An Assessment of Trauma Care in Arkansas

Resources, Capabilities and Quality of Care

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Introduction

Trauma is the leading cause of death among Americans younger than 45 years.[1] Because bleeding is a major contributor to trauma death, the Korean War brought about the concept of the "golden hour", which recognized the importance of getting the right patient to the right facility in the right amount of time. Regional and state trauma care systems and specialized trauma centers were later developed to reduce the mortality attributable to severe injuries. Studies have demonstrated that trauma care systems can reduce the preventable trauma death rate by as much as 30% for patients who reach the hospital alive.[2,3,4] Systematic reviews of published evidence also support trauma system effectiveness in reducing in-hospital mortality, primarily in urban areas.[5,6,7,8] Despite an Arkansas injury death rate of nearly 50% greater than the national rate, Arkansas remains the only state without any formally designated or verified trauma hospitals.

Purpose

The overall goal of this report is to advance trauma care in Arkansas. To accomplish this, we assessed Arkansas' capacity to provide trauma care to children and adults, identified needs and gaps in service, and provide the basis for development of a statewide or regional trauma care system(s) in the state. The goal of a trauma system is to assure that the "right patient" reaches the "right resources" in the "right amount of time." Formal trauma systems address the continuum of care, including injury prevention, emergency medical services (EMS) care, hospital resuscitation, stabilization and transfer, hospital definitive care, and rehabilitation services.

Methodology

Hospital discharge data were obtained from the Center for Health Statistics of the Arkansas Department of Health. We obtained 2004-2006 data which were the most recent, available years. Records were de-identified, with the exception of hospital identifier to allow for linking to the hospital surveys. We analyzed the combined, multiyear data to reduce the impact of random variation in trauma volumes.

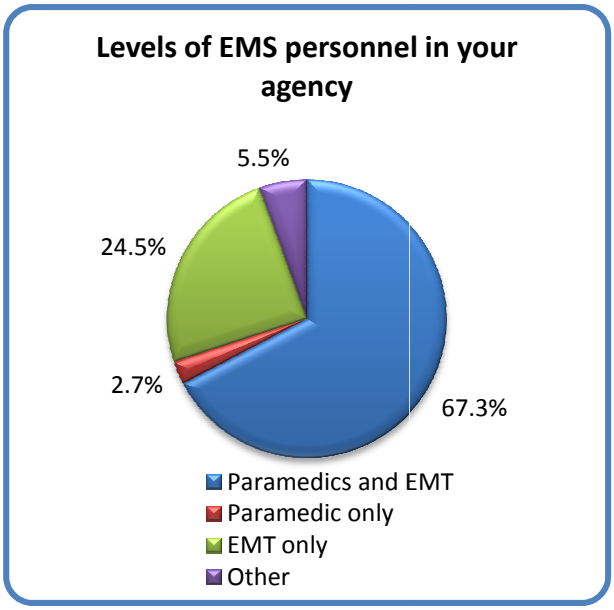
We conducted two surveys. First, all licensed acute care hospitals in Arkansas were surveyed to assess their trauma resources and capabilities, including a) personnel and equipment available for trauma; b) trauma team availability and composition; c) trauma transfer criteria, guidelines and issues; and d) willingness to participate in a trauma system, expected level of designation, and obstacles and barriers to participation. Second, all licensed EMS agencies were surveyed to assess a) personnel and equipment availability for trauma; b) current prehospital trauma activation and procedures; c) trauma destination issues and concerns; and d) willingness to participate in a trauma system, and obstacles and barriers to participation.

Both surveys were implemented using the Tailored Design Method[9] with a pre-notice letter, a questionnaire mailing, a thank you postcard, a replacement questionnaire to non-respondents, and a final priority mail contact. As an integral part of the study, we assured hospitals and EMS agencies that no individual identifiers would be disclosed in any of the results. The hospital survey was sent to each hospital administrator personally. The Arkansas Department of Health provided the contact mailing list. Hospital identifiers were included on each survey to eliminate duplication potential and for follow up purposes. The EMS survey was sent to each licensed EMS agency, utilizing licensing contact information from the Arkansas Department of Health, Section of Emergency Medical Services and

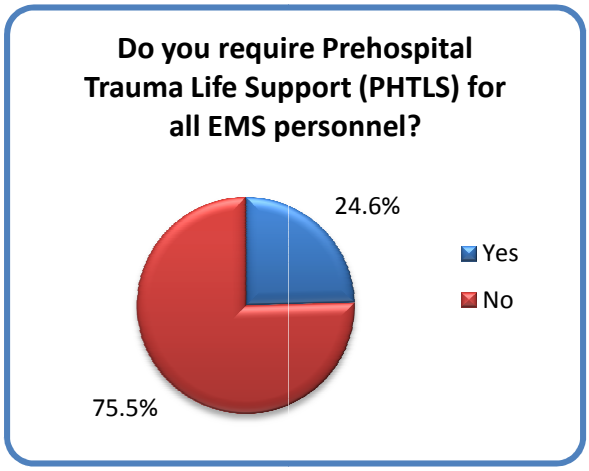
Trauma Systems. As some individuals coordinate for multiple agencies (i.e., a basic life support license and an advanced life support license within the same organization), we attempted to reduce duplication of effort by sending one survey per individual at each unique physical address. EMS agency identifiers were included on each survey to track responses and coordinate follow up reminders. We received excellent participation in the survey, with 86% of licensed hospitals and 83% of licensed EMS agencies returning the questionnaires.

EMS Survey Results

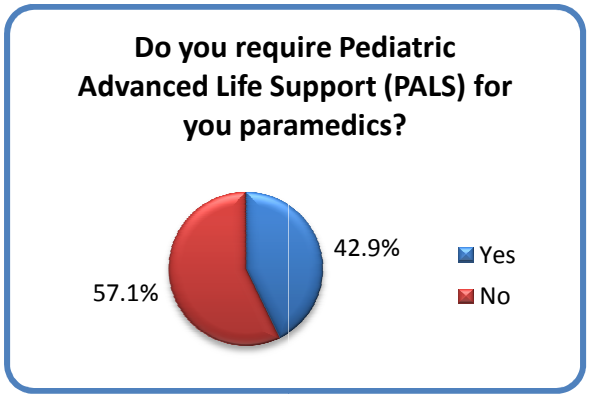
We asked EMS agencies to describe the training and certification level of personnel. About 2/3 of agencies have a combined staff with both paramedics and emergency medical technicians (EMTs). Nearly a quarter of EMS agencies are reported staffed by EMTs only (no advanced life support paramedic-level staff.) A few agencies report other combinations of personnel, including registered nurses and flight nurses.



About 1/4 of EMS agencies require their personnel to complete Prehospital Trauma Life Support (PHTLS) training. Some agencies reported difficulties locating and being able to afford this training for their personnel.

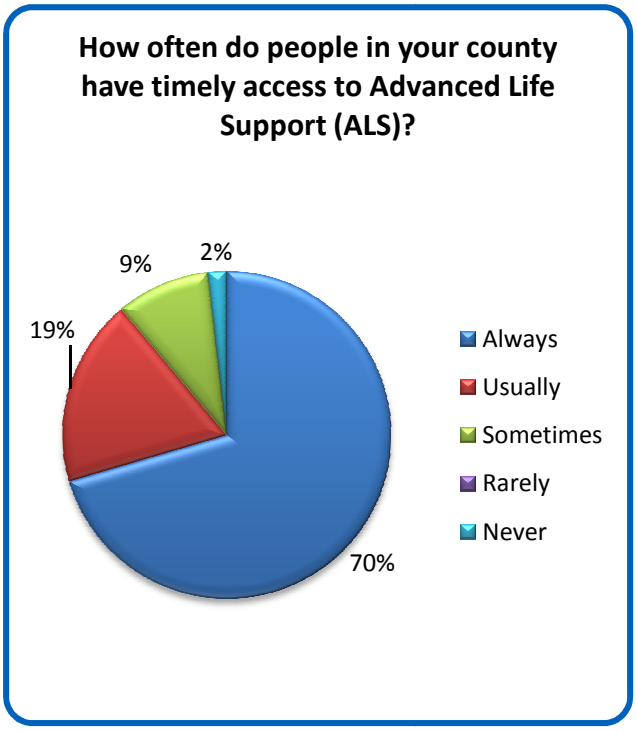


We also asked whether Pediatric Advanced Life Support (PALS) is required for paramedics in their agencies. Less than half require PALS for paramedics.

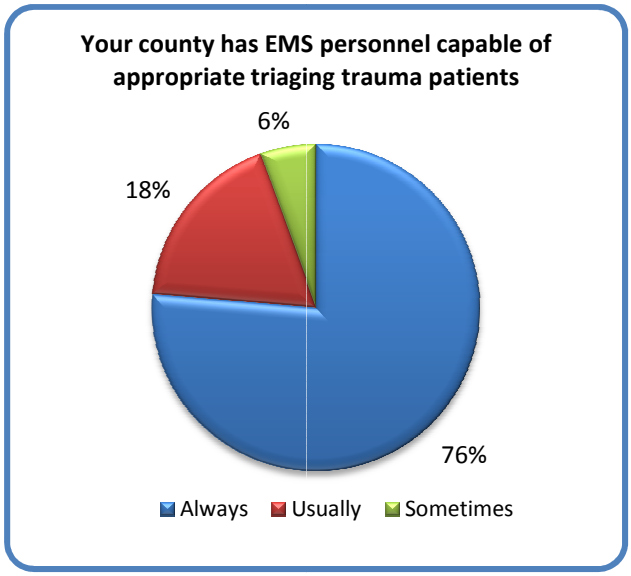


About 3 in 10 EMS agencies reported that they require other trauma-specific training, such as Advanced Trauma Life Support (ATLS) courses, Advanced Cardiac Life Support (ACLS), burn-specific training, PALS, and annual refreshers and continuing education for EMS personnel.

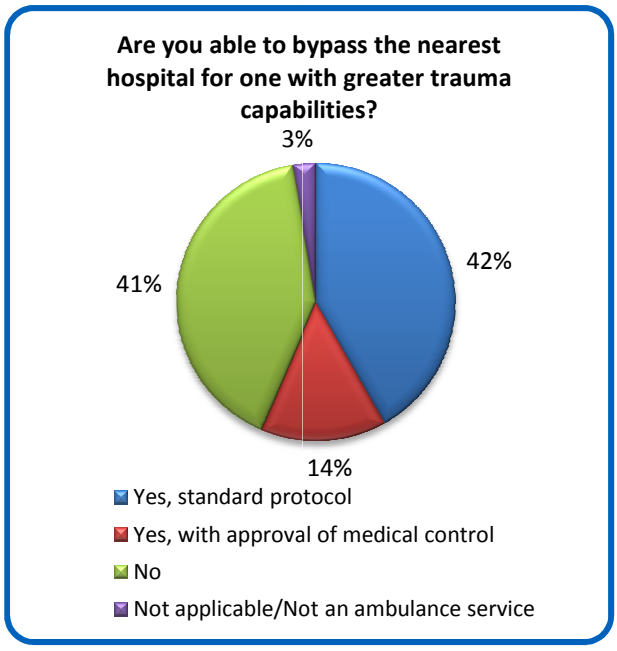
Seventy percent of EMS agencies reported that the people in their counties always have timely access to paramedic-level Advanced Life Support (ALS). One in 10 agencies reported that ALS-level care is rarely or never available in a timely manner to the people of their counties.



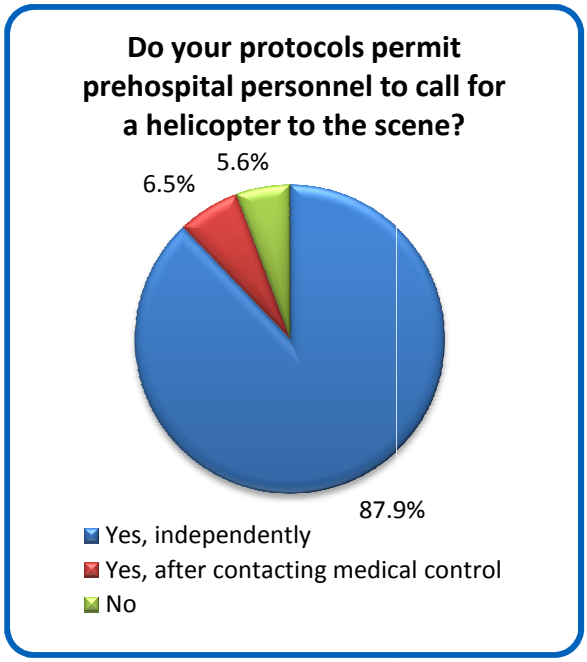
When asked about the availability of EMS personnel capable of appropriately triaging trauma patients, nearly 95% reported that this is always or usually available in their counties. No EMS agencies reported that this capability was rarely or never available.



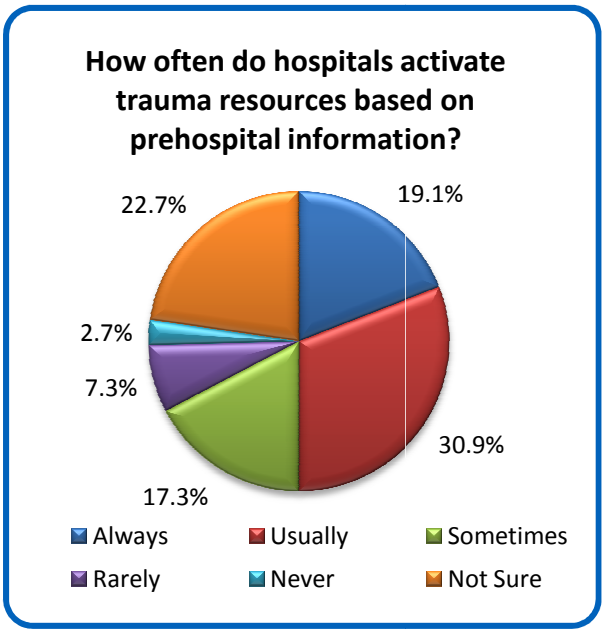
We asked EMS agencies whether they are able to bypass the nearest hospital to reach a hospital with greater trauma capabilities. Interestingly, more than half reported that they are able to do this now, either as standard protocol or with approval of medical control. A significant proportion (>40%) report that they are not able to bypass.



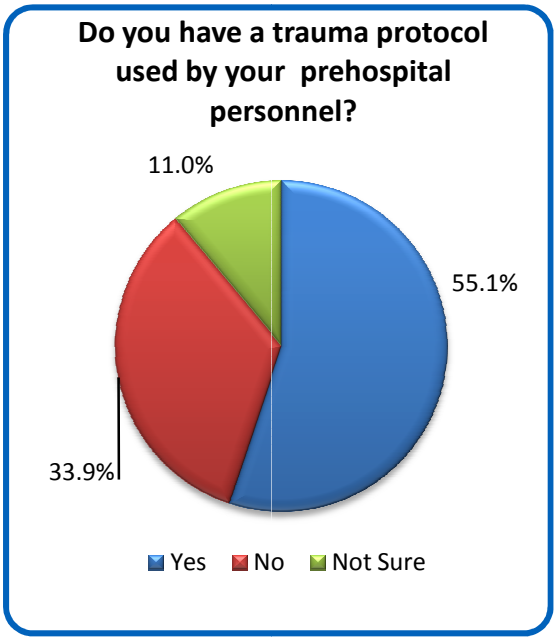
EMS personnel appear well-empowered to request air transport from the scene of a trauma, with nearly 95% reporting the ability to make this request.



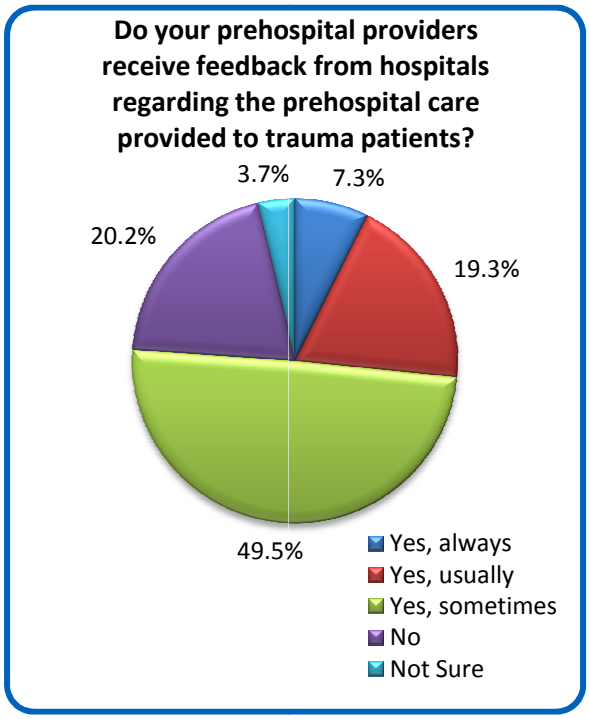
When asked about whether the receiving hospital activates trauma resources based on prehospital information, EMS reports varied widely. About half of the agencies reported that hospital always or usually activate resources based on their information, but nearly 1 in 4 reported that they were unsure as to whether hospitals mobilize resources based on their EMS reports. Another 1/4 reported that hospitals act on EMS reports only sometimes or rarely.



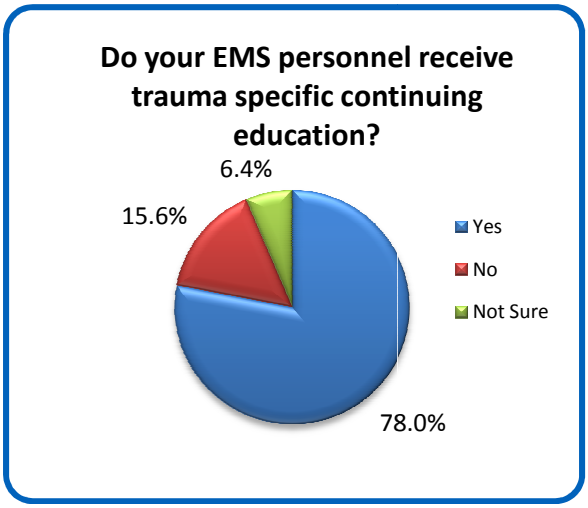
Slightly more than half of the EMS agencies reported having a trauma protocol in use by their EMS personnel.



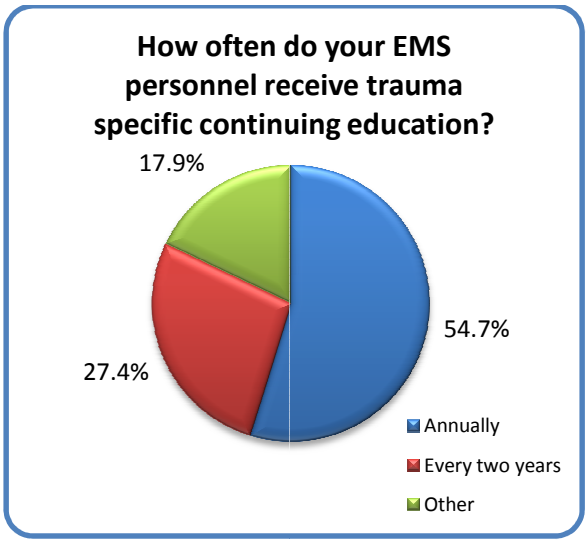
Feedback from hospitals regarding the prehospital care provided to trauma patients appears varied with a similar proportion of agencies not receiving feedback as always receiving feedback. Half reported that they 'sometimes' receive feedback.



More than 3/4 of EMS agencies reported requiring trauma-specific continuing education for their EMS personnel.



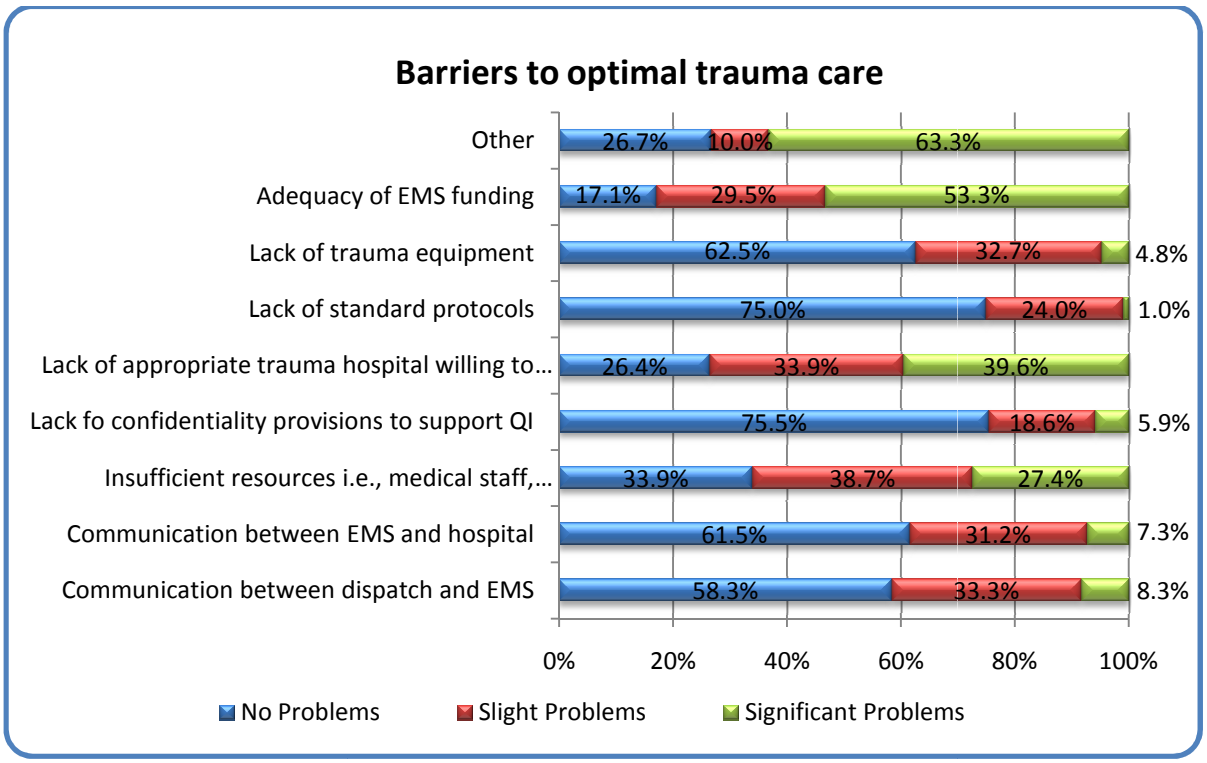
The frequency of trauma-specific continuing education varied.



We asked EMS agencies to describe any concerns regarding trauma care (prehospital or hospital) provided to Arkansans. Detail of their responses can be found in Appendix A. The following summarizes the main concerns identified by EMS agencies:

- Inadequate funding and training for EMS; Shortage of EMS personnel;
- Lack of hospital resources and response at receiving hospitals;
- Limited capabilities (people and equipment) to care for trauma; Physician specialists are limited or non-existent at local hospitals, especially neurosurgery;
- Lack of level I trauma resources; Shortage of trauma-capable hospitals;
- Hospitals refuse to accept trauma patients; Hospitals frequently on divert;
- Lack of communication on available hospital resources; EMS often does not know which hospital has neurosurgical and/or orthopedic care available;
- Lack of timely feedback by hospitals to EMS on the prehospital care provided; Confidentiality concerns keep some hospitals from providing feedback to EMS;
- Lack of statewide communications system with trauma receiving facilities; and
- Lack of a systems approach to trauma care in Arkansas.

When asked about barriers to optimal trauma care, the most frequent barriers reported by EMS agencies were lack of adequate funding of EMS, lack of appropriate trauma hospitals willing to accept trauma patients, insufficient resources, need for emergency medical dispatch training, and better communications.



Barriers to Optimal Trauma Care - Details

Communication between EMS and Dispatch Barriers

- Better and more dispatcher training needed
- Poor transmission in some areas/dead zones
- Better radios need
- Poor pay and high turnover among dispatchers

Communication between EMS and Hospital Barriers

- Limited radio communications
- Lack of a trauma system (destination issues)
- Local hospitals not always clear on their capabilities (i.e., on-duty personnel)
- Hospitals do not always take EMS seriously (lack of respect)
- Hospital diversion status is not always known to EMS
- No statewide interoperable radio system
- Radio transmission problems and dead zones
- Hospitals sometimes do not answer their radio calls

Insufficient resources such as medical staffing, technology

- More funding for equipment and training
- No level I trauma center in Arkansas/long distance to a trauma center/difficult to find a hospital willing to accept trauma patients
- Lack of EMS personnel across Arkansas/shortage of medics
- Hospital diversion is a problem due to personnel shortages and resources
- Lack of neurosurgeons
- Critical access hospitals have limited resources and capabilities

Lack of confidentiality provisions to support quality improvement

- EMS is often unable to get specific feedback on individual cases
- HIPAA makes it difficult for EMS to obtain information from hospitals
- EMS needs a formal feedback loop for shared information and data to improve prehospital care
- Prehospital quality improvement efforts are limited by lack of available hospital data

Lack of an appropriate trauma hospital willing to accept a trauma patient

- Statewide trauma system is need
- Too many hospitals are unwilling to accept trauma patients
- Diversion is a huge problem for EMS
- No trauma centers in Arkansas
- Everyone feels they are being dumped on, so everyone resists accepting trauma

Lack of standardized protocols

- No standardized protocols, except in Northwest Arkansas
- Adjoining districts should use the same protocols
- Training and education on protocols

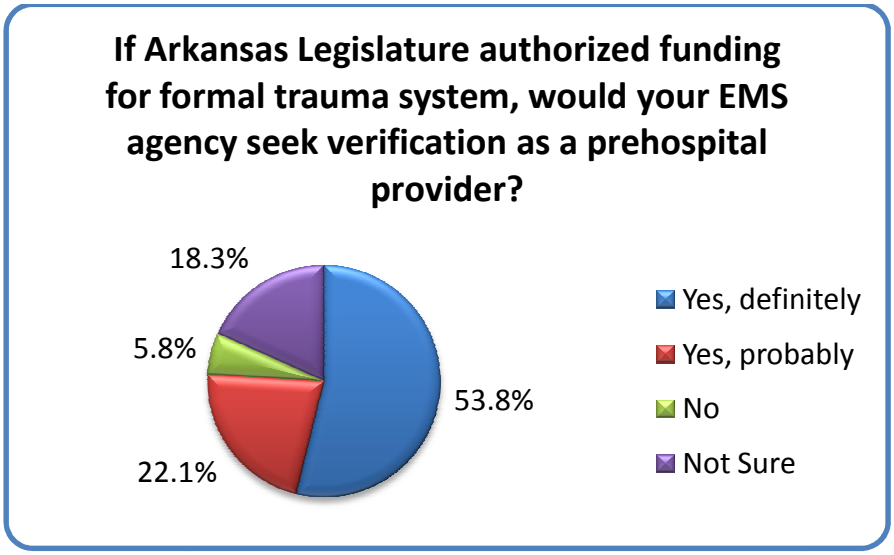
EMS Funding

- Pediatric trauma equipment is not available due to expense and lack of funds
- Rural counties cannot afford necessary equipment
- EMS is poorly funded; Most funding goes to fire departments, not EMS
- Better reimbursement for ambulance transports - trauma patients are often uninsured and do not have the ability to pay

Other Barriers

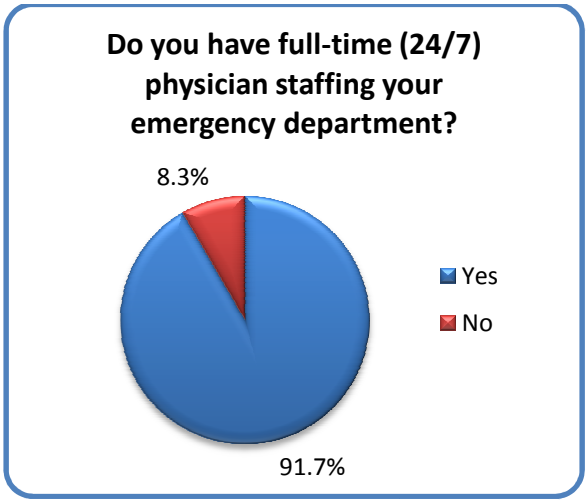
- Funds needed to pay for training and to retain personnel
- Arkansas needs a trauma center
- Private services have little access to grant funding, yet do much of the work
- Parity with nursing: why would someone go to paramedic school when they could make more money in nursing for the same amount of education?
- Donations and fund raisers - difficult to operate on these alone
- First responder training and communication with dispatch
- Continuous feedback loop needed so that EMS can learn what worked and did not work based on the hospital's review and outcome
- Lack of funding for hospitals to assure access for trauma patients

We asked EMS agencies whether they would participate in a formal trauma system and received strong support. More than half of the agencies indicated that they would definitely participate, with an additional 22% probable. A small percentage reported that they would not participate, and nearly 1 out of 5 agencies are not sure.

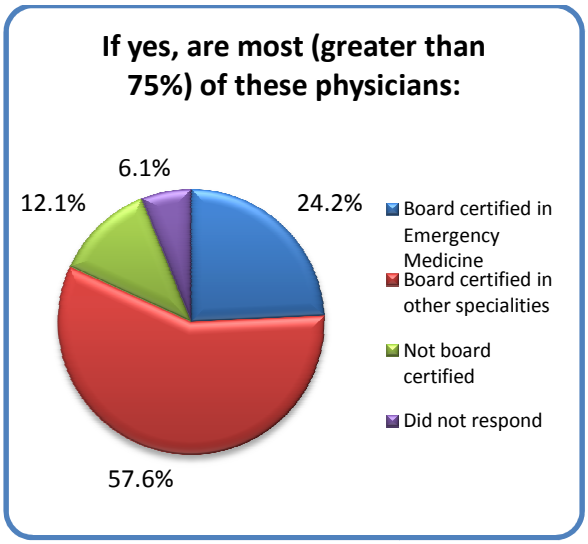


Hospital Survey Results

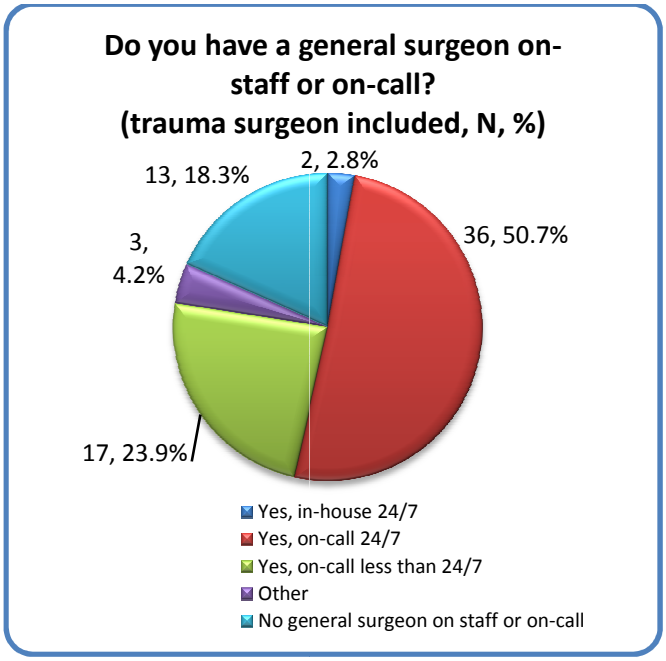
We asked hospitals about physician staffing in their emergency departments and found that over 90% have full-time physician coverage.



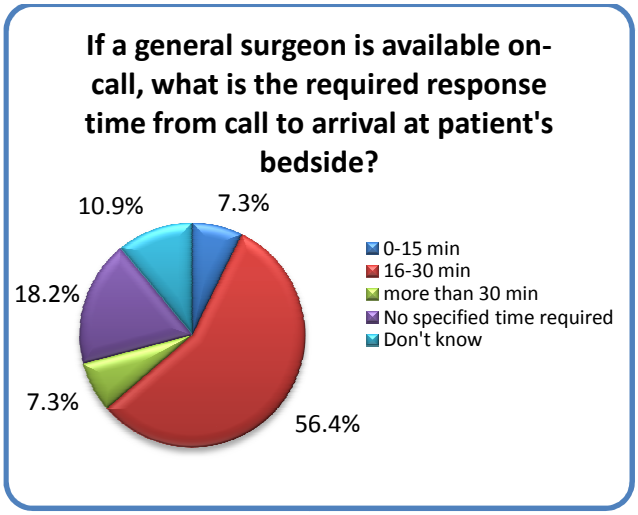
However, only 1/4 of these hospitals have physicians who are board certified in emergency medicine. Most hospitals reported that their emergency departments are staffed with physicians who are board certified in other specialties (e.g., family medicine).



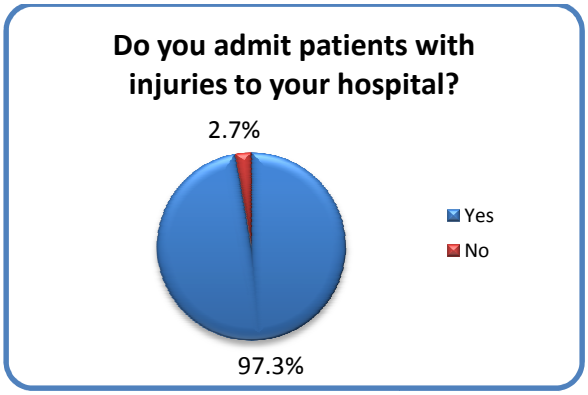
To assess the availability of general surgeons, we asked hospitals whether they have general surgeons and the extent of their coverage. About half of the hospitals reported general surgery coverage (on-call) 24 hours per day, 7 days per week. An additional quarter have general surgery coverage that is less than 24/7. Just over 18% of hospitals reported not having any general surgery coverage.



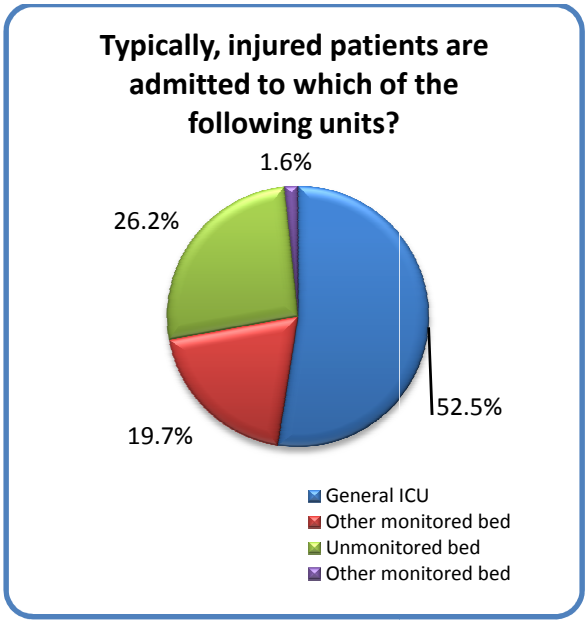
As trauma patients may require the prompt intervention by a surgeon, we asked hospitals whether they have a response time requirement. Nearly 2/3 required their surgeons to respond within 30 minutes, with the remaining hospitals either not requiring a specific response time or allowing more than 30 minutes.



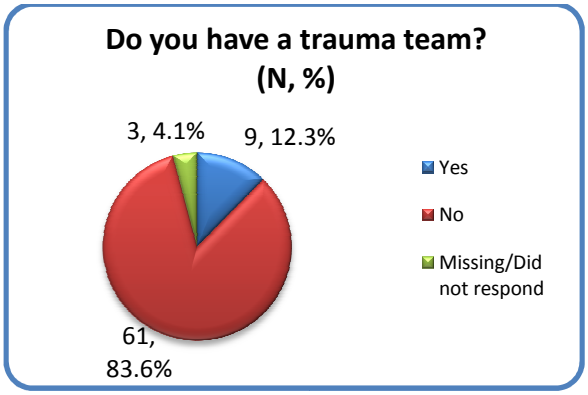
We asked hospitals whether they admit patients with injuries and verified with the administrative discharge data the presence of injury admissions. Nearly all responding hospitals admitted some injured patients.



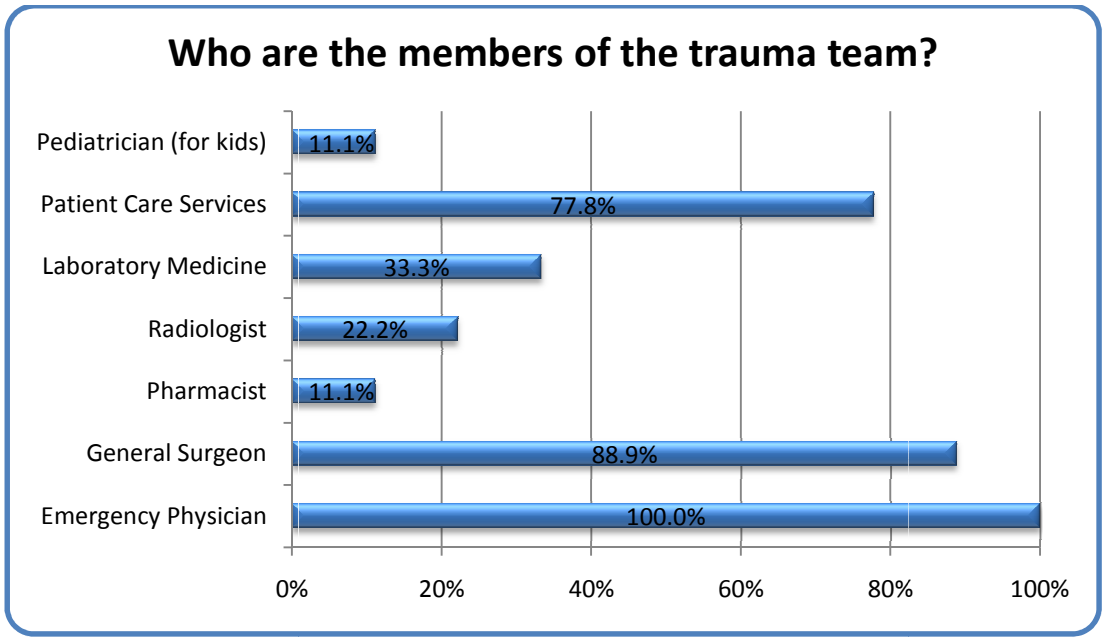
We asked hospitals about the unit to which they typically admit injured patients. More than 1/4 of hospitals typically admit patients to unmonitored beds.



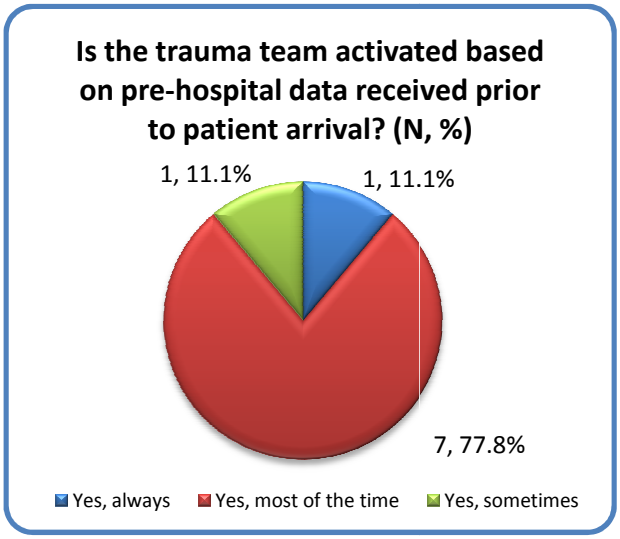
The availability of trauma teams is generally a requirement for higher levels of trauma designation. We asked hospitals whether they currently have trauma teams, with 9 hospitals reporting that they do.



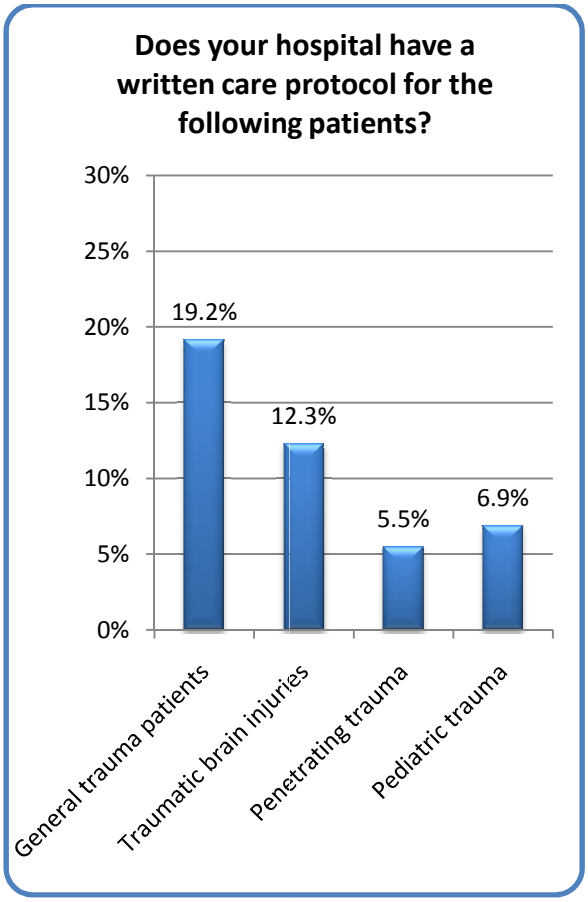
Not surprisingly, all trauma teams included an emergency physician, and all but one included general surgery. The remaining composition varied considerably by hospital.



For hospitals with a trauma team, all responded that they activate their team based on prehospital reports - at least some of the time.

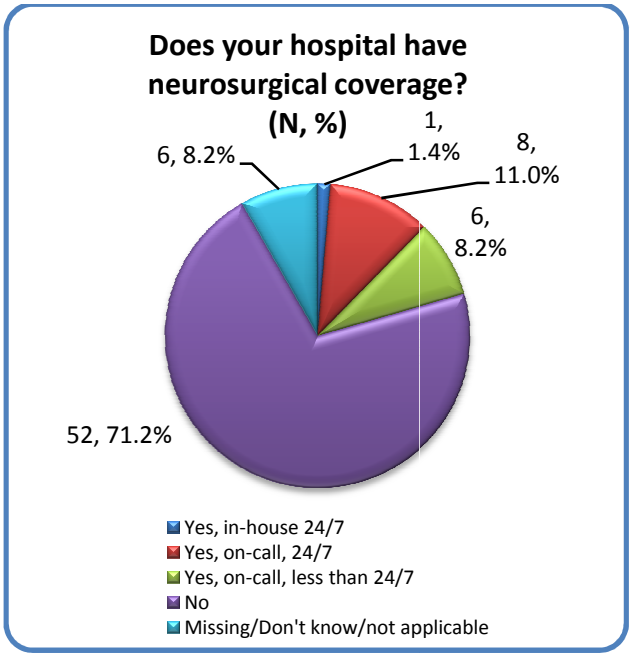


To reduce variability of care, written care protocols for trauma patients are typically recommended as part of the trauma designation process. Fewer than 1 in 5 Arkansas hospitals reported having a written protocol for the care of trauma patients. Even fewer reported having written protocols for the care of patients with traumatic brain injuries, penetrating trauma or pediatric trauma.

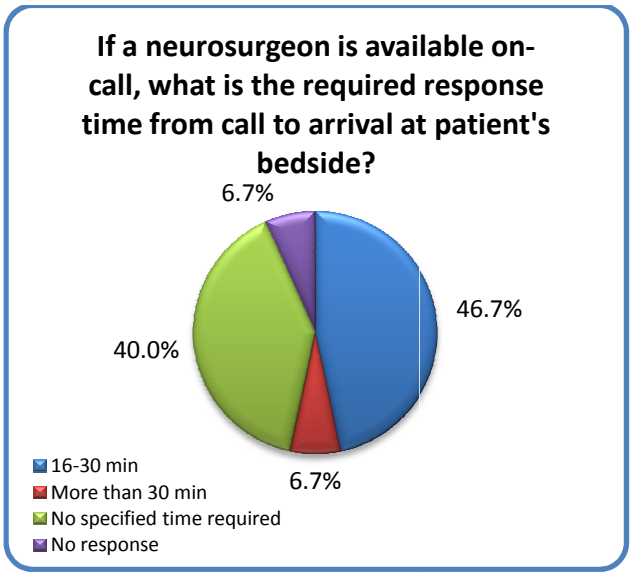


We asked hospitals whether they have neurosurgeons and if so, how often they are

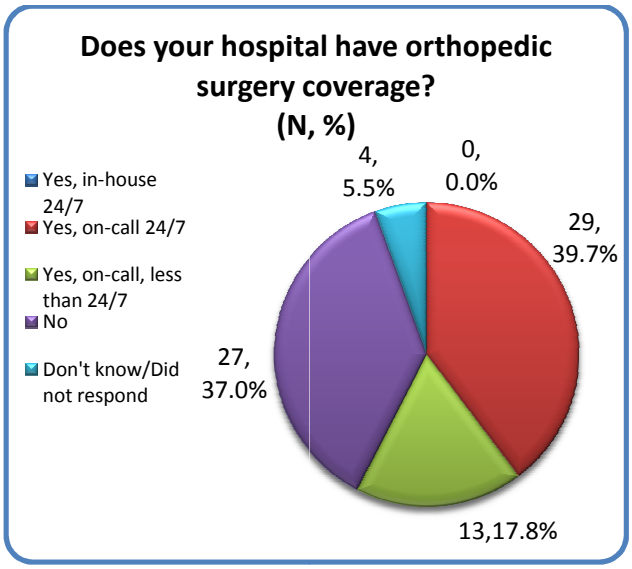
available for patient care. Nine hospitals reporting having full coverage (24 hours per day, 7 days per week), either in-house or on-call. Most Arkansas hospitals do not have neurosurgery capability.



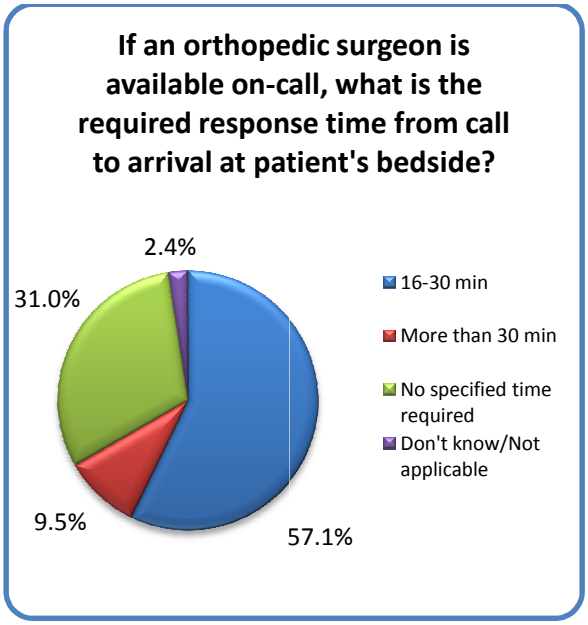
For hospitals that reported having neurosurgeons available on call, less than half (n=7) require a response time of 30 minutes or less. An equivalent number of hospitals have either no response time requirement or a response requirement of more than 30 minutes.



As orthopedic injuries are common among trauma patients, we asked hospitals about the extent of orthopedic coverage in their facility. About 4 out of 10 hospitals reported having around-the-clock orthopedic surgeons available on call. No hospital reported having in-house orthopedic surgeons.

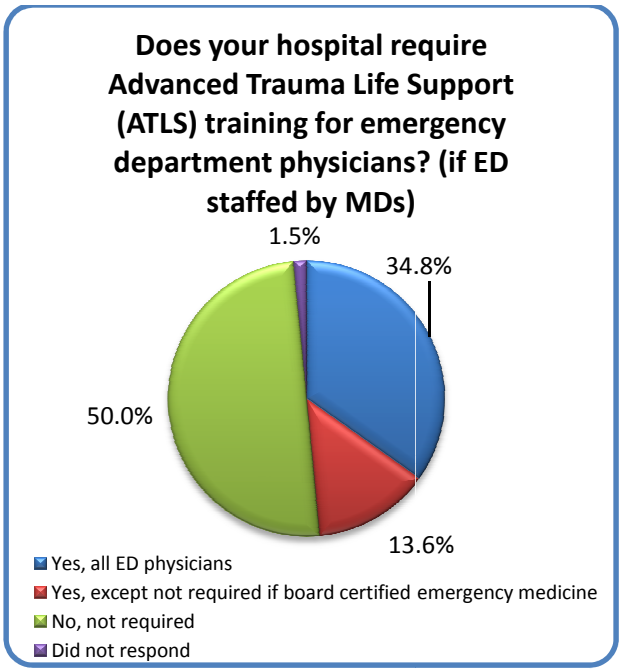


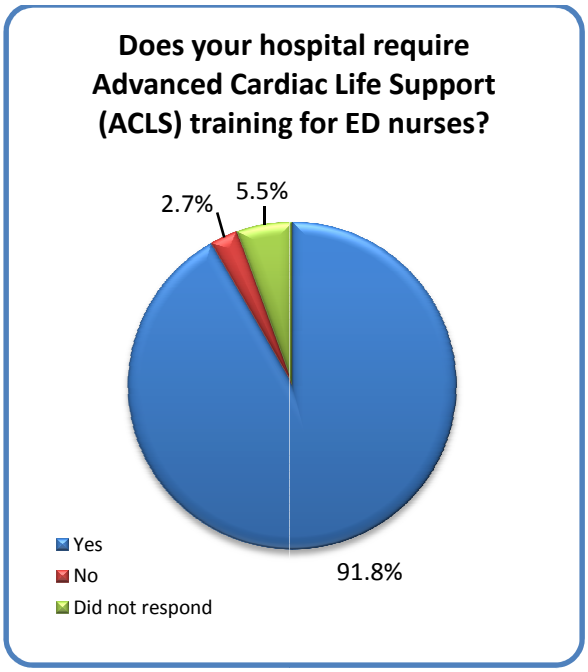
More than half of the hospitals with orthopedic surgery coverage require surgeons to respond within 30 minutes. About 40 percent have longer response time requirements or do not have any specified response time requirement for orthopedic surgeons.



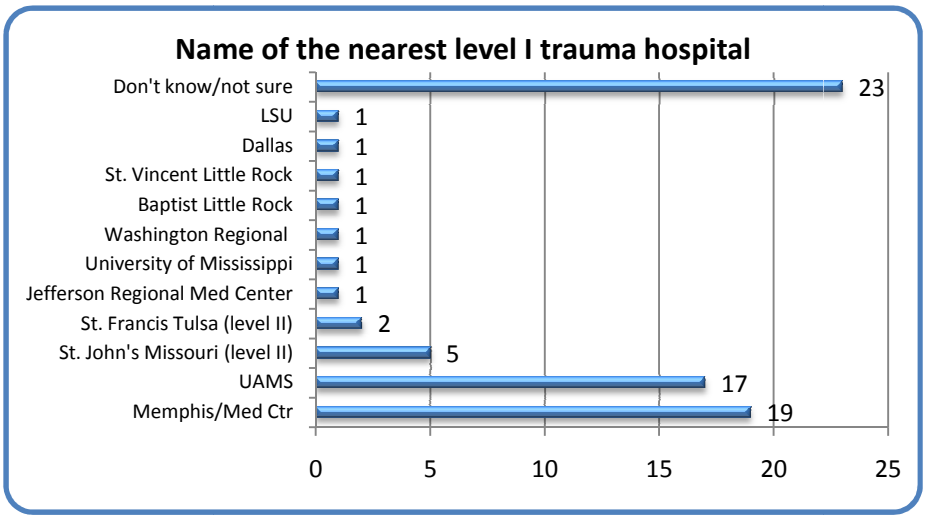
We sought to determine the proportion of hospitals that require Advanced Trauma Life Support (ATLS) training for their emergency department physicians. Half of the Arkansas hospitals reported that they do not require ATLS.

For emergency department nursing, Advanced Cardiac Life Support is typically a requirement of trauma designation. Better than 9 out of 10 Arkansas hospitals reported ACLS as a requirement for their emergency department nurses.

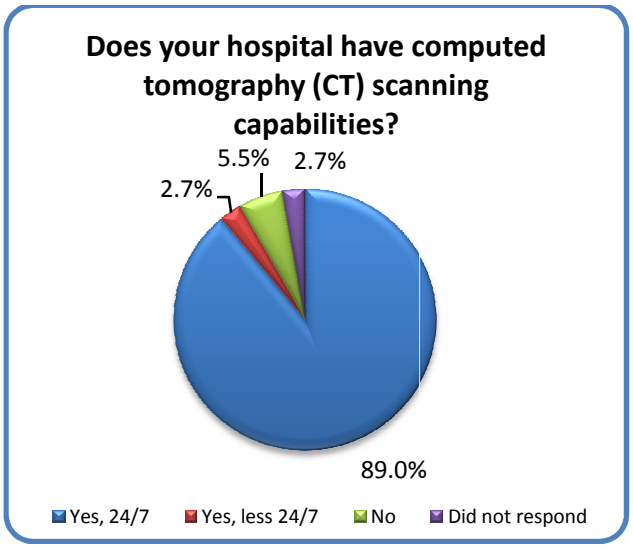




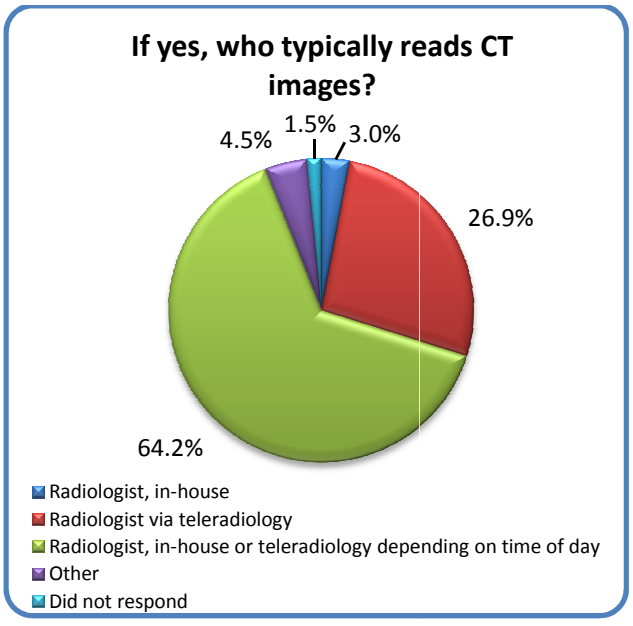
We asked responding hospitals to name the nearest level I trauma hospitals. Interestingly, 17 hospitals incorrectly identified UAMS as a level I trauma hospital. Baptist, St. Vincent, Jefferson Regional and Washington Regional were all identified incorrectly as level I trauma centers by one hospital each. Another 23 hospitals reported that they were not sure of the closest level I trauma facility. Collectively, 61.6% of hospitals did not know the name of the nearest level I trauma facility or incorrectly identified a hospital that is not designated or verified for trauma.



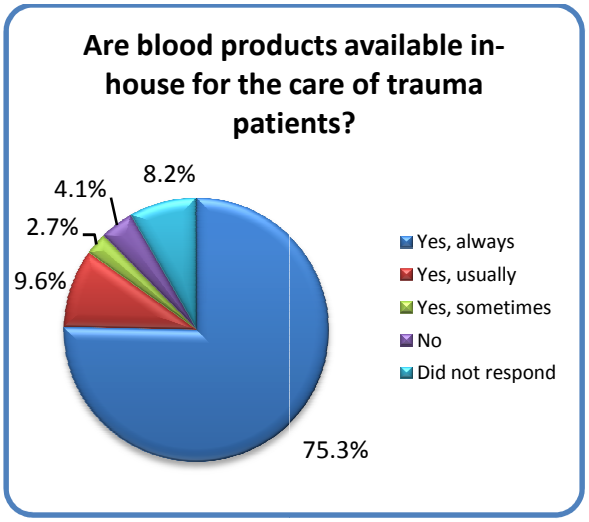
Nearly 9 out of 10 hospitals reported having computed tomography screening capabilities 24 hours per day, 7 days per week.



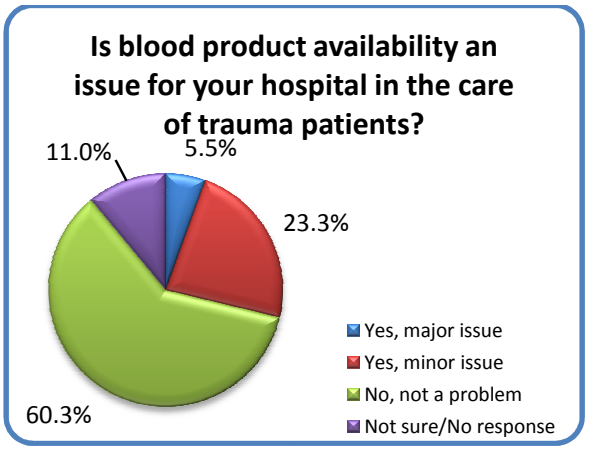
Most hospitals rely on both in-house radiologists and teleradiologists (radiologists who read images from remote locations). One in 4 hospitals rely solely on teleradiology for reading CT images.



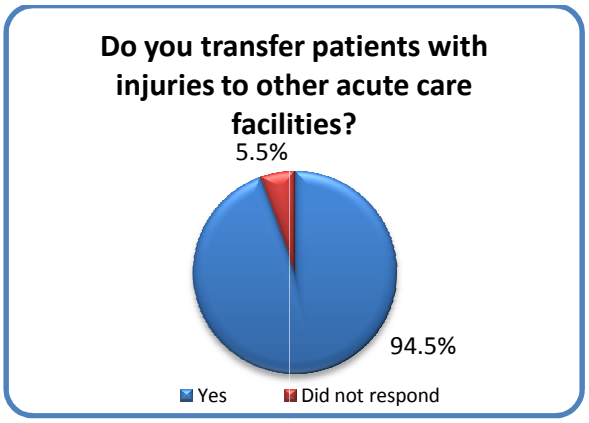
The availability of blood products is an important consideration in the care of trauma patients. Three out of 4 hospitals reported that blood products are always available for trauma patients.



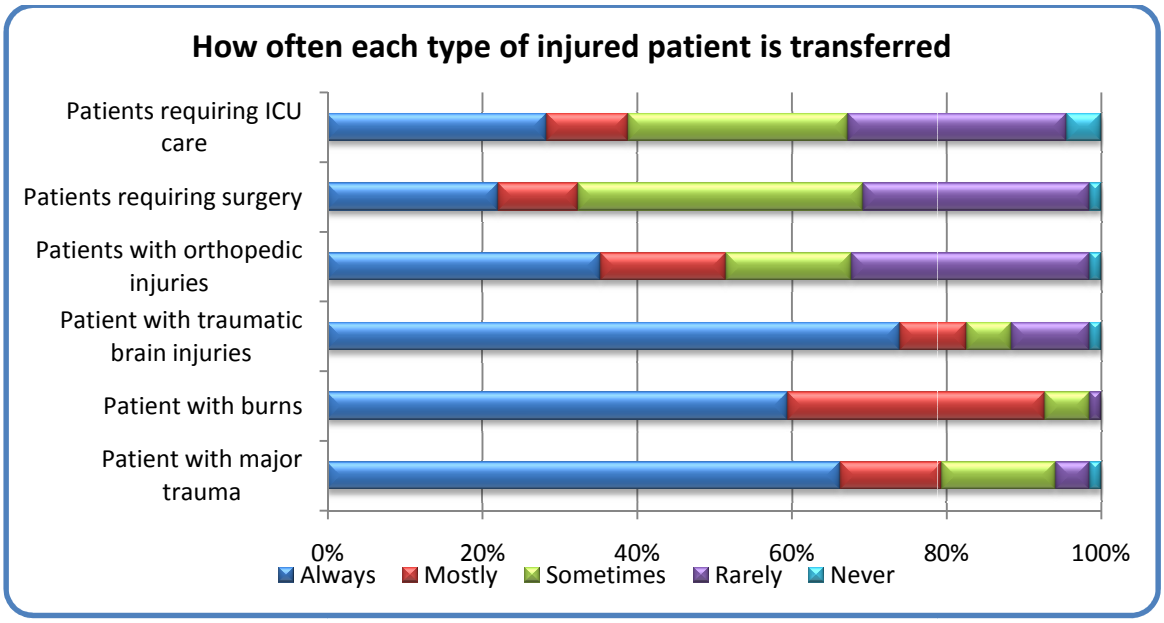
Blood product availability is a major issue for a small number of hospital. However, nearly 1/4 of hospitals reported minor issues with blood product availability for trauma patients.



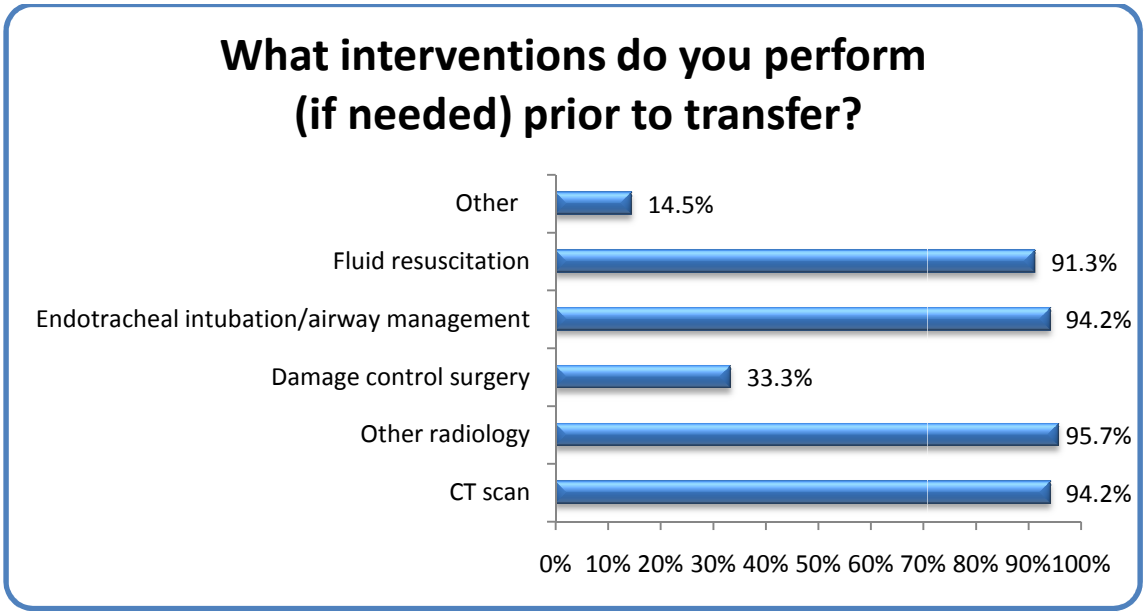
Nearly all hospital reported that they transfer patients with injuries to other hospitals, at least some of the time. No hospitals reported that they never transfer an injured patient.



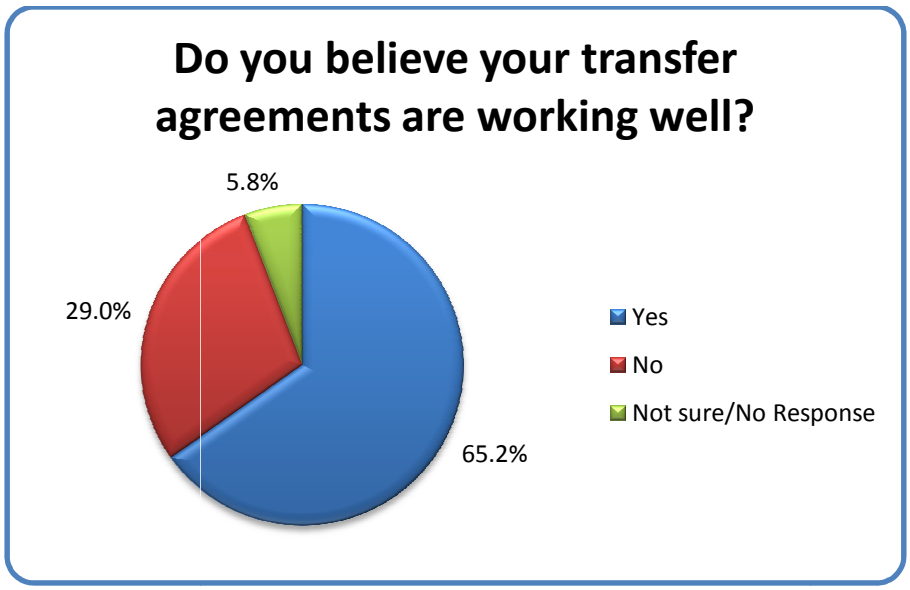
Two-thirds of responding hospitals report that they always transfer patients with major trauma. Patients with orthopedic injuries are less likely to be transferred as are other injured patients requiring surgery or intensive care unit resources.



We asked hospitals to report the types of interventions performed prior to transferring a patient. Establishing an airway (endotracheal intubation) and diagnostic imaging (films and/or CT) were both very common, with 94% of hospitals reporting this practice.



About 2/3 of hospitals reported that their transfer agreements are working well. However, the remaining hospitals reporting that transfer agreements were not working well or they were unsure about them.



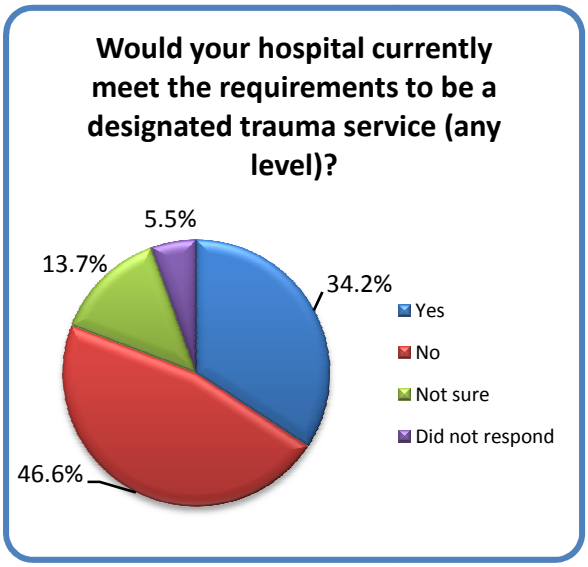
We asked hospitals to tell us why their agreements were not working well, and here are some examples of their responses:

> "For trauma patients, it is extremely difficult to find a facility willing to accept patients. It often takes 4-6 hours to make transfers."
>
> "At times, it may take 1 hour or longer before a transfer ambulance is available."
>
> "Many times, we cannot find a specialist willing to accept our patients."
>
> "UAMS frequently has no bed availability, and ACH helicopters take too long to arrive."
>
> "Recovery facility often on divert for adults."
>
> "UAMS won't accept patients frequently and is often on divert."
>
> "Lack of written transfer agreements is a problem."
>
> "Delays by county EMS have in the past delayed transfer of patients."

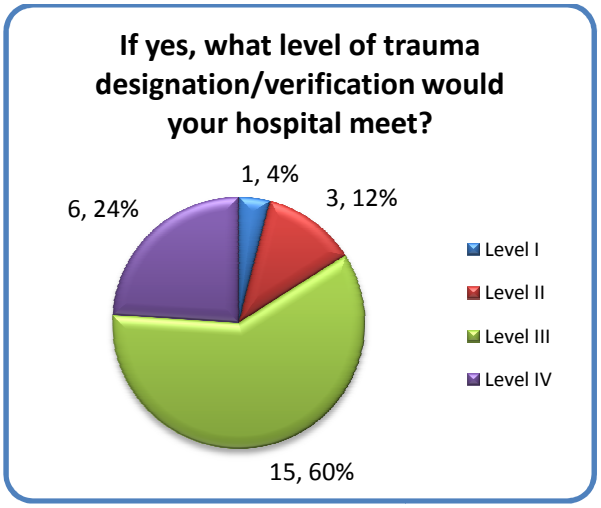
We asked hospitals to estimate the ground transport time in minutes to reach the closest receiving hospital. The responses ranged from several minutes to 4 hours, with an average ground transport time of 53 minutes. By air, the time to closest receiving hospital ranged from 5 minutes to 2 hours, with an average air transport time of 26.7 minutes.

Trauma Designation

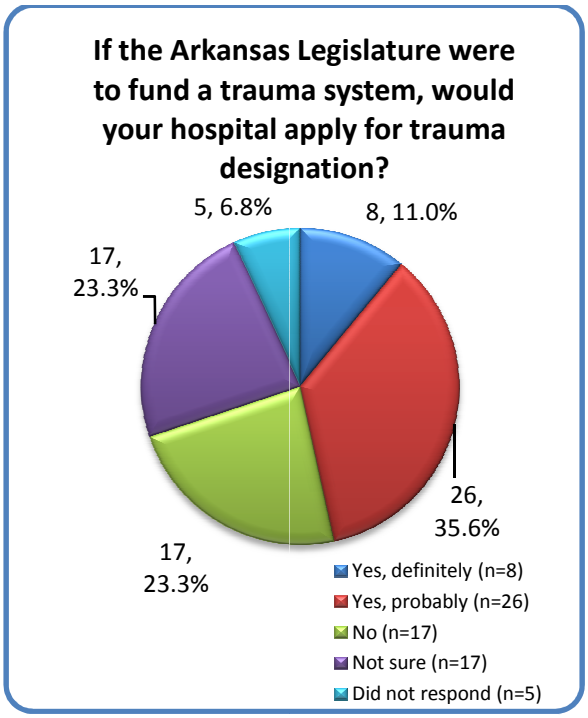
About 1/3 of Arkansas hospitals reported that they would currently meet the requirements to be a designated trauma service. Nearly half reported that they would not meet the requirements and an additional 10 hospitals were unsure about this.



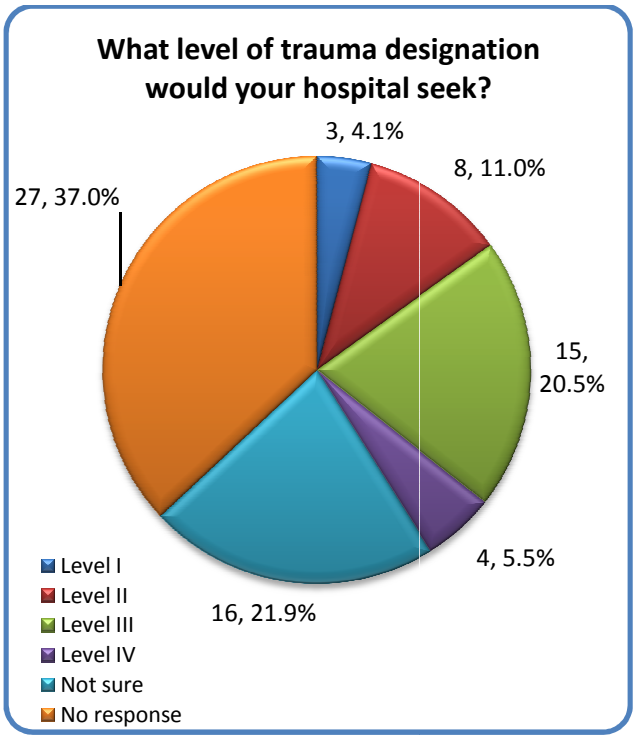
For those that would meet the requirement, 60% categorized themselves as meeting the requirements of a level III trauma service. Few hospitals would currently meet the requirements of a level I or level II trauma service.



As trauma funding is a major concern of hospitals in Arkansas, we asked hospitals to indicate whether they would apply for trauma designation if the Arkansas Legislature were to fund a trauma system. Only 8 hospitals reported that they definitely would apply for designation, but an additional 26 hospitals indicated that they probably would. A similar number of hospitals are either not planning to apply for designation or are not sure about whether they will apply.



Arkansas hospitals indicated their intent to apply for trauma designation, with expected applications for 3 level I trauma services, 8 level IIs, 15 level IIIs, and 4 level IVs. However, an additional 16 hospital reported that they were unsure as to the level of designation that they might seek.



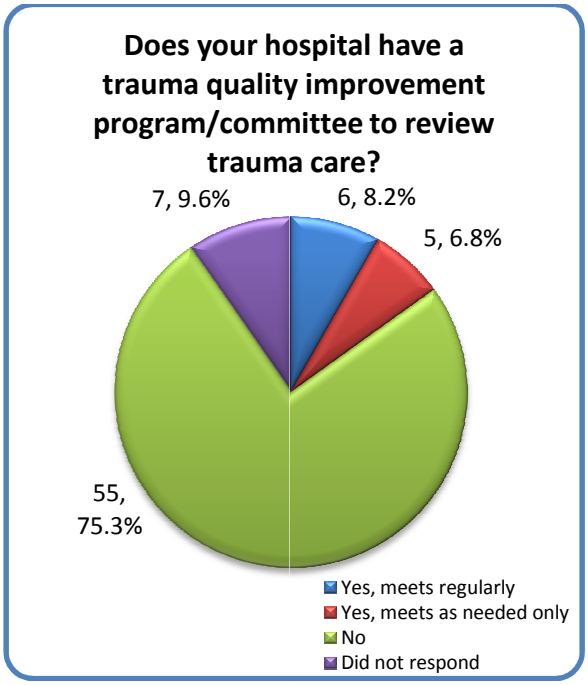
Barriers and Obstacles to Trauma Designation

We also asked hospitals to describe barriers and obstacles that might prevent them from designating for trauma. Detail of their responses can be found in Appendix B. The following summarizes the key barriers and obstacles as reported by the hospitals:

- Lack of trauma surgeons and board certified ER physicians, especially in small, rural hospitals;
- Limited specialists - general surgery, anesthesiology, radiology, orthopedic surgery, neurosurgery, maxillofacial surgery, otolaryngology, ophthalmology, etc. ;
- Lack of funding for teleradiology and other essential equipment for trauma;
- Limited depth of ancillary services;
- Lack of an intensive care unit (ICU) or limited ICU beds;
- Inadequate training of hospital staff and shortage of hospital staff (nursing);
- Inadequate physician support and commitment to trauma call;
- Lack of institutional support and commitment;
- Insufficient number of hospital beds; and
- Uncompensated trauma care/limited funding for trauma care.

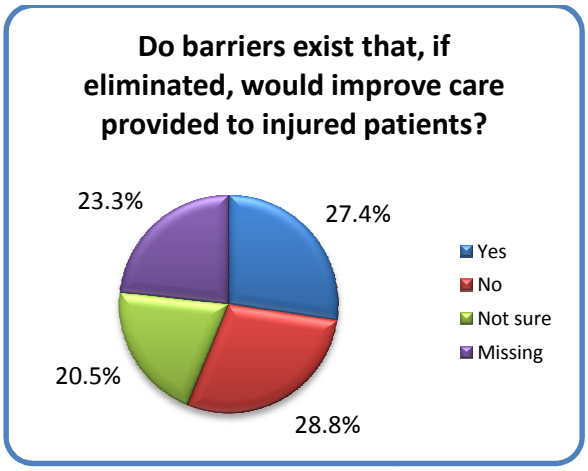
Trauma Quality Improvement Programs

A trauma quality improvement program is an essential component of a trauma service. About 15% of Arkansas hospitals reported having a trauma quality improvement program or committee that meets either regularly or as need. Most hospitals do not currently have this resource in place.



We asked hospitals to tell us if there are existing barriers that, if eliminated, would improve the care provided to injured patients. Responses from hospitals were varied, with a

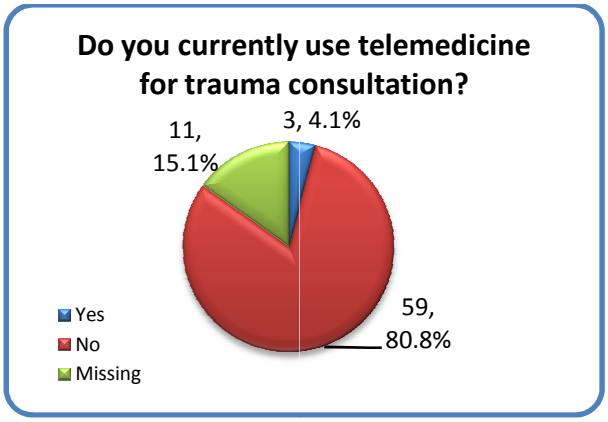
similar number of hospitals reporting barriers as reporting no barriers. Many hospitals were unsure or did not answer this question.



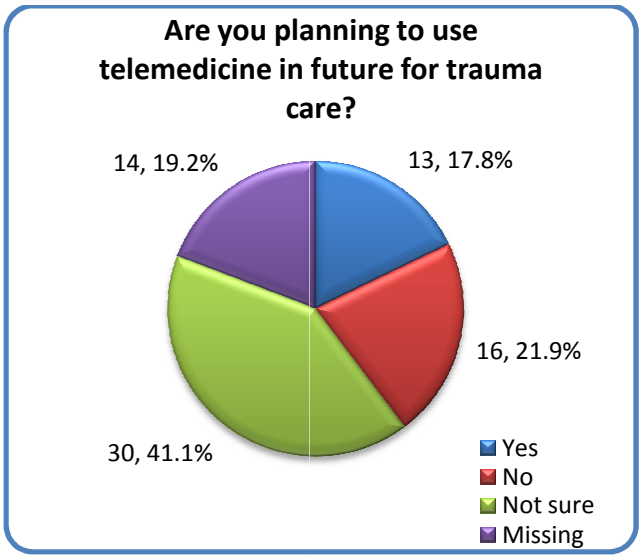
Details of the barriers reported by hospitals are included in Appendix B. A summary of these barriers is included here:

- Lack of an Arkansas trauma system with designated level I and II trauma centers that are geographically accessible to the various areas of the state;
- Lack of trauma surgeons, neurosurgeons, specialists, etc. to provide 24/7 trauma coverage;
- Hospitals unwilling to accept trauma patients even after making numerous calls; Transferring trauma patients is cumbersome and time consuming;
- Inadequate equipment necessary to support trauma;
- Lack of trauma training for hospital nurses;
- Inadequate communication between hospital staff, EMS, and physicians regarding trauma patients;
- Shortage of critical care beds;
- UAMS is often closed to trauma because of lack of capacity;
- Limited availability of neurosurgeons who are willing to accept patients with head trauma;
- Funding (uncompensated trauma care, cost of trauma readiness; cost to assure physician coverage, etc.);
- Lack of standardized trauma protocols specific to the type of injury and patient;

We asked hospitals whether they currently use telemedicine for trauma consultation, with only 3 hospitals indicating that they do this.



However, when asked about whether the hospitals plan to use telemedicine in the future for trauma care, the majority indicated that they are either planning to do so or are not sure. Less than 1/4 of hospitals reported that they were not planning to use telemedicine in the future.



Injury Hospitalizations

Who are the trauma patients and where do cases occur?
During the years 2004 to 2006, a total of 71,101 injury hospitalizations occurred in Arkansas, for an annual average of 23,700 hospitalizations. Of these, 1,891 patients died during their hospitalizations. Whether patients live or die is related to the severity of their injuries, with low mortality (1.7%) in patients with relatively minor injuries and high mortality (10.7%) in patients with major injuries. Table 1 provides descriptive information about the injured patients who were hospitalized in Arkansas hospitals during 2004-2006. The volumes presented are annual averages.

Table 1. Patient characteristics of selected hospitalization by Injury Severity Score*, Annual Average (based on 2004-2006 data)

Demographic	Injury Severity Minor (ISS<9)	Moderate (9-15)	Major (ISS≥16)	Unknown
Age				
mean (years)	56.7	68.1	48.1	61.6
0-9	562 (3.9)	66 (.9)	85 (4.9)	2 (.7)
10-19	834 (5.8)	296 (4.1)	184 (10.5)	8 (2.6)
20-29	1,226 (8.5)	403 (5.6)	249 (14.2)	20 (6.3)
30-39	1,226 (8.5)	320 (4.5)	183 (10.5)	30 (9.3)
40-49	1,618 (11.2)	442 (6.2)	223 (12.7)	43 (13.2)
50-59	1,596 (11.1)	509 (7.1)	206 (11.8)	37 (11.5)
60-69	1,691 (11.7)	653 (9.1)	167 (9.6)	37 (11.3)
70-79	2,303 (16.0)	1,426 (19.9)	195 (11.1)	57 (17.7)
80 +	3,355 (23.3)	3,068 (42.7)	259 (14.8)	89 (27.4)
Gender				
Female	7,755 (53.8)	4,499 (62.6)	633 (36.1)	184 (56.7)
Male	6,655 (46.2)	2,683 (37.4)	1,119 (63.9)	141 (43.3)
Race				
White	12,763 (88.6)	6,565 (91.4)	1,522 (86.9)	289 (88.9)
Black	1,419 (9.9)	500 (7.0)	178 (10.2)	31 (9.6)
American Indian	22 (.2)	8 (.1)	4 (.3)	--
Asian/Pacific Is.	26 (.2)	13 (.2)	8 (.5)	--
Other	79 (.6)	41 (.6)	16 (.9)	3 (.8)
Missing	100 (.7)	55 (.8)	24 (1.4)	2 (.7)
Ethnicity				
Hispanic	236 (1.6)	84 (1.2)	51 (2.9)	5 (1.4)
Non-Hispanic	14,093 (97.8)	7,051 (98.2)	1,681 (96.0)	317 (97.7)
Missing	81 (.6)	48 (.7)	20 (1.1)	3 (.8)
Residence Region				
Arkansas Valley	1,614 (11.2)	1,012 (14.1)	240 (13.7)	39 (12.0)
Metro	3,024 (21.0)	1,529 (21.3)	397 (22.6)	60 (18.4)
North Central	2,115 (14.7)	908 (12.6)	182 (10.4)	51 (15.6)
Northeast	1,668 (11.6)	800 (11.1)	137 (7.8)	55 (16.9)
Northwest	1,802 (12.5)	850 (11.8)	251 (14.3)	33 (10.1)
Southeast	1,160 (8.1)	503 (7.0)	131 (7.5)	23 (7.1)
Southwest	2,091 (14.5)	1,009 (14.1)	238 (13.6)	47 (14.4)

Demographic	Injury Severity Minor (ISS<9)	Moderate (9-15)	Major (ISS≥16)	Unknown
Out-of-State	924 (6.4)	568 (7.9)	175 (10.0)	18 (5.5)
Missing/unknown	2 (.02)	2 (.03)	1 (.04)	--
Payer				
Self Pay	1,674 (11.6)	497 (6.9)	290 (16.6)	30 (9.3)
Commercial/Blues/ WorkComp/HMO	3,683 (25.3)	1,243 (17.3)	650 (37.1)	66 (20.3)
Medicare	7,225 (50.1)	4,950 (68.9)	559 (31.9)	186 (57.3)
Medicaid	1,295 (9.0)	307 (4.3)	181 (10.3)	31 (9.7)
Other	533 (3.7)	186 (2.6)	73 (4.2)	11 (3.4)
Total	14,440	7,183	1,752	325

* The Injury Severity Score (ISS) is an anatomical scoring system that provides an overall score for patients with multiple injuries. Each injury is assigned an Abbreviated Injury Scale (AIS) score (Association for the Advancement of Automotive Medicine), allocated to one of six body regions (Head, Face, Chest, Abdomen, Extremities (including Pelvis), External). Only the highest AIS score in each body region is used. The 3 most severely injured body regions have their score squared and added together to produce the ISS score. The ISS ranges from 0 to 75. An AIS injury of 6 is unsurvivable and will automatically generate an ISS of 75.

In Table 2, we provide information about the hospital course of injured patients, including the admission type, the source of admission, and the discharge disposition. Patients with major trauma are much more likely to have an emergency admission, compared to patients with minor trauma. Similarly, major trauma patients are also more likely to be admitted from the hospital's emergency department. Just less than half of major trauma patients are discharged home routinely, while nearly 1/3 require post-acute care such as that of a skilled nursing facility or rehabilitation center.

Table 2. Hospital characteristics of trauma admissions by Injury Severity Score (annual average based on 2004-2006 data)

Demographic	Injury Severity Minor (ISS <9)	Moderate (9-15)	Major (ISS ≥16)	Unknown
Admission Type				
Emergency	6,700 (46.5)	3,886 (54.1)	1,220 (69.6)	122 (37.6)
Urgent	4,244 (29.5)	2,022 (28.2)	356 (20.3)	123 (37.8)
Elective	3,393 (23.6)	1,269 (17.7)	176 (10.0)	80 (24.5)
Newborn	65 (.5)	2 (.02)	<1 (.02)	--
Missing	8 (.1)	5 (.1)	1 (.04)	<1 (.1)
Admission Source				
Physician Referral	5,006 (34.9)	1,690 (23.5)	296 (16.9)	137 (42.3)
Clinical Referral	432 (3.0)	84 (1.2)	12 (.7)	8 (2.6)
HMO Referral	5 (.03)	1 (.01)	<1 (.02)	--
Transfer from a Hospital	889 (6.2)	780 (10.9)	258 (14.7)	21 (6.5)
Transfer from SNF	110 (.8)	116 (1.6)	4 (.4)	3 (1.0)
Transfer from HC	87 (.6)	80 (1.1)	14 (.8)	2 (.7)
ED	7,760 (54.1)	4,409 (61.4)	1,159 (66.2)	150 (46.4)
Court/Law Enforcement	18 (.1)	2 (.03)	2 (.1)	1 (.2)
Transfer within same Hospital	20 (.1)	10 (.1)	1 (.1)	1 (.3)
Missing	10 (.1)	5 (.1)	2 (.1)	--
Discharge Disposition				
Home, routine	8,949 (62.1)	2,051 (28.6)	829 (47.3)	202 (62.1)
Home with care	1,441 (10.0)	800 (11.1)	141 (8.0)	31 (9.5)
Transfer to another Acute care hospital	381 (2.6)	260 (3.6)	78 (4.4)	12 (3.7)
Rehabilitation	891 (6.2)	1,897 (26.4)	278 (15.9)	15 (4.7)
SNF/LTC/Nursing home	1,916 (13.3)	1,668 (23.2)	184 (10.5)	46 (14.2)
ICF/Other HC Facility	583 (4.1)	311 (4.3)	53 (3.0)	11 (3.4)
Died	243 (1.7)	191 (2.7)	188 (10.7)	8 (2.5)
Unknown	6 (.04)	5 (.1)	2 (.1)	--
Total	14,440	7,183	1,752	325

Arkansans experience trauma from a wide variety of injury mechanisms. Table 3 provides detail on the mechanisms for injury hospitalizations among Arkansans. Motor vehicle occupants account for the largest proportion of major trauma, followed closely by falls.

Table 3. Mechanism of injury of trauma admissions by Injury Severity Score, Annual Averages

Demographic	Injury Severity Minor (ISS <9)	Moderate (9-15)	Major (≥16)	Unknown
Mechanism of Injury				
Falls	5,766 (40.0)	4,738 (66.0)	524 (29.9)	109 (33.7)
MV occupant & unspec	1,338 (9.3)	750 (10.4)	542 (31.0)	16 (5.0)
MV motorcyclist	223 (1.6)	142 (2.0)	111 (6.4)	1 (.4)
ATV	159 (1.1)	73 (1.0)	50 (2.9)	<1 (.1)
Transport, other	263 (1.8)	136 (1.9)	62 (3.6)	2 (.7)
Bicyclist	55 (.4)	28 (.4)	20 (1.1)	--
Pedestrian	90 (.6)	54 (.8)	39 (2.2)	<1 (.1)
Struck by/against/cut/ Pierce	976 (6.8)	169 (2.4)	85 (4.9)	18 (5.4)
Fire/flame/heat	402 (2.8)	64 (.9)	11 (.7)	1 (.4)
Firearm	164 (1.1)	107 (1.5)	52 (2.9)	2 (.6)
Machinery	131 (.9)	48 (.7)	7 (.4)	2 (.7)
Suffocation	146 (1.0)	1 (.02)	1 (.04)	2 (.7)
Other	2,964 (20.6)	443 (6.2)	140 (8.0)	104 (31.9)
Missing/unknown	1,734 (12.0)	428 (6.0)	107 (6.1)	65 (20.1)
Intent				
Unintentional	11,967 (83.1)	6,575 (91.5)	1,500 (85.6)	246 (75.7)
Suicide	293 (2.0)	17 (.2)	22 (1.3)	6 (1.9)
Assault	410 (2.9)	177 (2.5)	118 (6.8)	6 (2.0)
Uncertain	1,739 (12.1)	413 (5.8)	112 (6.4)	67 (20.5)
Total	14,440	7,183	1,752	325

Trauma patients incur a wide variety of injuries to different body parts. While minor trauma may be limited to isolated injuries, major trauma often involves multiple body systems. In Table 4, we provide frequencies of injuries among hospitalized patients, along with the percentage of patients in each injury severity group with each type of injury. For example, 73.8% of major trauma patients had a diagnosis of traumatic brain injury, compared with 5.2% of minor trauma patients.

Table 4. Injury diagnoses‡ by Injury Severity Score, Annual Averages

Demographic	Injury Severity Minor (ISS <9)	Moderate (9-15)	Major (ISS ≥16)	Unknown
Diagnosis				
TBI	744 (5.2)	396 (5.5)	1,292 (73.8)	20 (6.2)
Fx Neck/Trunk (805-809)	2,413 (16.7)	1,362 (19.0)	604 (34.5)	40 (12.4)
Fx Upper Limb (810-819)	1,840 (12.8)	718 (10.0)	270 (15.4)	1 (.2)
Fx Lower Limb (820-829)	2,522 (17.5)	5,120 (71.3)	228 (13.0)	9 (2.9)
Dislocation (830-839)	398 (2.8)	79 (1.1)	41 (2.3)	3 (.9)
Sprains & Strains (840-848)	1,122 (7.8)	76 (1.1)	24 (1.4)	40 (12.2)
Thorax, Abdomen & Pelvis (860-869)	551 (3.8)	775 (10.8)	651 (37.1)	17 (5.1)
Open head, neck, Trunk (870-879)	1,341 (9.3)	384 (5.4)	285 (16.3)	1 (.2)
Open upper limb (880-884)	844 (5.9)	169 (2.4)	49 (2.8)	--
Upper limb amputations (885-887)	54 (.4)	9 (.1)	2 (.1)	--
Open lower limb (890-894)	674 (4.7)	119 (1.7)	44 (2.5)	--
Blood vessels (900-904)	84 (.6)	59 (.8)	27 (1.6)	7 (2.1)
Late effects (905-909)	114 (.8)	25 (.4)	13 (.8)	5 (1.4)
Superficial (910-919)	1,166 (8.1)	214 (3.0)	86 (4.9)	--
Contusion (920-924)	2,413 (16.7)	391 (5.5)	164 (9.4)	1 (.3)
Crushing injury (925-929)	47 (.3)	31 (.4)	8 (.4)	3 (.9)
Foreign bodies (930-939)	593 (4.1)	13 (.2)	7 (.4)	--
Burns (940-949)	536 (3.7)	92 (1.3)	16 (.9)	4 (1.2)
Nerves & SCI (950-957)	110 (.8)	76 (1.1)	42 (2.4)	18 (5.4)
Total	14,440	7,183	1,752	325

‡Injury diagnoses are not mutually exclusive. Patients may have multiple injury diagnoses.

In Table 5, we present hospital resource utilization for injured patients. Average hospital length of stay in days is included, along with a total number of hospital days (annual average). We also include average hospital charges and total hospital charges.

Table 5. Hospital Resource Utilization (length of stay and charges)

Demographic	Hospital Stay Mean (days)	Average Annual Total (days)	Hospital Charges Mean ($)	Average Annual Total ($)
Age				
0-9	5.2	3721	20523	14,687,627
10-19	4.9	6481	24826	32,836,523
20-29	5.0	9492	25966	49,292,123
30-39	5.3	9323	25771	45,331,189
40-49	5.5	12791	26219	60,976,654
50-59	5.8	13622	25375	59,597,417
60-69	5.9	15035	23739	60,494,885
70-79	6.4	25476	21644	86,157,549
80+	6.5	44014	18627	126,129,626
Gender				
Female	6.0	78426	20218	264,269,478
Male	5.8	61465	25587	271,153,968
Injury Severity				
Minor (ISS<9)	4.9	70610	17163	247,324,551
Moderate (ISS 9-15)	6.8	48844	26324	189,085,292
Major (ISS>=16)	10.4	18,224	53629	93,975,884
Unknown	5.6	1818	15863	5,150,187
Payer				
Self Pay	4.6	11462	23244	57,916,300
Private/Commercial	5.3	29901	26673	150,480,175
Medicare	6.4	82682	20194	260,886,286
Medicaid	6.5	11795	26749	48,540,519
Other	5.1	4097	22019	17,688,597
Total	5.9	139,713	22623	535,377,555

References

[1] Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, WISQARS, 2004.

[2] Stewart TC, Lane PL, Stefanits T. An evaluation of outcomes before and after trauma center designation using Trauma and Injury Severity Score analysis. *J Trauma*. 1995;39:1036-1040.

[3] Shackford SR, Mackersie RC, Hoyt DB, et al. Impact of a trauma system on outcome of severely injured patients. *Arch Surg*. 1987;122:523-527.

[4] MacKenzie EJ, Rivara FP, Jurkovich GJ, Nathens AB, Frey KP, et al. A national evaluation of the effect of trauma-center care on mortality. *N Engl J Med* 2006;354:366-78.

[5] Mann NC, Mullins RJ, MacKenzie EJ, Jurkovich GJ, Mock CN. Systematic review of published evidence regarding trauma system effectiveness. *J Trauma*. 1999;47(3)Supplement:S25-S33.

[6] Mullins RJ and Mann NC. Population-based research assessing the effectiveness of trauma systems. *J Trauma*. 1999;47(3):S-59-S66.

[7] Mackenzie EJ. Review of evidence regarding trauma system effectiveness resulting from panel studies. *J Trauma*. 1999;47(3)S34-S41.

[8] Celso B, Tepas J, Langland-Orban B, Pracht E, Papa L, et al. A systematic review and meta-analysis comparing outcome of severely injured patients treated in trauma centers following the establishment of trauma systems. *J Trauma* 2006;60:371-378.

[9] Dillman DA. Mail and Internet Surveys: The Tailored Design Method, 2nd edition. John Wiley and Sons, Inc., New York, NY, 2000

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Appendix A

EMS Concerns Regarding Trauma Care

We asked EMS agencies to describe any concerns regarding trauma care (prehospital or hospital) provided to Arkansans. Here are their responses:

- The funds to operate trauma training and implementation needs to be provided from some source other than EMS.
- Our service is very remote as far as trauma care is concerned. We teach our EMTs and paramedics to strive for as short of a scene time as possible. They are excellent at rapid response, treatment and transport. This is often a massive effort that comes to a halt when the patient arrives at the ER. They sit for hours waiting on a specialty care hospital willing to accept them.
- No level 1 trauma center in Arkansas
- There is too much time on scene doing skills that should be done en route.
- Most ERs in area are ill qualified to handle a broken finger, let alone a trauma patient.
- Often it seems that facilities in Little Rock are slow to accept trauma patients. We have issues with them not accepting an unstable patient. However, often times our facility does not have the resources to stabilize trauma victims.
- We need a level 1 trauma hospital in NW Arkansas.
- We need more trained personnel and another ambulance.
- In our area, we never know if our hospitals have neurosurgery or orthopedics available when we respond to trauma. It is at best hit or miss.
- We do not have a trauma center.
- There needs to be a statewide trauma protocol that is mandated to be followed.
- Early access to a trauma center is needed.
- Lack of resources and funding limit specialized trauma care in rural Arkansas.
- Hospitals on frequent diversion!
- There are not enough trauma hospitals in the state.
- In rural Arkansas, small hospitals can't attract the specialists such as surgeons or highly skilled ER physicians because of a lack of social activities and poor school systems. Low reimbursement also makes it hard on rural hospitals. Because payment for services is so low, we can't afford a quality CT machine or state of the art monitoring equipment. Salaries can't compete with metro areas. For quality educated nurses in specialty areas, it's just a bad cycle that I have seen getting worse over the past 20 years of my career.
- We need better communication between prehospital and hospital personnel during trauma calls. We also need regular implementation of the trauma alert protocol.
- There are no Arkansas-based trauma centers located in the Eastern part of Arkansas.
- Our biggest concern is that our closest hospital does not have the equipment or personnel to handle major trauma, and when we transport the patient there, it delays the time get the patient transferred to a more appropriate facility for the care they need.
- Arkansas needs prehospital trauma training to provide the care that citizens deserve. Also, EMS needs a conduit for feedback from the hospital. (HIPAA is big obstacle)
- Neurosurgeons are in short supply, and none is willing to take call. Patients with head injuries are severely underserved in Arkansas.

- No neurosurgeons. Patients are poorly served once they reach the hospital. If you suffer a head injury you are out of luck. Other hospitals are becoming increasingly stringent on accepting patients from other areas.
- Our nearest trauma center is in Memphis, TN and sometimes we don't get the same treatment as Tennessee EMS providers.
- There are not enough physicians that specialize in trauma in rural areas. We should have never let our EMS go private because there is not enough federal money to provide EMS with the resources needed.
- Rules and regulations are in place, but no funding stream. No incentive for compliance by hospitals and/or specialty services such as neurosurgery, thoracic surgery etc. The community does not demand an improvement in services.
- No trauma centers available in Northwest Arkansas!
- We need a trauma center for referral of true trauma cases from rural hospitals. We also need affordable training in PHTLS and PALS readily available for EMS personnel. Also, we need reimbursement for uncompensated trauma care.
- Patients have to stay at small hospitals too long (sometimes 8 hours) waiting on larger hospital to accept them.
- There are very few trauma designated facilities n Arkansas.
- No level 1 trauma designated hospital. Trauma sustain funding failed at the legislature
- Arkansas does not have a state trauma system. Current rules and regulations do not support the best interest of Arkansans in need of definitive trauma interventions.
- In our area, there seems to be a lack of concern in getting trauma care updated.
- Not enough funding or resources for equipment and training.
- There is not an organized trauma system in Northwest Arkansas. No hospital in NW Arkansas specializes in trauma care. Traumatically injured Arkansans are cared for by physicians and hospitals who do not want to provide them care.
- Arkansans need trauma care hospital, the nearest one is the Med in Memphis, TN
- Lack of statewide communications system with trauma receiving facilities.
- Only concern is that we do not have a trauma center for Arkansas. If we did have a trauma center in a central location, would the aircrafts be larger units than current service by air-wal. They are limited in certain weather condition to make scene flight when a larger helicopter as Hospital Wing or Memphis Town has made the flight and returned to the Med safely. One other concern is the communication between our local 911, EMS and hospital at a scene involving a trauma or multiple traumas.
- No trauma system. Diversion of receiving facilities in LR - no way to know who is on diversion. Under-utilization of air medical ambulances.
- Financial barriers - funding for further training & equipment.
- Would like to see more Level I hospitals

Appendix B

Hospital Concerns

We also asked hospitals to describe barriers and obstacles that might prevent them from designating for trauma. Here are their responses:

- We do not have surgical services as we are a critical access hospital.
- Lack of trauma surgeons and board certified ER physicians.
- Availability of medical manpower - orthopedic and neurosurgery. We have only 1 general surgeon who cannot be expected to be available 24/7, 365 days per year. We have CRNA coverage only and no physician anesthesiologist
- We do not have orthopedics on call 24/7.
- We do not have available specialty staff in-house at all times as needed for designation.
- We lack the necessary physicians.
- Our hospital does not have a surgical team in-house - no surgeon available- no radiologist available- no specialty physicians are available in-house.
- Lack of 24/7 trauma surgeons, neurosurgeons, general staffing and scope of services.
- Our hospital is a critical access hospital.
- Specialists are unavailable.
- We do not have a general surgeon on-site 24/7 and we do not take care of burns.
- Our hospital lacks funding for teleradiology/DACS/other essential equipment.
- Small hospital size and capability.
- Depth of staff ancillary services, x-ray, respiratory therapy, ob, single surgeon cannot be on call 24/7/365 days per year.
- No neurosurgery at our hospital.
- We lack 24 hrs. in-house physician coverage and have no ICU beds.
- No in-house 24/7 coverage.
- If we had full ophthalmology coverage & ENT maxillofacial trauma coverage, we could possibly qualify for a level 2 designation.
- Shortage of physician specialties; not available.
- Not enough adequately trained staff
- Inadequate physician support
- We are a rural critical access hospital.
- Limited resources.
- Our size-we are critical access & do not have access to specialty physicians
- No surgery at our hospital.
- Physician specialty availability
- Institutional support and commitment (UAMS/ACH)
- Unassigned call responsibility by specialists
- Neurosurgery availability; on-site surgical team 24/7
- Uncompensated trauma care; insufficient number of beds
- Specialty services not available
- Buy-in from surgeons & orthopedists
- CAH Hospital

- No ICU; lack of adequate equipment & staff
- Lack of surgeon
- No neurosurgeon
- No anesthesiology in-house except for 2 day shifts per week.
- Lack of buy-in from surgery & orthopedics.
- No In-house surgeons or anesthesia 24/7.
- Limited specialty physician coverage

We asked hospitals to tell us if there are existing barriers that, if eliminated, would improve the care provided to injured patients. Here are barriers listed by hospitals.

- We need a level I trauma hospital in Little Rock.
- Arkansas needs a trauma system with designated level I and II trauma centers that are geographically accessible to the various areas of the state.
- Arkansas needs reform specifically for trauma.
- Our hospital needs an available trauma surgeon, neurosurgeon, etc. here 24/7.
- Specialists are not available for trauma patients.
- Local specialists are difficult to recruit to our hospital.
- Neurosurgery and general surgery coverage is lacking.
- Finding a willing receiving hospital is difficult even after making numerous calls.
- We are limited by specialty physician availability and by equipment necessary to support a trauma service. We also need increased levels of training for our nurses.
- We need better training and communication between hospital staff, EMS, and physicians.
- There is a shortage of critical care beds at this hospital. Also UAMS is often closed to trauma because of lack of capacity. We get head trauma from outside of our usual service area because many neurosurgeons have quit taking care of head trauma. How long can our 2 neurosurgeons continue to provide almost 24/7 coverage?
- Limited availability of neurosurgeons who are willing to accept traumatic brain injuries.
- Tertiary centers should be required to readily accept trauma patients. Currently, the ability to transfer trauma patients is very cumbersome and time consuming.
- Funding is difficult for trauma patients.
- Cost of having the required specialists in-house and available to support trauma care 24/7 is a barrier.
- Physician resources: anesthesiology, accepting physicians, specialty physicians
- If and when a trauma system is designed for Arkansas, it must be designed with fixed responsibilities for the system to assure arrangements for transfer of trauma victims within the system. Often rural hospitals' ER physicians spend several hours on the telephone trying to arrange for the transfer of trauma victims. That time could (and should) be used providing medical care to the trauma patient and to other ER patients.
- We need a trauma system & funding to support trauma care!!
- Our hospital would be interested in networking with other critical access hospitals who currently use trauma protocols specific to the type of injury/patient.
- We need a trauma system desperately.
- There needs to be a trauma system for the state of Arkansas, because it is becoming increasingly more difficult to get physicians to accept trauma patients from rural areas.