

The Evolution of the Rhode Island Trauma System: Where Do We Stand?

Shea C. Gregg, MD, David T. Harrington, MD, FACS, and Charles A. Adams, Jr, MD

A 51 year-old male was brought by to his local hospital after being assaulted. Upon arrival, the patient was unresponsive and showed signs of head trauma. His vital signs included an elevated blood pressure and heart rate. Due to his depressed mental status, the patient was emergently intubated. A CT scan of his head to assess for intracranial injuries revealed an intracranial hemorrhage that necessitated neurosurgical consultation for possible surgical management. Due to the potential of brain herniation, and the fact that neurosurgical services were unavailable at the outside hospital, the patient had an ambulance arranged for transfer to the state's only trauma center. After all communications were conducted between the two facilities and the patient was acutely stabilized, the patient was finally enroute for definitive neurosurgical care.

Today the trauma system in Rhode Island could efficiently respond to, triage, diagnose, transfer, and ultimately treat this patient. Although this could be considered a success story, a truly efficient system that facilitates both open communication and proper education would support transferring this patient to the definitive care facility without delays for imaging given the patient's depressed mental status and need for immediate neurosurgical evaluation. Given the existence of such cases, the Rhode Island trauma system continues to be an evolving entity. An understanding of its history along with an appraisal of its status can elucidate the goals of those who remain committed to providing the best possible care for those who are injured within Rhode Island.

THE EARLY DEVELOPMENT OF EMERGENCY MEDICAL SYSTEMS (EMS)

A trauma system is an integrated, organized approach to the administration of care to all levels of injured patients in a defined geographic region.¹ Hallmarks include programs that aim to reduce the incidence of injury; ease of passage through the pre-hospital, inter-hospital, and inpatient care environments; and supports to assist in patient reintroduction into society.

Before 1966, the need for such a concept was not fully appreciated on a national level. In "Accidental Death and Disability: the Neglected Diseases of Modern Society," the **National Academy of Sciences (NAS)** reported that in 1965, 52 million people were injured and 107,000 people died as a result of accidental injuries.² In addition to delineating the magnitude of the problem, this manuscript described the deficiencies in those early "trauma systems;" e.g., first aid was not universally required for ambulance attendants; funding for pre-hospital transport depended on the community and thus varied highly; there were no standards for resuscitation or means by which to compare different management strategies; and research funding for the trauma epidemic was incongruent with the severity of the problem.² Subsequently, the National Traffic and Motor Vehicle Safety Act (1966), the Highway Safety Act (1966), and the EMS Systems Act (1973) were passed to address the short-comings of limited trauma care. From them, both national and state agencies became empowered to build more effective emergency systems.

One of the most fundamental components in the administration of emergent trauma care is that of the **emergency medical technician (EMT)**. In Rhode Island, the first EMT training program was established in 1974, using funds from the EMS Systems Act passed the previous year.³ The curriculum published in 1971 by the US Department of Transportation recommended 25 lessons involving 71 hours of classroom training with 10 hours of in hospital training.⁴ The classroom-based subjects covered airway management, management of cardiac arrest and shock, bandaging and splinting, automobile extrication, and lifting and moving patients. Didactic sessions followed by testing stations allowed for demonstration of each particular skill set. The in-hospital training program allowed participants to apply lessons learned in the classroom to the patient care environment. Those who passed the course received the designation of EMT-A and met the basic requirements for transporting the sick and injured.

Since then, numerous technological advances and evidence-based practices have been developed in the pre-hospital care arena; e.g., updated approaches to cardiopulmonary resuscitation and advanced cardiac life support; more compact monitoring/defibrillating devices; and various airway adjuncts to assist in patency. Despite the ongoing importance of training EMTs the basic principles of safe patient care and transport, it became apparent that more specialized training was necessary. Designations including EMT-Cardiac and EMT-Paramedic have been recognized and serve in Rhode Island. They administer more advanced skills including cardiac arrhythmia recognition, pharmacologic treatment, and intravenous therapy to those who may require them in the field. In addition, more complex dispatch networks now ensure efficient transport to health care facilities around the state.

THE STATION NIGHTCLUB FIRE: LESSONS LEARNED IN A MASS CASUALTY DISASTER

On February 20, 2003, one of the deadliest fires in US history took place at the Station Nightclub in West Warwick, Rhode Island: 96 people died at the scene, and 215 people were injured.⁵ After the establishment of a field triage site and activation of the state and hospital-based disaster plans, the injured patients were transported to hospitals in and around the state. With Rhode Island Hospital the state's only level one trauma center, the multiple drills that were run to educate and coordinate the response to a mass casualty incident were suddenly put to the test.

In two published reviews of the incident, the state's response to this tragedy was critically evaluated.^{5,6} Several positive components of the response were discovered in addition to actions that could be improved upon. Among the positive, the triage scene was described as "orderly" and abundant transporting agencies were available to facilitate the exodus of patients.⁵ At Rhode Island Hospital, shift change at the time of the incident produced plenty of dedicated

staff to care for the numerous patients. The structure of the response, with emergency medicine and trauma surgery working together in the emergency department, allowed for efficient triage and administration of care.⁵ In terms of physical plant, the emergency department, patient care floors, and operating rooms were transformed to accommodate the various degrees of injured patients that influxed suddenly into the system. Rhode Island Hospital succeeded in achieving a 0% mortality among the 64 patients evaluated.⁶

Despite the numerous achievements, a few systems-based shortcomings became obvious. As discovered in the 9/11 disaster, communication could have been improved. Specifically, EMS crews had limited guidelines or oversight directing the regional transport of their respective patients. As a result, matching the degrees of injury with the regional resources that could best accommodate them did not happen as efficiently as it could have.⁵ Additionally, the inter-hospital communications both inside and outside the state regarding bed and resource allocation was limited and thus resulted in facility and patient mismatches and possibly unnecessary, prolonged transport times.^{5,6} Finally, the intra-hospital movement of patients around the facility challenged the system at RIH.⁵ Although it may seem minor, moving patients in and around care areas that may not possess such fundamental items as oxygen and suction becomes extremely cumbersome when faced with a large patient surge.

Like any tragic event, the successes and difficulties have taught lessons that reinforced the importance of preparedness, coordination, and communication among members who have dedicated their careers to providing emergency care. By critically evaluating such experiences, new plans and protocols were and can be developed to improve the efficiency of the Rhode Island trauma system.

TODAY'S TRAUMA SYSTEM: THE CONFLUENCE OF YESTERDAY'S TEACHINGS

Traumatic injury continues to be one of the leading causes of morbidity and mortality in Rhode Island. Based on hospital discharges between 1998 and 2002, approximately 24,254 people were discharged from Rhode Island's hospitals

with the diagnosis of injury.⁷ When analyzing subgroups, Rhode Island hospitals admitted 14,220 patients following a motor vehicle associated injury between 1991 and 2002,⁸ 706 suicide attempts a year were evaluated between 1989 and 1998,⁹ and 28,678 falls in those older than 60 years of age presented between 1991 and 2001.¹⁰ In order to effectively respond to such statistics, more than 79 ambulance companies now service the regions throughout Rhode Island. At Rhode Island Hospital alone, our trauma team activations for the past year totaled 5,796. Every patient received a trauma team consultation which included a trauma history and physical exam, laboratory and imaging studies, and any interventions as indicated. As a result of such volume, a dedicated trauma/critical care team including attendings, residents, nurses, technicians and innumerable support staff comprise the "Trauma Service" and are available 24 hours a day for both in-hospital management and inter-hospital consultation/transfer.

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Outside of the hospital, new technology and committees have been developed to improve communication between parties involved in providing trauma care. To address the ongoing issue of hospital capacity on a day to day basis, Rhode Island has developed computer-based capacity boards which alert both EMS and the individual facilities as to whether each hospital is accepting or diverting patients. This is updated by the state's Department of Health throughout the day. From an administrative standpoint, the Emergency Medical Services Advisory Committee (EMSAC) is an advisory council for chiefs of EMS from all serving populations to have an open discussion on how to improve relationships, and foster improved care. Members represent trauma, the emergency department, and disaster management. In terms of pre-hospital care, the EMS operations commit-

tee is a multidisciplinary group that discusses issues currently faced by the hospital and EMS communities. Finally, the LIFE-GUARD response team was established after 9/11 to efficiently transfer critically ill patients between facilities or from scenes. When activated, the transfer vehicle is staffed by an emergency medicine physician and two paramedics who are capable of delivering the highest level of emergency care at the initial patient encounter. In summary, there are more opportunities today that promote follow-up, ongoing communication, and efficient administration of patient care than ever before.

Another component of today's trauma system includes educational programs. To enhance the education of pre-hospital care providers, "Rescue Rounds" are monthly didactic sessions that cover such topics as airway management and current treatment modalities. These are open to all members of the EMS community and are typically led by members of the Trauma Surgery service. In addition to these less formal sessions, Advanced Trauma Life Support® is offered several times throughout the year to trauma care providers. This curriculum, developed by the American College of Surgeons, teaches the principles for emergent triage, evaluation, and management of trauma. Other courses, including EMT certification classes, lifeguarding courses, and cardiopulmonary resuscitation (CPR) can be found via the internet

CHALLENGES AND FUTURE DIRECTIONS

Despite the existence of pre-hospital, inpatient, and post-hospital care components in various capacities around the state, a truly established "Trauma system" with definitive regionalization of care has yet to be fully agreed upon. In a review of one aspect of regionalized care, Harrington et al. evaluated inter-facility transfers for the period of 2001-2003.¹¹ Their report described average transfer times to the definitive level one trauma center that averaged 160 minutes. Interestingly, these prolonged times were observed in those patients who were severely injured (Injury severity score < or = 40) and thus could benefit the most from the resources a level one trauma center could provide. As evidenced by our initial case report, delays in transfer included the per-

formance of unnecessary imaging directed by the primary facility when resources were not immediately available to manage the findings. Other reasons for delays included inefficiently performed indicated procedures and/or the performance of unnecessary procedures. Despite such interventions, 6% of patients arrived hypotensive and up to 10% of the patients required various immediate interventions. Although several questions arose as to why delays existed and why certain procedures were being done at the outside facilities, the absence of the requirement of ATLS training among emergency medical physicians was hypothesized to contribute to the underlying lack of appreciation of quick triage in the multiply injured patient.¹¹ To help remedy these situations, the Rhode Island Department of Health developed early interagency transfer guidelines to aid in recognizing injury patterns that would benefit from early transfer to a level one trauma center. Additionally, direction for when to request communication between transferring and receiving facilities has been established to ensure optimal safety in the patient transfer process. With the adoption of these criteria, repeat study of transfer times and outcomes is warranted.

Although transfer times between facilities are one endpoint worthy of evaluation, others need to be addressed. Given that Rhode Island is a state that is small enough to allow for efficient transport times of those most critically injured to the level one trauma center, the Rhode Island Department of Health increased the catchment area for Rhode Island Hospital to a 30 mile radius. This was done to encour-

age EMS providers to transport all levels of injury to the facility that has the broadest resources available. What has yet to be developed given the possibility of longer transport times are the regional response algorithms that dictate what agency will be backing up individual rescues when a specific rescue travels outside a coverage area. Such a plan needs to be developed to ensure true efficiency of response to all regions. In terms of patient care, another limitation continues to be resource allocation for those who are recovering and rehabilitating from various accidents. In one example, neurologic related trauma (i.e. head and spine injuries) account for several trauma admissions to our level one trauma center every year. Following the patient's acute management and in-hospital rehabilitation, if the need for long term care becomes necessary, resources remain limited. Due to this void, in-hospital costs can be increased as a result of prolonged hospitalizations in acute care facilities. By building a larger network of rehabilitation services, this patient population, and others, can potentially be better served.

SUMMARY

The Rhode Island Trauma System today has been shown to demonstrate several positive attributes in the delivery of patient care; however, ongoing efforts need to continue in the realms of field and inter-facility communication, efficiency in inter-hospital transfer, and rehabilitation services. Through ongoing dialogue and the fundamental desire to improve, it remains our goal to provide patients the best care possible during one of the most stressful times of their lives.



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Shea C. Gregg, MD, is Assistant Professor of Surgery, The Warren Alpert Medical School of Brown University.

David T. Harrington, MD, FACS, is Director, Rhode Island Burn Center, and Associate Professor of Surgery, The Warren Alpert Medical School of Brown University.

Charles A. Adams, Jr, MD, is Assistant Professor of Surgery, The Warren Alpert Medical School of Brown University, and Chief, Division of Trauma & Surgical Critical Care, Rhode Island Hospital.

Disclosure of Financial Interests

The authors have no financial interests to disclose.

CORRESPONDENCE

Shea C. Gregg, MD
Rhode Island Hospital
593 Eddy Street, APC 435
Providence, RI 02903
Phone: 401-444-0369
e-mail: sgregg@lifespan.org