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The impact of trauma systems on patient outcomes

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In Brief

Trauma is the leading cause of death for those aged 46 years and younger in the United States. The recognition of traumatic injuries as a pressing public health epidemic has led to the birth and expansion of trauma systems. The modern US trauma system has evolved over the course of a century. From its origins in military conflicts over a century ago – where the injured were triaged through tiered echelons of increasingly capable treatment – a comprehensive trauma system now encompasses clinical care for the injured, injury prevention, education, advocacy, data collection, research, and disaster preparedness and response.

The publication of "Accidental Death and Disability: The Neglected Disease of Modern Society" in 1966 first highlighted the burden of injury and the need for a structured civilian trauma system. A national effort to reduce motor vehicle-related injuries via vehicle standards and driver safety education followed — a first success case in nationally reducing injury rates. At the same time, from the Cook County Hospital in Chicago to the University of Maryland Hospital and the University of Louisville Hospital, early trauma units emerged. In 1973, a federal grant helped early local leaders in trauma care integrate into the first emergency medical services (EMS) systems. Coordinated care of the injured began.

The American College of Surgeons Committee on Trauma (ACS COT) has been integral in leading US trauma system development. Mirroring tiered echelons of increasing treatment capacity conceptualized by the military, ACS COT verifies trauma centers ranging from level IV/V (centers limited to initial evaluation/stabilization) to level I (tertiary center with 24-hour capability for definitive trauma care). ACS COT spearheads trauma education programs for surgical trainees, quality improvement through data collection and benchmarking, and advocates for federal legislation related to injury prevention.

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Trauma systems have impacted care for the injured patient at all stages, from injury prevention to disaster preparedness. The Centers for Disease Control and Prevention has funded urban development projects to reduce gun violence long-term and was integral in building a national concussion surveillance system. With support of the White House, ACS has launched STOP THE BLEED, a public awareness campaign to save bleeding patients using on-field tourniquets; more than a million people around the world have undergone training. Research to optimize EMS systems (eg, comparing "scoop and run" and extensive prehospital care) and triage (ie, balancing delivery of cost-effective and appropriate level of care) continue.

Most US trauma systems are organized as regionalized trauma networks (RTN), a single entity comprised of acute care hospitals within a region working to reduce the burden of traumatic disease. Inclusion of many hospitals to partake in trauma patient care to the extent of their capabilities– an inclusive RTN – has been associated with decreased mortality rates compared to a system wherein trauma patient care is limited to several highly specialized centers (an exclusive RTN). Inclusive RTNs have shown to especially benefit rural trauma patients who face geographic and resource barriers to timely high-quality trauma care. Incorporating existing rural hospitals within trauma systems as level III or IV trauma centers have helped formalize transfer protocols and facilitate specialty consultation.

Beyond optimizing clinical care, trauma systems coordinate research and quality improvement. All ACS COT-verified trauma centers participate in the National Trauma Data Bank and the Trauma Quality Improvement Program (TQIP). National Trauma Data Bank helps highlight broad issues and trends characterizing the current state of care for injured persons, and is the primary source for outcomes research on US trauma patients. TQIP allows individual trauma centers to receive feedback on their performance against risk-adjusted national benchmarks for specific injury outcomes. Many institutions utilize TQIP to inform practical improvements ranging from curbing venous thromboembolism rates to accurately assessing trauma readmission rates. Assessing the impact of injury beyond hospitalization remains a challenge, as a national effort to track long-term trauma outcomes is lacking.

Trauma systems are at the vanguard of disaster preparedness. Responses to prior mass casualty events have helped some trauma systems prepare for future disasters with pre-determined command structures and triage plans to ensure patients can be managed without overwhelming any individual trauma center. The true preparedness of most trauma systems within the United States is unclear. Simulations have shown outcomes disparity based on geography; those living in cities with higher concentration of trauma centers are expected to have lower mortality rates and not all trauma systems appear adequately prepared to handle mass casualty events. The ongoing Coronavirus Disease 2019 pandemic has highlighted the importance of disaster preparedness. Building on the infrastructure and coordination already thriving in established trauma networks, the ACS has provided a framework for establishing regionalized medical operation centers to help the US healthcare system coordinate care amidst one of greatest system-wide challenges in recent decades.

The burden of injury is global. Outside of the United States, trauma systems vary in maturity. The World Health Organization has published a how-to guide for national quality improvement in trauma care, yet a minority of mid-to-low income countries have implemented these guidelines. Even high income countries have yet to establish comprehensive trauma systems, with many lacking national trauma registries. Despite the work-in-progress, the impact of a trauma system on improved patient outcomes has been replicated internationally. Dedicated trauma teams, formalized triage protocols, and EMS systems have consistently shown to decrease mortality among injured patients.

This monograph details the burden of trauma, the origins of the US trauma system, and explores the components of a comprehensive trauma system. We assess how our trauma systems have impacted the delivery of cost-effective and high-quality care of the injured patient, and offer a brief perspective on trauma systems around the globe today. We hope readers will gain better understanding of the critical role of trauma systems in addressing the ongoing public health epidemic that is injury.