Section 1 Core Principles in Trauma Anesthesia

Chapter 1

Trauma Epidemiology, Mechanisms of Injury, and Prehospital Care

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Trauma Epidemiology

Trauma is defined as physical damage to the body as a result of mechanical, chemical, thermal, electrical, or other energy that exceeds the tolerance of the body. Although trauma is often thought of as a series of unavoidable accidents, in reality it is a disease with known risk factors. Like other diseases such as cancer and heart disease, trauma risk factors are modifiable and injuries can be avoided before their occurrence. There are three phases of injury:

1. Pre-injury
2. Injury
3. Post-injury

The pre-injury phase includes the events prior to trauma and is impacted by risk factors such as drug and alcohol intoxication, medical and environmental conditions, and behavioral factors. The injury phase is when energy is transferred to the victim's body through a series of mechanisms related to blunt, penetrating, crush, blast, and rotational injury. The post-injury phase commences as soon as transfer of energy is complete. Since approximately 50% of trauma deaths are catastrophic events (massive head injury, upper spinal cord, heart, and great vessel trauma) that occur within moments of the injury, the only way to avoid them is through preventive strategies. An understanding of the basic epidemiology of traumatic injury is thus imperative if we wish to decrease the burden of this disease on society.

The most effective means of reducing mortality from trauma is modification of risk factors and prevention of injuries through education, legislation, and research. Examples of preventive measures for motor vehicle trauma include:

- Legislation concerning alcohol consumption
- Proper child occupant restraint in cars
- Front and rear seat belts
- Air bags
- Speed limit controls
- Laminated windshields
- Crash resistant fuel systems
- Energy absorbing steering wheels

The problem of traumatic injury in the United States is enormous. In the United States, trauma (including unintentional injury, homicide, and suicide) was the third leading cause of death in 2014 after heart disease and malignant neoplasms for people of all ages; it was also the leading cause of death in children and in adults up to 44 years of age (see Figure 1.1).

10 Leading Causes of Death by Age Group, United States – 2

Rank	<1	1–4	5–9	10–14	15–24	25–34	35–44	45–54	55
1	Congenital Anomalies 4,746	Unintentional Injury 1,216	Unintentional Injury 730	Unintentional Injury 750	Unintentional Injury 11,836	Unintentional Injury 17,357	Unintentional Injury 16,048	Malignant Neoplasms 44,834	Ma Neo 11
2	Short Gestation 4,173	Congenital Anomalies 399	Malignant Neoplasms 436	Suicide 425	Suicide 5,079	Suicide 6,569	Malignant Neoplasms 11,267	Heart Disease 34,791	H Di 74
3	Maternal Pregnancy Comp. 1,574	Homicide 364	Congenital Anomalies 192	Malignant Neoplasms 416	Homicide 4,144	Homicide 4,159	Heart Disease 10,368	Unintentional Injury 20,610	Unint I 1
4	SIDS 1,545	Malignant Neoplasms 321	Homicide 123	Congenital Anomalies 156	Malignant Neoplasms 1,569	Malignant Neoplasms 3,624	Suicide 6,706	Suicide 8,767	Chro Res Di 16
5	Unintentional Injury 1,161	Heart Disease 149	Heart Disease 69	Homicide 156	Heart Disease 953	Heart Disease 3,341	Homicide 2,588	Liver Disease 8,627	Dia Me 13
6	Placenta Cord. Membranes 965	Influenza & Pneumonia 109	Chronic Low. Respiratory Disease 68	Heart Disease 122	Congenital Anomalies 377	Liver Disease 725	Liver Disease 2,582	Diabetes Mellitus 6,062	I Di 12
7	Bacterial Sepsis 544	Chronic Low Respiratory Disease 53	Influenza & Pneumonia 57	Chronic Low Respiratory Disease 71	Influenza & Pneumonia 199	Diabetes Mellitus 709	Diabetes Mellitus 1,999	Cerebro-vascular 5,349	Ce va 11
8	Respiratory Distress 460	Septicemia 53	Cerebro-vascular 45	Cerebro-vascular 43	Diabetes Mellitus 181	HIV 583	Cerebro-vascular 1,745	Chronic Low. Respiratory Disease 4,402	Su 7
9	Circulatory System Disease 444	Benign Neoplasms 38	Benign Neoplasms 36	Influenza & Pneumonia 41	Chronic Low Respiratory Disease 178	Cerebro-vascular 579	HIV 1,174	Influenza & Pneumonia 2,731	Sep 5
10	Neonatal Hemorrhage 441	Perinatal Period 38	Septicemia 33	Benign Neoplasms 38	Cerebro-vascular 177	Influenza & Pneumonia 549	Influenza & Pneumonia 1,125	Septicemia 2,514	Influ Pne 5

Data Source: National Vital Statistics System, National Center for Health Statistics, CDC.
Produced by: National Center for Injury Prevention and Control, CDC using WISQARS™.

Figure 1.1. Leading causes of death by age group in the United States – 2014.

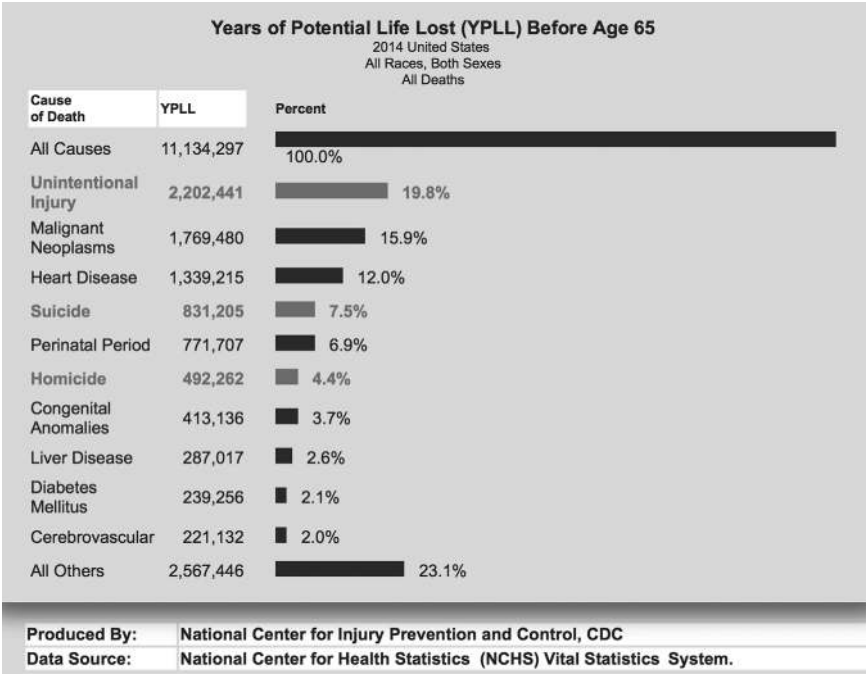

Figure 1.2. Years of potential life lost (YPLL) before age 65, United States – 2014.

In total, about one person will die every 3 minutes due to injury in the United States. As the majority of fatal injuries occur in the young, trauma is also responsible for more years of potential life lost before age 65 than any other disease, accounting for 31.7% of years lost from all causes (see Figure 1.2). The two leading causes of injury death are those due to vehicular injuries and those due to firearms, which together account for about half of fatal injuries (see Figure 1.3).

In addition to death, the problem of non-fatal injury is staggering. In 2014, a total of 26.9 million people in the United States suffered non-fatal injuries requiring medical treatment. Of those, 2.5 million required hospitalization. The economic impact is immense. In 2013, the total lifetime medical and work cost of injury and violence in the United States was $671 billion, of which $457 billion was the cost associated with non-fatal injuries. The 10 leading causes of non-fatal injuries stratified by age in the United States in 2013 are listed in Figure 1.4. In almost every age group, the leading cause of non-fatal trauma admissions is falls.

The costs to society are tremendous and include:

- Emergency medical services (EMS)
- In-hospital medical care
- Rehabilitation
- Wage and productivity loss
- Damage to property and goods
- Costs to employers, such as having to train and hire new workers
- Administrative costs

10 Leading Causes of Injury Deaths by Age Group Highlig
Unintentional Injury Deaths, United States – 2014

Rank	<1	1–4	5–9	10–14	15–24	25–34	35–44	45–54	
1	Unintentional Suffocation 991	Unintentional Drowning 388	Unintentional MV Traffic 345	Unintentional MV Traffic 384	Unintentional MV Traffic 6,531	Unintentional Poisoning 9,334	Unintentional Poisoning 9,116	Unintentional Poisoning 11,009	U
2	Homicide Unspecified 119	Unintentional MV Traffic 293	Unintentional Drowning 125	Suicide Suffocation 225	Homicide Firearm 3,587	Unintentional MV Traffic 5,856	Unintentional MV Traffic 4,308	Unintentional MV Traffic 5,024	U
3	Homicide Other Spec., Classifiable 83	Homicide Unspecified 149	Unintentional Fire/Burn 68	Suicide Firearm 174	Unintentional Poisoning 3,492	Homicide Firearm 3,260	Suicide Firearm 2,830	Suicide Firearm 3,953	
4	Unintentional MV Traffic 61	Unintentional Suffocation 120	Homicide Firearm 58	Homicide Firearm 115	Suicide Firearm 2,270	Suicide Firearm 2,829	Suicide Suffocation 2,057	Suicide Suffocation 2,321	U
5	Undetermined Suffocation 40	Unintentional Fire/Burn 117	Unintentional Other Land Transport 36	Unintentional Drowning 105	Suicide Suffocation 2,010	Suicide Suffocation 2,402	Homicide Firearm 1,835	Suicide Poisoning 1,795	
6	Unintentional Drowning 29	Unintentional Pedestrian, Other 107	Unintentional Suffocation 34	Unintentional Fire/Burn 49	Unintentional Drowning 507	Suicide Poisoning 800	Suicide Poisoning 1,274	Unintentional Fall 1,340	
7	Homicide Suffocation 26	Homicide Other Spec., Classifiable 73	Unintentional Natural/ Environment 22	Unintentional Other Land Transport 49	Suicide Poisoning 363	Undetermined Poisoning 575	Undetermined Poisoning 637	Homicide Firearm 1,132	U
8	Unintentional Natural/ Environment 17	Homicide Firearm 47	Unintentional Pedestrian, Other 18	Unintentional Suffocation 33	Homicide Cut/Pierce 314	Homicide Cut/Pierce 430	Unintentional Fall 504	Undetermined Poisoning 820	U
9	Undetermined Unspecified 16	Unintentional Struck by or Against 38	Unintentional Struck by or Against 16	Unintentional Poisoning 22	Undetermined Poisoning 229	Unintentional Drowning 399	Unintentional Drowning 363	Unintentional Suffocation 452	
10	Unintentional Fire/Burn 15	Unintentional Natural/ Environment 35	Unintentional Firearm (Tied) 14	Homicide Cut/Pierce 19	Unintentional Other Land Transport 177	Unintentional Fall 285	Homicide Cut/Pierce 313	Unintentional Drowning 442	U

Data Source: National Center for Health Statistics (NCHS), National Vital Statistics System.
Produced by: National Center for Injury Prevention and Control, CDC using WISQARS™.

Figure 1.3. Leading causes of injury deaths by age group highlighting unintentional injury deaths, Unite

National Estimates of the 10 Leading Causes of Nonfatal Inju
Treated in Hospital Emergency Departments, United States – 2

	Age Groups								
Rank	<1	1–4	5–9	10–14	15–24	25–34	35–44	45–54	55–
1	Unintentional Fall 134,229	Unintentional Fall 852,884	Unintentional Fall 624,890	Unintentional Struck By/Against 561,690	Unintentional Struck By/Against 905,659	Unintentional Fall 742,177	Unintentional Fall 704,264	Unintentional Fall 913,871	Uninten Fa 930,
2	Unintentional Struck By/Against 28,786	Unintentional Struck By/Against 336,917	Unintentional Struck By/Against 403,522	Unintentional Fall 558,177	Unintentional Fall 814,829	Unintentional Overexertion 638,745	Unintentional Overexertion 530,422	Unintentional Overexertion 461,114	Uninten Overex 266,
3	Unintentional Other Bite/Sting 12,186	Unintentional Other Bite/Sting 158,587	Unintentional Cut/Pierce 112,633	Unintentional Overexertion 294,669	Unintentional Overexertion 672,946	Unintentional Struck By/Against 599,340	Unintentional Struck By/Against 444,089	Unintentional Struck By/Against 390,931	Uninten Stru By/Ag 261,
4	Unintentional Foreign Body 10,650	Unintentional Foreign Body 139,597	Unintentional Other Bite/Sting 107,975	Unintentional Cut/Pierce 114,285	Unintentional MV-Occupant 627,565	Unintentional MV-Occupant 526,303	Unintentional MV-Occupant 374,231	Unintentional Other Specified 385,221	Uninten MV-Occ 227,
5	Unintentional Other Specified 10,511	Unintentional Cut/Pierce 83,575	Unintentional Overexertion 93,612	Unintentional Pedal Cyclist 84,732	Unintentional Cut/Pierce 431,691	Unintentional Cut/Pierce 402,197	Unintentional Other Specified 300,154	Unintentional MV-Occupant 343,470	Uninten Oth Speci 212,
6	Unintentional Fire/Burn 9,816	Unintentional Overexertion 81,588	Unintentional Pedal Cyclist 74,831	Unintentional Unknown/ Unspecified 84,668	Other Assault * Struck By/Against 381,522	Other Assault * Struck By/Against 342,514	Unintentional Cut/Pierce 297,769	Unintentional Cut/Pierce 282,353	Uninten Cut/P 189,
7	Unintentional ** Inhalation/ Suffocation 8,294	Unintentional Other Specified 65,120	Unintentional Foreign Body 63,450	Unintentional MV-Occupant 73,692	Unintentional Other Specified 321,914	Unintentional Other Specified 336,990	Other Assault* Struck By/Against 207,287	Unintentional Poisoning 237,328	Uninten Poiso 153,
8	Unintentional Cut/Pierce 7,139	Unintentional Fire/Burn 52,884	Unintentional MV-Occupant 58,114	Unintentional Other Bite/Sting 64,848	Unintentional Other Bite/Sting 177,665	Unintentional Other Bite/Sting 180,922	Unintentional Poisoning 175,870	Other Assault * Struck By/Against 169,688	Uninten Oth Bite/S 97,4
9	Unintentional Unknown/ Unspecified 5,735	Unintentional Unknown/ Unspecified 41,297	Unintentional Dog Bite 43,499	Other Assault * Struck By/Against 62,829	Unintentional Unknown/ Unspecified 163,923	Unintentional Poisoning 180,448	Unintentional Other Bite/Sting 138,410	Unintentional Other Bite/Sting 145,349	Other As Stru By/Ag 73,6
10	Unintentional Overexertion 4,985	Unintentional Poisoning 32,443	Unintentional Unknown/ Unspecified 35,303	Unintentional Other Transport 35,609	Unintentional Poisoning 152,962	Unintentional Unknown/ Unspecified 129,308	Unintentional Unknown/ Unspecified 106,498	Unintentional Unknown/ Unspecified 110,102	Uninten Unkno Unspe 67,9

* The "Other Assault" category includes all assaults that are **not** classified as sexual assault. It represents the majority of assaults.
** Injury estimate is unstable because of small sample size.
Data Source: NEISS All Injury Program operated by the Consumer Product Safety Commission (CPSC).
Produced by: National Center for Injury Prevention and Control, CDC using WISQARS™.

Figure 1.4. National estimates of the 10 leading causes of non-fatal injuries treated in hospital emergenc
2013. MV: motor vehicle

- Private and public health insurance
- Police and legal costs
- Costs arising from fatal and non-fatal trauma

In addition, multiple recent terrorist events in both Europe and the United States, along with the continued issue of inner-city urban violence, have alerted the public to the potential for mass casualties at any time without warning, along with the need for effective care of victims of trauma. The necessity of injury prevention together with the need for efficient care of the injured patient are crucial public health issues, given the enormity of this problem.

Funding for Research

While there are well-funded research and prevention programs for chronic diseases like cancer, cardiovascular disease, and HIV/AIDS due to high public awareness, trauma is often viewed as the result of unavoidable accidents, and support for research or prevention programs is comparatively small. In 2015, the National Institutes of Health (NIH) appropriated $399 million for injury research. In the same year $5.4 billion was spent on cancer research, $2.0 billion on research for cardiovascular disease, and $3.0 billion on HIV/AIDS. These amounts have not changed significantly since 2010.

Prevention

Many factors often hamper the efforts of trauma prevention programs, such as the decisions by motorcyclists and bicycle riders not to use helmets and the reluctance of employers and laborers to invest in safety devices for workplace/machinery safety. Regulations in the form of incentives, laws, or oversight are often required to increase compliance and improve trauma prevention. Unfortunately, special interest groups have commonly opposed seat belt or helmet laws, as these are viewed as a restriction of freedom and individual rights. When laws to prevent injuries have been introduced, significant improvements in mortality are often demonstrated.

As an example, the use of helmets by motorcycle riders reduces the risk of death by 37% and is 67% effective in preventing brain injuries. States with helmet laws have an 86% compliance rate for wearing helmets, while states without such laws have only a 55% rate of helmet use. All states that have introduced helmet laws have experienced significant decreases in motorcycle fatalities (see Table 1.1).

Table 1.1. Reduction in motorcycle fatalities after enacting motorcycle helmet law

State	Reduction (%)
California	37
Oregon	33
Nebraska	32
Texas	23
Maryland	20
Washington	15

Table 1.2. Lives saved by restraint use and minimum drinking age laws (21 years), and additional lives that would have been saved at 100% compliancy with seat belt and motorcycle helmet use, 2011–2015

	Lives saved, age 4 and younger	Lives saved, age 5 and older	Lives saved, age 13 and older	Lives saved, all ages	Lives saved	Additional lives that would have been saved at 100% use	
Year	Child restraints	Seat belts	Frontal air bags	Motorcycle helmets	Minimum drinking age law	Seat belts	Motorcycle helmets
2011†	262	12,071	2,341	1,622	543	3,396	707
2012†	285	12,386	2,422	1,715	537	3,051	782
2013	263	12,644	2,398	1,640	507	2,812	717
2014†	253	12,801	2,400	1,673	486	2,815	661
2015	266	13,941	2,573	1,772	537	2,804	740

Source: 2011–2014 Fatality Analysis Reporting System (FARS) Final Files and FARS 2015 Annual Report Files.

† 2011–2012 estimates differ from previously published estimates due to a computational correction. Previous estimates did not properly account for 2011 through 2013 model year passenger vehicles.

The National Highway Traffic Safety Administration (NHTSA) estimates that three-point safety belts in frontal positions are 45–60% effective in preventing fatalities in frontal collisions and 50–65% effective in preventing moderate-to-critical injuries. Despite this knowledge, the national rate of seat belt usage is only 82%. States that have enacted primary seat belt laws have increased seat belt usage rates by an average of 14% over states without seat belt laws. According to the NHTSA, nationally 250 additional lives could be saved per year and 6400 serious injuries prevented for every one percentage-point increase in safety belt use. Table 1.2 details lives saved with various public health initiatives from 2011 to 2015.

Mechanisms of Injury

Transfer of energy occurs due to blunt and penetrating trauma according to Sir Isaac Newton's first law of motion, which states that "a body in motion will stay in motion unless acted upon by an outside force."

Severity of injury is related to three factors:

1. Kinetic energy absorbed by the body (KE = mass × velocity^2/2)
2. Direction the energy travels through the body
3. Body structure density: solid (water dense) organs are more likely to rupture than hollow (air dense) organs. Bone and cartilage are more rigid and have greater density

Falls

In the United States, falls are the most common cause of non-fatal injuries. In 2014, 9.2 million non-fatal unintentional falls were reported. In the same year, 33,018 patients

suffered fatal injuries due to unintentional falls. Falls from a height, such as a ladder or a scaffold, are more common in the working age population. As patient age increases, falls down stairs and falls from standing become more common. In the elderly population, falls are much more common and are more likely to be lethal. As an example, in those aged 65 and over, the mortality rate for unintentional falls in 2014 was 0.59% compared with 0.02% in those aged 35–44. The incidence of falls has been increasing, and given the widespread use of anticoagulants in the elderly, it is likely that the severity of injuries, even from ground level falls, will increase. Characteristics of the contact surface, position of the person upon landing, and change in velocity determine injury severity.

- Landing on feet: full force is transmitted up the axial skeleton with injuries to the calcaneus, tibia, femoral neck, and spine. Intra-abdominal organs may be avulsed off their mesenteries or peritoneal attachments.
- Landing on back: energy is transferred over a larger area.
- Landing on head: severe head injury and cervical spine fractures.

Transportation-related Injuries

Motor vehicle collisions (MVCs) are the leading cause of death due to injury. In addition, vehicular trauma fatalities rank third in terms of years of life lost (the number of remaining years that the person would be expected to live had they not died) behind only cancer and heart disease. In 2015, more than six million police-reported MVCs occurred, resulting in over 1.6 million injuries. Injuries may occur from frontal or rear impact, from lateral and rotational impact, and due to restraint devices. Each of these impacts is associated with characteristic patterns of injury.

- Frontal impact – down and under: fracture dislocations of the ankle, tibia, knee; fractures of the femur and acetabulum.
- Frontal impact – up and over: rib fractures, sternal fracture, blunt cardiac injury (contusion, valve disruption, rupture), pulmonary trauma, cervical spine fracture, facial fractures, head injury, abdominal trauma.
- Lateral impact: injury of clavicle, ribs, lung, pelvis, and spleen. Other injuries may occur: femur fracture, aortic tear.
- Rear impact: whiplash injuries.
- Sideswipe/rotational: combination of injury patterns as in frontal and lateral impacts.
- Rollover: complicated spectrum of injuries depending on forces, restraints, roof deformation, and ejection.
- Ejection: may result in severe crush or total amputations. Increased risk of death.
- Seat belt and air bag: restraint devices protect against head, face, chest, abdominal, and extremity trauma. The lap belt when worn above the iliac crest can result in hyperflexion of the torso over the seat belt with anterior compression fracture of the lumbar spine (Chance fracture). A shoulder restraint may cause trauma to the clavicle. Deployment of the airbag can cause corneal, facial, and neck trauma.

To prevent injuries due to seat belts, booster seats are recommended for small children. Rollover crashes with ejection of the passenger are considered to have the greatest injury potential, as just about any type of injury can result, due to the multitude of forces involved in this injury pattern.

Most people who die in MVCs are the vehicle occupants, and about one-quarter of fatalities caused by MVCs involve pedestrians, bicyclists, and motorcycle riders. In 2014, a total of 32,675 people, or just under 100 per day, died as the result of such vehicular collisions. This is an improvement from the 43,510 reported killed in such collisions in 2005. MVCs are the leading cause of death for every age from 5 through 24 in the United States (Figure 1.3). The decrease in the fatality rate of these collisions in the last few decades is due to the widespread use of better automotive design and the use of seat belts and airbags, emphasizing the role of preventive strategies in decreasing injury mortality.

With motorcycle and bicycle collisions, the potential for injury is high, because the rider is frequently ejected and there is very little protection for the passenger. A massive amount of energy is transferred to the cyclist on impact. The main piece of equipment that offers protection is a helmet. Injury patterns are as follows:

- Frontal impact, ejection: any part of the head, chest, or abdomen can hit the handlebars. Blunt abdominal injuries and femur fractures may occur.
- Lateral impact or ejection: open or closed extremity fractures occur on the impacted side. Secondary injury occurs upon landing.
- Laying down the bike: increases the stopping distance for kinetic energy to dissipate. Soft tissue injuries and road burn on the down limb. Injury severity decreased by wearing protective gear.
- Helmets: these are designed to reduce direct force to the head and disperse it over the entire foam padding of the helmet. There is no doubt that helmets reduce the risk of fatal head injury after motorcycle and bicycle collisions.

Pedestrian injuries often affect children, the elderly, and intoxicated persons. The pattern of injury depends on height of the patient and type of vehicle.

- Bumper impact: tibia–fibula fractures, knee dislocations, and pelvic injuries.
- Hood and windshield impact: truncal injuries such as rib fractures or splenic trauma. If the victim is thrown into the air, other organ compression injuries may occur.
- Ground impact: this occurs when the patient slides off the car and hits the ground and may result in head and face injuries as well as extremity fractures.

Penetrating Trauma

Gun-related deaths are the second leading injury-related fatality in the United States, second only to MVCs. In 2014, there were 21,334 suicides and 10,945 homicides due to firearms. In total, there were 32,279 violence-related firearm deaths in the United States in 2014. The problem of homicide due to guns is particularly acute in the young, inner-city, African-American male population. Homicide due to firearms is the second leading cause of death, only behind unintentional motor vehicle traffic, in those aged 10–14 and 15–24. The firearm death rate has steadily increased over the past few decades, due almost exclusively to the homicide rate in the adolescent and young adult population. Attempting to prevent such inner-city violence has become an important public health effort.

Determinants of tissue damage from a bullet are:

- Amount of energy transferred to the tissues.
- Time it takes for the transfer to occur.
- Surface area over which the energy is transferred.
- Velocity of the bullet (kinetic energy).

- Wound ballistics like cavitation, trajectory, yaw, tumbling, and fragmentation.
- Entry and exit wounds. These are critical determinants of trajectory and path of the missile. The trajectory may not be linear if the bullet ricochets off bony structures.

Another significant mechanism of penetrating trauma is that of stab wounds. Stab wounds produce damage by sharp, cutting edges. Surrounding damage is minimal, and there is no blast effect as seen in gunshot wounds. Mortality, while still present, is generally much lower. In 2014, 2,609 patients died due to violence-related cutting and piercing deaths in the United States. In the same year, a total of 2.2 million non-fatal such injuries occurred, for a mortality due to this mechanism of 0.1%.

Blasts or Explosions

Blasts or explosions cause injury in three distinct manners:

1. Primary: direct effect of high-pressure waves on the tympanic membrane, lung (pulmonary edema, hemorrhage, bullae, or rupture), and bowel. Intraocular hemorrhage and retinal detachment may occur.
2. Secondary: objects rendered mobile by the explosion may cause penetrating and/or blunt trauma.
3. Tertiary: the patient may become mobile from the blast and injuries may be similar to those sustained from a fall or ejection.

Prehospital Care

In order for trauma victims to have the highest chance for a successful outcome, it is essential that they receive optimal care as soon as possible after the injury. In the United States, most trauma victims will first encounter the healthcare system via the emergency medical services (EMS) system, which is a network of services encompassing rescue operations, prehospital emergency care by specially trained personnel (emergency medical responder, emergency medical technician, advanced emergency medical technician, and paramedic). Each provider has different training requirements and scope of practice. This system is based on the premise of bringing EMS providers to the patients. These trained providers are responsible for the initial assessment and management of the trauma patient in the field. The emphasis is to bring the patient to the hospital as fast as possible after basic rescue techniques such as airway management and intravenous (IV) access are performed at the scene. The emphasis is clearly on rapid transport to the hospital for definitive treatment, since trauma patients who are exsanguinating need to have bleeding controlled as soon as possible to increase their chance of survival. Definitive control of most bleeding cannot be achieved in the field; therefore, transport to the hospital, where a trauma surgeon is available, must proceed as quickly as possible.

In 1966, the paper *Accidental Death and Disability: the Neglected Disease of Modern Society* was published. It was argued that there were no standards in prehospital care. As a response to this, the Department of Transportation published the Emergency Medical Technician – Ambulance (EMT-A) curriculum in 1969, followed by the EMS Systems Act of 1973. The two groups of patients who stood to benefit from this system were the cardiac patient and the trauma patient. It became apparent in the 1980s that definitive care between these two groups of patients is fundamentally different. Since the trauma patient who is exsanguinating needs operative intervention as soon as possible, any delay in reaching a