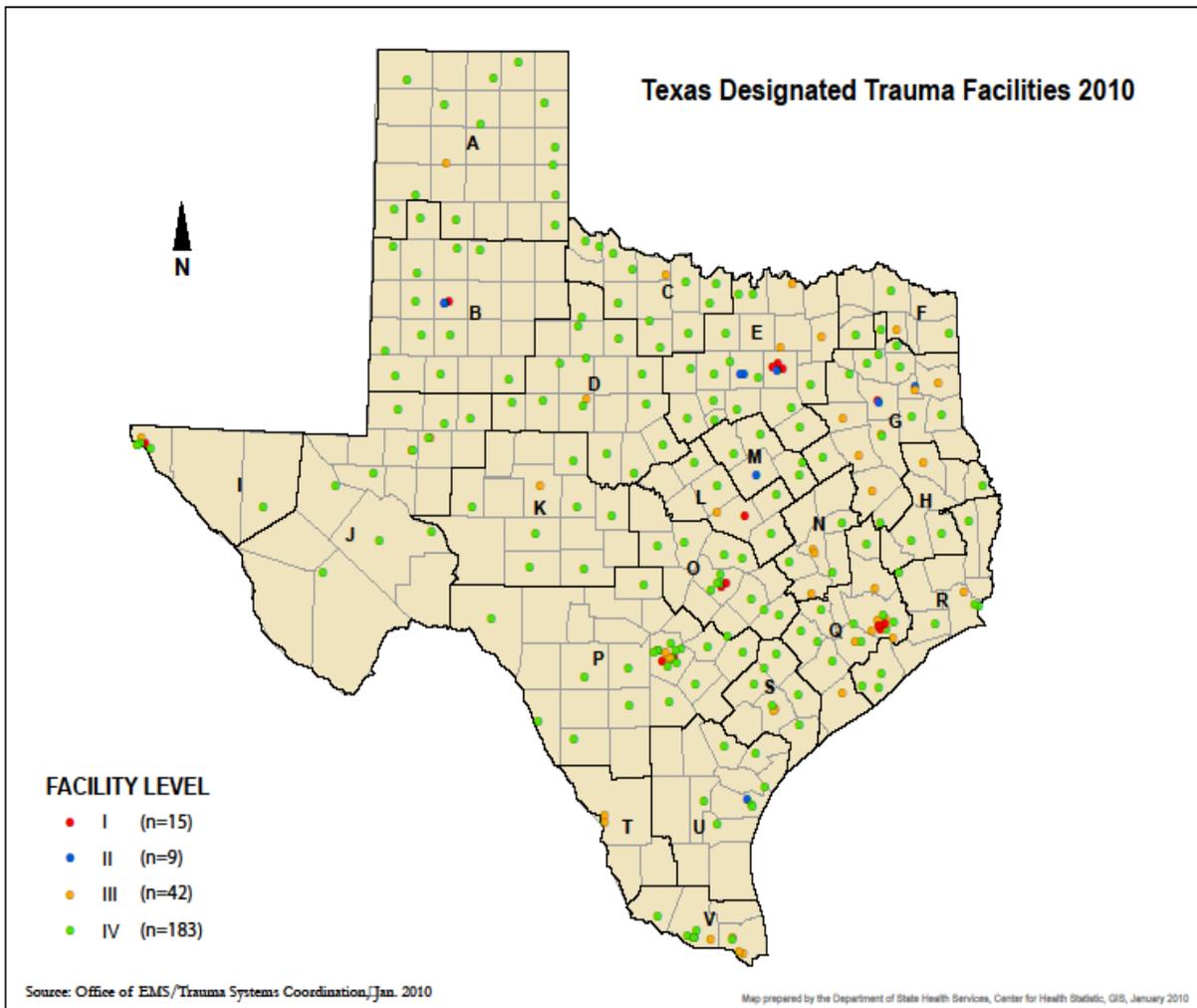


Figure 1. Location of trauma centers in Texas by facility level within the 22 trauma service areas.

PROBLEM STATEMENT

Texas has some of the highest performing trauma centers in the nation. Of the 16 level I trauma centers, 14 are near or east of the Interstate-35 corridor, which incorporates the Dallas, Fort Worth, Austin, San Antonio, and the Houston-Galveston metropolitan areas. This distribution corresponds to the population density of the state. The majority of the level II trauma centers are also clustered in the eastern half of the state. See Figure 1.

Only two level 1 and one level II trauma centers provide service to the western half of the state. Many of the trauma service areas in the western half of the state are dependent upon level III trauma centers that serve as the regional trauma resource centers. In some instances, these lead facilities are high functioning level III trauma centers and may approach level II trauma center criteria.

Texas level I and level II trauma centers are expected to be open to receive critical trauma patients from level III and level IV trauma centers. Diversion of critical trauma patients to other trauma centers is expected to be rare, less than 5% of the time according to the American College of Surgeons criteria for level I trauma centers. The Houston-Galveston area was served by three level I trauma centers until Hurricane Ike forced the evacuation and closure of the level I trauma center at University of Texas Medical Branch (UTMB) in Galveston in 2008. This resulted in an increase in the number of critical trauma patients beyond which the remaining 2 level I trauma centers in Houston had capacity to manage. For example, in the 2 months following Hurricane Ike, one of the Houston Level I trauma centers was diverting (not accepting transfers) trauma patients 40% of the time. Because there was not a level II trauma center (expected to have resources to manage some of the same critically injured patients as level I trauma centers) in the trauma service area, the triage guidelines were changed to have less critically injured transfer trauma patients sent to level III trauma centers. Even after making this change, the level I trauma center was diverting patients an average of 15% of the time during much of 2009.

In written and verbal discussions presented during the consultation visit, the American College of Surgeons site visit team was asked to specifically consider the Houston-Galveston area when assessing the need for additional trauma centers. It was stated that this legislative study was requested because of the impact of the damage and closure of the level I trauma center in Galveston after Hurricane Ike on the level I trauma centers based in Houston.

The two Houston level I trauma centers are located in trauma service area Q, but because of their location, these level I trauma centers must also serve several surrounding trauma service areas, including H, R, N, and S. As noted on the map in Figure 1, none of these trauma service areas has a level II trauma center, so the two Houston level I trauma centers must be prepared to provide care to patients with critical injuries from these adjacent areas when requested. Fortunately these trauma service areas H, R, N, and S have several level III and level IV trauma centers that can provide care to patients with less serious injuries.

Injury is a significant problem in the state of Texas. The total number of nonfatal injuries reported to the state trauma registry in 2006 was 115,694. This number includes only the injuries severe enough to meet criteria for the registry inclusion. The number of nonfatal injuries is much higher when considering that a much larger number are treated at hospital emergency departments and discharged home. Unfortunately, injuries treated and released from Texas emergency departments are not yet reported, so the actual number of Texans injured and treated annually is not known. An estimate of the number of injured Texans treated in emergency departments and released can be calculated using the following generally accepted formula:*

For every person who dies from injury, an estimated 10 persons are hospitalized or transferred for specialized medical care, and 178 persons are treated and released from a hospital emergency department.

13,197 injury deaths x 10 = 130,197 injury hospitalizations
13,197 injury deaths x 178 = 2,349,066 emergency department visits

In 2007, the number of reported hospitalizations for injury conditions in each trauma service area served by Houston level I trauma centers is reported in Table 1.

*Vyrostek, S. B., Annest, J. L., & Ryan, G. W. (2004, September 3). Surveillance for fatal and nonfatal injuries—United States, 2001. In Surveillance summaries. Morbidity and Mortality Weekly Report, 53 (No. SS-7), 2–11.

Please Note Updated Information in Paragraphs Above: Injury is a significant problem in the state of Texas. A total of 29,821,159 injuries required treatment in 2006, and of these, 2,048,806 required patient transfer to another facility or hospitalization. In 2007, the number of reported hospitalizations for injury conditions in each trauma service area served by Houston level I trauma centers is reported in Table 1.

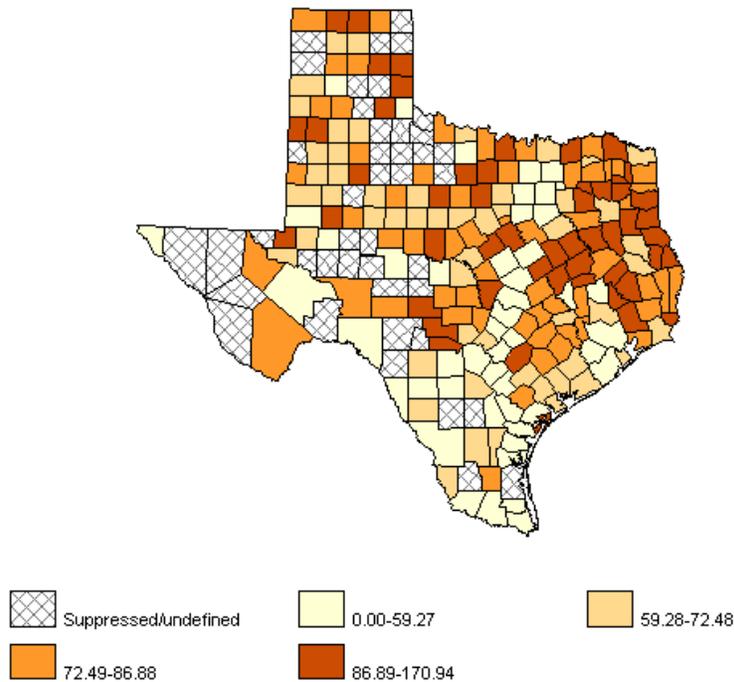
TABLE 1: INJURY HOSPITALIZATIONS BY TRAUMA SERVICE AREA (TSA)

Trauma Service Area	Injury Hospitalizations
R	4,450
Q	14,352
H	958
S	950
N	1,729

Source: DSHS Injury Epidemiology and EMS/Trauma Registry Group (2007)

Texas reported 13,197 injury deaths in 2006, with an age-adjusted mortality rate of 58.56 per 100,000 population. This compares with the national injury age-adjusted mortality rate of 58.82 per 100,000 population (Office of Statistics and Programming, National Center for Injury Prevention and Control, CDC, 2010). The rate of injury mortality varies widely by county in Texas. See Figure 2. Additionally, the range of injury mortality rates varies widely among the counties in the trauma service areas served by the Houston level I trauma centers. See Table 2. The population by trauma service area is noted in Table 3. Higher injury mortality rates may be associated, in part, by the distance from a level I trauma center, lack of expeditious patient transfer resources to transport critically injured patients to a level I trauma center, or an inability to access a level I trauma center that is unable to accept any additional patients.

2000-2006, Texas
 Death Rates per 100,000 Population
 All Injury, All Intents, All Races, All Ethnicities, Both Sexes, All Ages
 Annualized Crude Rate for Texas: 55.50



Reports for All Ages include those of unknown age.

* Rates based on 20 or fewer deaths may be unstable. These rates are suppressed for counties (see legend above); such rates in the title have an asterisk.

Produced by: Office of Statistics & Programming, National Center for Injury Prevention & Control, CDC
 Data Sources: NCHS National Vital Statistics System for numbers of deaths; US Census Bureau for population estimates.

Figure 2. Injury mortality rates per 100,000 population in Texas counties, 2000-2006.

TABLE 2: INJURY MORTALITY RATES IN 2006 BY COUNTY IN THE TRAUMA SERVICE AREAS (TSA) SERVED BY THE HOUSTON LEVEL I TRAUMA CENTERS

Trauma Service Area	County	Population 2006	Injury Death Rate per 100, 000*
R	Brazoria	286, 773	57.54
	Chambers	32, 383	52.50
	Galveston	282, 126	66.99
	Hardin	50, 419	65.45
	Jasper	34, 863	100.39
	Jefferson	245, 922	84.17
	Liberty	77, 176	97.18
	Newton	14, 338	174.36
	Orange	84, 026	111.87
	Q	Austin	26, 928
Colorado		21, 629	92.47
Fort Bend		487, 047	36.75
Harris		3, 830, 130	54.85
Matagorda		37, 063	75.55
Montgomery		399, 941	70.01
Walker		64, 026	53.10
Waller		38, 475	67.58
Wharton		42, 252	44.97
H		Angelina	82, 424
	Nacogdoches	62, 867	82.71
	Polk	46, 349	127.30
	Sabine	10, 449	143.55
	San Augustine	9, 217	86.80
	San Jacinto	24, 739	92.97
	Tyler	21,042	85.54
	S	Calhoun	20, 843
Dewitt		20, 432	34.26
Goliad		7, 195	125.09
Jackson		14, 559	54.95
Lavaca		19,368	77.45
Victoria		86, 334	62.55
N	Brazos	167, 228	46.04
	Burleson	18, 101	60.77
	Grimes	24, 802	84.67
	Leon	16, 218	110.99
	Madison	13, 534	103.44
	Robertson	16, 171	61.84
Washington	32, 181	72.96	

* Bold indicates the counties with an injury mortality rate in excess of the Texas state average of 58.56 per 100,000 population.

TABLE 3: 2009 POPULATION ESTIMATES BY TRAUMA SERVICE AREA

Trauma Service Area	Population
Q	5,302,102
H	258,562
R	1,129,746
S	167,922
N	301,428
Total	7,159,760

CURRENT STATUS - HOUSTON-GALVESTON

Texas faces challenges that are similar to other states with regard to the number and distribution of trauma centers. The difference with Texas is that these challenges are exacerbated by the state’s geography and population distribution. Houston has had significant problems with trauma center capacity – partly attributed to the closure of the University of Texas Medical Branch at Galveston (UTMB) following Hurricane Ike.

Several factors must be considered when determining the appropriate number and distribution of trauma centers in the Houston-Galveston area. First, Houston is the fourth most populous city in the United States. This fact alone presents serious challenges to maintaining adequate trauma bed capacity within the geographic area. Houston also has the second largest number of highway lane miles per capita in the United States which creates challenges of transport time, as well as the risk for motor vehicle crash related injuries. Texas also has a high percentage of individuals with personal handguns, and the suburbs of Houston have half of the state’s 20 most legally armed ZIP codes.

States designate trauma centers through many different mechanisms. Some, like Texas, have used voluntary designation, meaning that any hospital can be designated at any level for which they can meet the state-specified criteria. Other states have performed a needs assessment and made determinations of location, level, and number of trauma centers through a public process to determine an “ideal” distribution of trauma centers within each geopolitical area (e.g., Washington state). Oregon used a combination of these two methods with the addition of legislative language that eliminates the possibility of competing level II trauma centers in Portland (where two

level I trauma centers already exist). The trauma center verification process also varies state-by-state.

The data for determining an adequate number of level I trauma centers depend on the venue. Variation in population/trauma center capacity ratios is significant across the United States. One frequently mentioned recommendation is to have one level I trauma center per one million population in the service area. The Houston city population is estimated to be 2.2 million and is served by two level I adult trauma centers (Ben Taub and Memorial Hermann), as well as two pediatric level I trauma centers; however, this ratio maybe misleading. The Houston trauma service area has no level II trauma centers to function in a supporting role. It was reported that UTMB is back in service as a trauma center, but it has not been operational long enough to seek re-verification as a level I trauma center by the American College of Surgeons.

The population served by the two Houston adult level I trauma centers is clearly much greater than just the city of Houston with more than 5 million in its trauma service area. An additional 2 million people reside in the other trauma service areas for which the Houston trauma centers are the referral center. See Table 3. Based on population estimates of the Houston's trauma service area and neighboring trauma service areas, it appears that two or three level I large trauma centers are inadequate.

During 2003, both of Houston's level I trauma centers were reported to be on diversion more than half of the available total open time. Approximately half of these diversion hours were secondary to emergency department (ED) saturation, but trauma saturation was also frequently a factor. These diversion problems existed before Hurricane Ike closed UTMB, a nearby level I trauma center serving the Galveston. This is another indicator that the capacity of the three trauma centers had been exceeded.

The threat of natural disasters should, of course, be of concern to those responsible for trauma patient care. However, manmade threats (such as industrial incidents and terrorism events) must also be considered when planning for an adequate number of trauma centers. The close physical proximity of the two Houston trauma centers to each other could place them at simultaneous risk for closure by a single natural or manmade event. Thus, geographic distribution of level I trauma centers has the potential to become as significant an issue as total capacity. If both Houston level I trauma centers were incapacitated, no other adult Level I (or level II) trauma center closer than UTMB exists. UTMB, when once again verified and operational as a level I trauma center, would clearly be unable to handle the entire region's trauma volume should Houston's level I trauma centers both close, however briefly.

One potential argument against increasing the number of level I or level II trauma centers within Houston or its suburbs is that it could dilute the clinical trauma experience of Ben Taub and Memorial Hermann. The health professionals in level I trauma centers need a high volume of critically injured patients to maintain their skills in this specialty care. However, the number of critically injured trauma patients that must be treated in a level I trauma center for that facility to remain at the highest levels of efficiency and

clinical expertise is not known. The two level I Houston trauma centers are extremely busy trauma centers and are at the apex of volume in the United States. Many level I trauma centers appear to provide equivalent care with roughly half the annual trauma volume seen in either of Houston's level I trauma centers.

As the population of Houston is expected to grow, additional trauma care capacity will be required. The threat of natural and manmade disasters is likely to remain unchanged or even increase. After reviewing the population estimates, the impact of the loss of the UTMB trauma center in Galveston on diversion rates for the Houston level I trauma centers, and the historical diversion rates at the Houston trauma centers, it is the opinion of the American College of Surgeons site visit team that the trauma capacity of the Houston hospitals is insufficient to meet daily and surge demands.

RECOMMENDATIONS:

- The State Office of EMS and Trauma Services, in conjunction with the appropriate regional advisory committees, should conduct a needs analysis in the Houston metropolitan area and the Houston/Galveston corridor, taking into account anticipated population growth, shifts in population distribution, and utilization of current resources. Using this data, the lead agency should:
 - Identify one or more hospitals with appropriate resources and geographic location as candidates for designation as level I or level II trauma centers.
 - Encourage and assist the candidate hospital or hospitals to become designated trauma centers at the level appropriate to their resources and commitment.

CURRENT STATUS - LEAD LEVEL III TRAUMA FACILITIES

In an ideal trauma system, each geographic region would have at least one level I or level II trauma center at its center and within a thirty-minute transport time. These higher level trauma centers should be supported by well-distributed level III and/or level IV facilities that serve to care for the larger volume of less severely injured patients. This arrangement conserves resources at the level I and II trauma centers for the patients with the most severe injuries.

This concept of the ideal trauma system described above is rarely achieved for many reasons. Hospitals and populations are rarely evenly distributed. Hospitals may or may not choose to participate in a regional or statewide trauma system. When hospitals volunteer to participate, it is at whatever level they choose to be designated – assuming they can meet the criteria for that level. The question of the optimal level of participation of any given facility is quite complex and beyond the scope of this brief discussion. However, what is clear is that, regardless of designation level, trauma centers should be held to a set standard of performance commensurate with that level of designation. Additionally, they should be able to guarantee that level of performance 24 hours a day, 365 days a year.

The lead level III trauma facilities play a critical role in the Texas trauma system. Often referred to as “Super Level III” facilities, these facilities are where the spirit of the Texas medical community shines most brightly. Many of these level III trauma centers function at a higher level than they are designated, meaning they have some physician specialists, e.g. a neurosurgeon, that make it possible to care for some injuries usually referred to level II facilities.

Since these level III centers are not bound to level II standards or criteria pertaining to staff and resource availability, care can be potentially variable by time of day, day of week and other factors. For example, usually the lead level III trauma center does not have enough neurosurgeons or other specialty surgeons to guarantee that care coverage 24 hours a day, 365 days a year. When the neurosurgeon is not available, the severely injured patient must be transferred to a level I or level II trauma center in another trauma service area.

Hospitals sometimes elect to seek designation at a level lower than they might be capable, perhaps because of the financial commitment the higher level designation requires or willingness of specialty physicians and surgeons to be available for emergency care. Thus, the optimal designation of a trauma center is a delicate balance between patient need and hospital capacity and commitment.

The reality is that the population of Texas exists in many different patterns and densities. The hospitals serving these populations are different in size, focus, financial viability, age, and commitment. It is unreasonable to expect that each of 22 trauma service areas will be able to support a level I or II trauma center, especially since many

of these trauma service areas cover large rural areas with relatively small populations. It is in these trauma service areas that the lead level III facilities are so valuable.

What is not known is whether changing the designation of a lead level III trauma center to a level II designation would improve the trauma care provided. If such a facility were to add capability or coverage by certain critical surgical specialties, then the change in designation would be expected to improve trauma patient care. If this is a low-volume level III trauma center with all necessary committed surgical specialties, and the only obstacle to achieving level II verification is the presence of a formal second call schedule for surgeons, the change to level II status would not be expected to result in better care. The need for back-up response at these low volume facilities would be a rare occurrence.

While the role of these lead level III facilities is critical to the continued success of the Texas trauma system, it is also true that much of trauma care is time-sensitive. If a level III trauma center is not able to provide emergency neurosurgical care for an epidural hematoma, the time required for fixed-wing transport to a higher level of care may prove lethal for the patient. These issues and questions require continuous data collection and analysis to identify the issues that need to be addressed to promote the provision of optimal care for all injured patients.

Generally speaking, it is better for a facility to consistently operate above the expectations of its designation level than to sporadically operate at levels below its designated expectations. It is essential to referring hospitals, surrounding EMS agencies, and the public to know and understand the baseline level of service that can be counted on 24 hours a day, 365 days a year. On those days when they are operating above that baseline, it is a bonus in the patient's interest. However, if facilities are operating below their baseline capabilities, variability could result in delays in care and errors associated with a transfer to a second trauma center.

RECOMMENDATIONS

- The Governor's EMS and Trauma Advisory Committee and the State Office of EMS and Trauma Services should evaluate processes and care at the "super level III trauma centers" in all trauma service areas that do not have level I or level II trauma centers.
- Determine if a need for a "level III plus" exists with designation criteria that falls between level II and level III trauma center criteria. If such a designation is needed, develop criteria and a designation process for implementation.
- Hold each of these lead level III trauma centers accountable to the same uniform standards and a baseline level of response care 24 hours a day, 365 days a year.