



**White Paper on Guidelines for the development of
International Trauma Systems**

IFEM Trauma Special Interest Group



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On behalf of the IFEM Trauma Special Interest Group and a special thanks to those members of the Special Interest Group who contributed to this paper

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1. Executive Summary

This White Paper has been produced by the International Federation of Emergency Medicine (IFEM) Trauma Special Interest Group (SIG) in order to provide a framework for the assessment and development of Trauma systems. This paper is based on best current international evidence which shows that well developed Trauma Systems improve patient outcomes. The paper provides a framework for clinical staff, who provide care for seriously injured patients, to assess their own Trauma Systems and inform further development as appropriate. The main goal of this paper is to provide a mechanism for improvement in Trauma System development based on current needs and resources.

Injury is a major cause of death and disability worldwide and many of these deaths and injuries occur in low and middle income countries. Most deaths and injuries are preventable, but they also require a well developed system of injury prevention as well as the provision of appropriate and timely care and access to rehabilitation services so that these people can get back to a normal economic and social life.

Trauma Systems require a well developed Emergency Care System but there are many other points of care and areas of support required for the provision of the safe care for seriously injured patients across the globe.

The development of appropriate Trauma Systems depends on both fundamental clinical and infrastructure components and IFEM member nations are encouraged to use this paper in order to influence local stakeholders and decision makers.

The main text describes a framework for developing a system of major trauma care based on available resources and what can be done in order to improve services for all injured patients.

The appendices provide details and definitions around that framework.

2. Background

According to the latest Global Burden of Disease (GBD) study published in 2015¹, injuries caused 10% of the global burden of disease in 2013. More than 9 people die every minute from injury or violence and 5.8 million people from all ages and socio-economic groups die of injuries (both intentional and unintentional) each year.

Road traffic crashes (RTCs) contributed 29% of the injury related deaths followed by self-harm and falls at 17.6% and 11.6% respectively.

According to the WHO Global Status on Road Safety Report 2015², which provided an update on the progress of the WHO “Decade of Action for Road Safety 2011-2020”, the number of road deaths has plateaued at 1.25 million per year.

Road fatalities are the leading cause of death in the 15-29 year age group and cost governments between 2-5 % of GDP in direct and indirect costs. While serious injuries as a result of RTC's are more difficult to quantify, they are estimated to range from 10-30 times the frequency of traffic fatalities. WHO has estimated that up to 50 million people are injured each year in RTC's, which

results in significant cost in both the provision of medical care as well as loss of income earning potential.

Moreover, 90% of the deaths and injuries due to RTCs occur in the low- and middle-income countries (LMICs) where both injury prevention strategies and the ability to deliver high quality healthcare are variable.

3. The role of the International Federation for Emergency Medicine (IFEM)

IFEM is well placed to contribute to a reduction in the burden of injury worldwide. While Acute Care and Trauma surgery are important in the delivery of trauma care, the delivery of both acute care as well as both elective and trauma surgical services is variable at best in many LMICs, whereas most countries have Emergency Medicine (EM) services available with different level of development and maturation. Hence IFEM is well placed to contribute to the development and maturation of Trauma care services particularly in LMICs. The best way to further develop trauma care is by assisting with the development of inclusive Systems of Trauma Care where all components, including emergency medicine and surgical services, contribute towards improvements in particular countries or regions depending on the needs and resources.

This paper will propose a way forward for IFEM to offer countries and regions opportunities to improve the care of acutely injured patients using the unique insights and expertise of Emergency Medicine in conjunction with other stakeholders.

4. The role of IFEM member nations

Member nations can support improvement in their countries' trauma system by encouraging Governments and other funding bodies to invest in injury prevention strategies as well as the provision of timely and appropriate acute trauma resuscitation and access to appropriate surgical and critical care services.

5. The role of individual hospitals and their clinical teams

At a hospital level, improvement in emergency trauma care can be achieved by developing a well resourced emergency care system which is capable of rapid assessment, resuscitation and timely investigations, and then timely transfer of care to surgical and other acute inpatient units.

Finally, hospitals and funding bodies must invest in the provision of appropriate rehabilitation services so that injured patients are able to return to their pre-injury functional ability.

6. Trauma systems explained

The US Trauma System Agenda for the Future⁴ has identified key issues in addressing 4 fundamental components of the Trauma system and 8 key infrastructure elements that are critical for a functional trauma system.

4 Fundamental components of a Trauma System are:

- Injury prevention
- Prehospital care
- Acute Care Facilities
- Post-hospital care

8 Key infrastructure elements of a Trauma System are:

- Leadership (local, regional and government)
- Professional resources
- Education and advocacy
- Information management
- Finances
- Research
- Technology
- Disaster preparedness and response

7. Recommendations of the White Paper

- 7.1** A mature (Level 1) Trauma system should have all of the following essential and support structures in place:
- 7.1.1 Governance and funding support for Trauma Care provided as a priority at the highest level of Government and International Health Organisations.
 - 7.1.2 Identification of and support given for the next generation of Trauma leaders, identified nationally and internationally.
 - 7.1.3 Recognition of Trauma as a disease process which can be studied and managed by evidence-based principles, and increasingly with application of novel and advanced technology.
 - 7.1.4 Excellent and secure digitalised national and state Trauma Registry Data used to guide injury prevention strategies, policy, research and resource allocation.
 - 7.1.5 Highest standard of EMS Providers with excellent, communication, diagnostic and resuscitative skills and provide rapid access to appropriate definitive care.
 - 7.1.6 Acute Care Hospitals: provide a full range of high level services across all disciplines including Emergency Medicine, Pathology and Blood Bank, Radiology, Trauma Surgery and appropriate Surgical subspecialty support, Intensive Care Services, acute Trauma Wards with appropriately trained nursing and allied health staff and access to appropriate rehabilitation services for physical and psychological recovery from Injury.

- 7.1.7 Rehabilitation services including traumatic brain injury and other non-neurological injuries.
- 7.1.8 Provision of Trauma education and training for the next generation Trauma clinicians.
- 7.1.9 Trauma research is a high priority and should be supported by Government.
- 7.1.10 Support for high quality ED Trauma Management Quality Improvement programs locally and via international network.

7.2 Next tier Trauma systems (Level 2-4)

- 7.2.1. Government aware of need for funding and support for a definitive Trauma System but variable provision of necessary staff resources and infrastructure.
- 7.2.2. Trauma data registry of variable quality depending on resources available.
- 7.2.3. Injury prevention program will be informed by the trauma registry data and will be a Government initiative with support from the local Trauma clinicians.
- 7.2.4. EMS providers will vary from minimal or no care at scene to basic and advanced life support skills.
- 7.2.5. Acute care hospitals will provide a variable level of care depending on staffing and infrastructure in all areas- Emergency Department, Pathology and Radiology services, Acute surgical services, intensive care (critical care services), Trauma ward beds, allied health and access to Rehabilitation services.
- 7.2.6. Emergency Department staff will vary from untrained junior doctors, career medical officers and Emergency Specialists who have been part of a recognised EM Specialty Program
 - 7.2.6.1. Emergency nursing staff will vary in training and experience.
 - 7.2.6.2. Pathology services include basic haematology, biochemical and blood bank services.
 - 7.2.6.3. Radiology services will include access to plain radiology, ultrasound, CT and MRI scanners.
 - 7.2.6.4. Acute Trauma surgery will vary from general surgeons who provide all initial care and then transfer to a definitive surgical subspecialty to the full range of Trauma related subspecialties (gastrointestinal, cardiothoracic, orthopaedic, vascular, plastic and burns surgery).
 - 7.2.6.5. Intensive care units will vary from permanent Consultant-led Departments with appropriately trained junior medical and nursing staff to ‘high dependency’ units with non-speciality trained medical and nursing staff. The highest level of ICU will provide a wide range of services including ventilation, haemodynamic support and monitoring, renal replacement therapy, brain injury monitoring and palliative care services.
 - 7.2.6.6. Allied health staff will include physiotherapy, occupational therapy, speech pathology, psychology and social work.

- 7.2.6.7. Rehabilitation services will vary from general to specialised orthopaedic, brain and spinal injury services.
- 7.2.6.8. Trauma education and training services will vary according to available resources.
- 7.2.6.9. Trauma research output will also vary with experience of senior staff and resources which will enable this activity.
- 7.2.6.10. A functional Trauma Quality Improvement program will depend on an accurate and adequate trauma registry data, availability of an appropriately senior trauma clinician to drive the process and adequate support by the hospital administration and other clinical services involved in trauma care

8. Appendices

Appendix 1

Definitions

Trauma is defined as the result of a physical force applied to a human body, which results in both physiological and anatomical derangement, which is temporary or permanent and can result in severe disability or death.

Trauma is a disease with identifiable causes, established and agreed methods of treatment and accepted methods of prevention.

A **Trauma System** is an organized and coordinated initiative in a defined geographic area that delivers the full range of care to all injured patients and is integrated within the local public health system, which provides optimal care for the acutely injured population. A trauma system must also have injury prevention and post-injury care strategies closely embedded within the overall system.

Problem: Internationally, trauma systems are not universal and vary by region and country, depending on the, experience and training of trauma clinicians, resources available, geographic remoteness, and cultural traditions.

Solution: Simple, clear, and organized guidelines applicable to facilities worldwide are essential to provide optimal care for injuries that would otherwise lead to morbidity and mortality without proper care.

We define **Level 1** facilities such as tertiary care hospitals with multiple specialties in High Income Countries" (HIC).

Level 2 facilities are staffed by general practitioners or generalist hospital doctors and some specialists. Often these are located in Middle Income Countries (MIC) with one or two major hospitals.

Level 3 facilities are basic clinics such as those in Low Income Countries (LIC) with variable standards in healthcare systems. Trauma system guidelines could benefit all countries' ability to care for victims of trauma by creating standards for an internationally inclusive system, which would enhance the capabilities of all level facilities. Emergency medicine, critical care and surgical capabilities play a fundamental key role in an advanced trauma system which requires hospitals to commit resources across all departments involved in the care of injured patients and, in particular, the commitment of surgical resources towards the care of these patients^{1,3}.

Level 4 facilities are located in isolated or rural settings and are able to provide initial resuscitation, stabilisation and transfer of injured patients to a higher level of care.

Our goal is to promote guidelines applicable to various levels of facilities worldwide to maximize trauma treatment capabilities while using available resources efficiently.

US Trauma Care Centre Classification⁵

Level I Trauma Facilities

A Level I Trauma Centre is a comprehensive regional resource which is a tertiary care facility central to the trauma system. A Level I Trauma Centre is capable of providing total care for every aspect of injury – from prevention through rehabilitation. These centres generally serve large cities or population-dense areas. Elements of Level I Trauma Centres include:

- 24-h in-house coverage by general surgeons, and prompt availability of care in specialties such as orthopaedic surgery, vascular surgery, neurosurgery, anaesthesiology, emergency medicine, interventional radiology, internal medicine, plastic surgery, oral and maxillofacial, paediatric and critical care.
- Referral resource for communities in nearby regions.
- Provides leadership in prevention, public education to surrounding communities.
- Provides continuing education of the trauma team members.
- Incorporates a comprehensive quality assessment program.
- Operates an organized teaching and research effort to help direct new innovations in trauma care.
- Program for substance abuse screening and patient intervention.
- Meets minimum requirement for annual volume of severely injured patients.
- Provides leadership in mass casualty response and disaster preparedness

Level II Trauma Facilities

A Level II Trauma Centre is able to initiate definitive care for all injured patients. These centers either supplement the clinical activity of a nearby Level I centre or serve as the lead trauma facility in less population-dense regions.

Level II Trauma Centre include:

- 24-h immediate coverage by general surgeons, as well as coverage by the specialties of orthopaedic surgery, neurosurgery, anesthesiology, emergency medicine, radiology and critical care.
- Established links with Level 1 facilities to enable rapid transfer of appropriate patients.
- Tertiary care needs such as cardiac surgery, hemodialysis and microvascular surgery may be referred to a Level I Trauma Centre.
- Provides local injury prevention and continuing education programs for staff.
- Incorporates a comprehensive quality assessment program.

Level III Trauma Facilities

A Level III Trauma Centre has demonstrated an ability to provide prompt assessment, resuscitation, surgery, intensive care and stabilization of injured patients and emergency operations. These centres frequently treat patients who may require transfer to a higher level of care.

Elements of a Level III Trauma Centre include:

- 24-h immediate coverage by emergency medicine physicians and the prompt availability of general surgeons and anesthesiologists.

- Incorporates a comprehensive quality assessment program
- Has developed transfer agreements for patients requiring more comprehensive care at a Level I or Level II Trauma Center.
- Provides back-up care for rural and community hospitals.
- Offers continued education of the nursing and allied health personnel or the trauma team.
- Involved with injury prevention efforts and must have an active outreach program for its referring communities.

Level IV Trauma Facilities

A Level IV Trauma Center has demonstrated an ability to provide advanced trauma life support (ATLS) prior to transfer of patients to a higher level trauma center. It provides evaluation, stabilization, and diagnostic capabilities for injured patients. These are usually located in rural areas and provide supplemental care.

Elements of Level IV Trauma Centers include:

- Basic emergency department facilities to implement ATLS protocols and 24-h laboratory coverage. Available trauma nurse(s) and physicians available upon patient arrival.
- May provide some basic surgery and critical-care services if available.
- Has developed transfer agreements for patients requiring more comprehensive care at a Level I or Level II Trauma Center.
- Incorporates a comprehensive quality assessment program
- Involved with injury prevention efforts and must have an active outreach program for its referring communities.

Fundamental Components of Trauma Care

A. Injury Prevention

- Each State will have a core injury prevention program that provides assistance to local areas, with information and materials coordinated via a central repository or clearinghouse.
- Trauma registry data will help with problem identification and program evaluation and will be fully coordinated with the EMS and public health systems.
- A comprehensive study of the epidemiology of injuries and trauma will be conducted and predictive models regarding injury occurrence will be developed.
- Injury prevention legislation will be enacted, where compelling evidence exists.
- Injury prevention efforts will be conducted on a collaborative basis, with input from and the involvement of multiple stakeholders and constituency groups.
- Injury prevention will be recognized as a legitimate public and governmental activity, similar to other safety programs such as fire prevention. Proper funding will be secured for injury prevention, with a greater portion of public health dollars allocated for injury prevention.
- Injury prevention efforts will be seen as a legitimate health care cost that is directly reimbursable to providers.
- Injury prevention programs, and their availability to the general public, will be required by lead agencies who designate all levels of trauma centers and by the public health systems.
- Injury prevention will be integrated into existing health delivery systems, such as pediatric and rural health clinics, and prevention materials will be readily available at places where families usually receive care.

B. Prehospital Care

- EMS and first responders will be more integrated within the health care system, with links to prevention and acute care, and will be more focused on promoting overall community health, as described more fully in the EMS Agenda for the Future.
- Trauma care will be coordinated and integrated using standard protocols and triage. Triage criteria will be redesigned to ensure more accurate assessment, which facilitates direction and placement of patients to the most appropriate care setting.
- Transport vehicles (air and ground) will be strategically placed rather than facility based and will be used appropriately to facilitate rapid access and response, especially in areas that are least accessible.
- A national 911 system, covering both wireless and wireline telephone systems, will be developed and implemented, with standard, seamless protocols that are evidence-based and that address bystander interface. Access to prehospital trauma care in rural areas will be greatly enhanced through development of consistent standards and more efficient deployment of limited resources.

- Enhanced communications among all components of the trauma care team during the pre-hospital phase will speed deployment of resources, produce more appropriate triaging, and result in better patient outcomes.

C. Acute Care Facilities

- There will be a distributed system of acute care facilities and trauma care systems will be implemented across the country.
- Research will be conducted to determine the effectiveness of the current tiered resource allocation guidelines.
- The appropriate volume of patients with specific injuries that are needed at the highest echelon of care will be studied and clearly identified so that research and treatment options can be continually explored.
- Trauma systems will be linked on a regional basis through databases and technology to ensure efficient and effective patient care nationwide.
- There will be consistent standards for rural and urban trauma services, with the goal of every community having access to a consistent level of trauma care.
- All injury care providers within a community will be recognized as part of the system and will provide data to a system-wide database, and injury care will be monitored throughout the system.
- Most facilities, whether small community hospitals or large tertiary care centers, will have a designated role to play in the trauma system and the capacity to manage injured patients to one degree or another.
- Facilities in the system will have multi-casualty capabilities.
- The appropriate match of resources will be identified for injured patients with special needs, such as elderly, remote rural, or pediatric patients.
- Innovative treatment methods will be explored, including utilization of mobile trauma units for rural areas.

D. Post-Hospital Care

- Long-term care coverage will be available, affordable, and encouraged to help address post-hospital care needs.
- Post-hospital care will focus on helping patients achieve greater independence, a higher degree of functionality, and a faster return to productivity.
- Functional recovery will go beyond traditional rehabilitation and include psychological support.
- Home-based care and monitoring will be used to manage costs and speed recovery, especially in areas lacking access to care.
- Appropriate support groups will be established and encouraged.
- Trauma Registry data will include post-hospital care and rehabilitation so that the value and cost-effectiveness of the full cycle of trauma care can be more readily assessed.

- Research concerning the effectiveness of post hospital care will be supported.

E. Comprehensive Trauma Care System: Key Infrastructure Elements Leadership

- A National Trauma System Leadership Council will be developed to advocate for system development in a facilitative manner, serve as the locus for policy development and support, and coordinate the work of federal agencies and professional organizations with injury-related programs.
- All states will establish a Lead Agency to coordinate and administer trauma system development.
- A best practices study will be conducted to identify the optimal components and configuration for local and state lead agencies.
- The effectiveness of trauma system elements will be continually examined.
- State legislators and governors will be informed about the need for an identified and adequately funded lead agency for trauma systems in their region.

F. Professional Resources

- Professional resources in the system will be patient focused, team-oriented and physician led.
- New categories of providers and the use of physician extenders will address the need for additional resources.
- Creative opportunities for recruitment and retention of personnel will be explored.
- Reimbursement for all types of providers will be appropriate and sufficient so as to encourage participation in trauma care.
- Incentives for attracting trauma specialization, including addressing the burden of liability, will be explored.
- Ongoing professional education opportunities will be available and accessible.
- Volunteers will supplement career resources and will be enlisted to promote injury prevention as well as deliver care.

G. Education and Advocacy

- A compelling educational campaign will be launched to position trauma and injury as a disease rather than a random occurrence and to increase public awareness of the need for injury prevention and the value of trauma care.
- Targeted educational programs will be developed to inform policy makers about the value of community-based trauma care in order to promote passage of legislation to support trauma system activities, including injury prevention.
- Trauma care providers and advocates will form or integrate into coalitions with trade associations, large corporations and payers to conduct public education programs about injury and injury prevention and to advocate for legislation to support injury prevention and trauma system activities.
- Health insurers will have a clear appreciation of the cost effectiveness of injury prevention and will provide incentives for safe behavior.

- Communication, education, and training approaches for the public and key constituency groups will be thoroughly coordinated yet distinctly segmented and targeted to achieve maximum impact.
- The number of injuries and trauma cases will be reduced through education and training of clinicians, management and administrative personnel, volunteers, community support groups, potential "bystanders," and other key constituency groups.
- Trauma and injury prevention education and training will be increased for all healthcare professionals, beginning at post-graduate levels and continuing throughout their careers, appropriate to the level of their involvement in health risk assessment, primary care, or injury care.
- Advocacy efforts will facilitate passage of new laws designed to reduce injuries and trauma cases (based on evidence) and stronger enforcement of existing laws.
- Tort reform will be enacted to facilitate greater access to trauma services and facilities.
- There will increased awareness of the vulnerability of the older population.

H. Information Management

- A national database and uniform data standards will be used to facilitate hospital operations and provide regional and national information regarding availability of post-hospital care.
- Trauma care will be designated as a specific research area for epidemiological study. Predictive models will be developed regarding outcomes and will be used in making funding and resource deployment decisions.
- Pre-hospital and functional outcomes will be tracked and used in a Total Quality Management initiative to improve policies, procedures, and processes throughout the trauma continuum.
- Information related to the complete cycle of trauma-from prevention to post-hospital care-will be collected, analyzed, and made available to facilitate improvements in injury prevention, response times, patient care, and rehabilitation.
- Information systems should be usable for multi-center studies.
- A standardized training course will be used to enable trauma registers to collect and categorize data in a consistent, comparable manner.
- Clear evidence will exist to document the contribution of an injury management system (prevention and treatment) to a community's overall health, and additional research will demonstrate which components of a trauma system provide the most value.
- Tools will be developed and region-specific injury data will be available to assist communities in making decisions about their specific needs related to trauma system development, particularly which components will best meet community health needs.
- The culture of quality improvement will shift from using data to blame individuals to using the data to improve performance of the system.
- Access to and appropriate protection of patient records and quality improvement data will be addressed through legislative and regulatory changes at state and federal levels.

- Efforts to enhance patient confidentiality should be balanced with the need for strong research.

I. Finances

- Trauma systems will be recognized as a public good and therefore valued and adequately funded not only for the clinical care they actually deliver, but also for the level of readiness required to meet the needs of all injured persons.
- The appropriate level of readiness in a community will be determined by a broad-based group of community members, including citizens, local employers, trauma and health care providers, and payers.
- There will be a "rural modifier" to the fee schedule for rural EMS providers.
- There will be dedicated funding for trauma system infrastructure costs.
- An open dialogue with managed care organizations, public and private, and other payers will facilitate greater mutual understanding of the costs of providing health care, ultimately leading to equitable payment mechanisms, which may include "carve outs" or risk sharing.
- There will be ongoing dialogue and review regarding the cost-effectiveness of trauma care systems.
- A system will be created for reimbursing providers for uncompensated trauma care without cost shifting to non-governmental payers .
- The public will be encouraged to obtain long-term care coverage to augment other forms of payment for post-hospital care.
- Alternative payment mechanisms will be examined, tested, and piloted, especially in rural areas.
- Additional funding sources,should be explored.

J. Research

- Relevant Government bodies will establish a National Institute for Injury within a National Institutes of Health.
- Federal agencies involved in or funding trauma research will be coordinated through a formal institutional process.
- There will be formal efforts to interest young professionals in trauma research and there will be sponsored training programs in all types of research.
- Types of research conducted will include fundamental basic research, crash investigation research, evidence-based medicine, best practices, clinical trials, clinical guidelines, and health services and systems research.

K. Technology

- Automotive telematics systems and GPS in motor vehicles will be used to locate crashes, monitor vital signs, and determine injury severity. GPS will also provide real-time route navigation for ambulances.
- Access technologies such as ACN and wireless E9-1-1 will be fully developed.
- Various technological innovations will be used to provide services remotely.

- Monitoring devices will be used in a variety of settings, including computer chip implants to monitor patients and the use of monitoring devices in a patient's home, which would support injury prevention and rapid response.
- Computer chips will enable automatic transfer of sophisticated crash information and will permit injury research databases to be utilized to evaluate and improve auto design.
- An artificial neural network will determine the most appropriate site for patient care given the extent of a patient's injury.
- Access numbers will be consolidated to eliminate confusion and streamline access nationwide.
- Patient simulation technology will be used for provider education.
- Medical input will be sought early in the design phase of future technologies to ensure that these developments are coordinated with the health care system and result in improved patient outcome.
- Dedicated resources will be available for technology analysis.

L. Disaster Preparedness and Response - Conventional and Unconventional

- Trauma systems will be an integral part of regional and state disaster plans and will integrate with efforts of the public health system to provide disaster preparedness.
- Trauma and EMS systems will be integrated with other resources through the incident command system and will coordinate in advance with other regional resources such as law enforcement and public health.
- There will be targeted education covering all weapons of mass destruction (identification and response) for all providers.
- Hospital-based decontamination will be available in addition to more traditional field decontamination.
- A nationwide network of hospital and community surveillance systems will enable rapid identification of all major health threats, including those related to weapons of mass destruction. EMS electronic data systems will be an integral part of this surveillance system.
- Emergency communications systems will connect all levels of the response infrastructure, but will be developed with redundancy to assure backup when needed.
- The public health infrastructure will be reinforced to enable it to more effectively respond to emerging threats.
- Medical command centers will be an integral part of disaster incident command or incident management systems, to assure the most appropriate medical response.
- There will be an optimal resources document for the role of trauma systems in disaster preparation and response.

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