

Trauma Education and Prevention



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KEYWORDS

- Trauma education • ATLS • Injury prevention • Motor vehicle safety
- Motorcycle safety • Helmet safety

KEY POINTS

- Advanced Trauma Life Support (ATLS) is the worldwide standard for the initial management of the trauma patient, teaching a safe, common approach to this care.
- Rural Trauma Team Development Course teaches providers at small facilities how to apply the principles of ATLS in their own environment, emphasizing teamwork and communication.
- Surgical skills for trauma are taught in 3 courses, each targeting surgical trainees and attending surgeons to help them acquire and maintain the technical skills necessary for life-saving treatment.
- Motorcycle helmet laws have consistently resulted in reductions in serious injury and death owing to motorcycle crashes. Helmet law repeal has repeatedly shown increases in serious injury.

TRAUMA EDUCATION

Injury is now recognized as a disease that carries a significant public health burden. The care of the severely injured patient spans many domains—prehospital, emergency room, operating room, intensive care unit, inpatient hospitalization, and postdischarge rehabilitation. Although definitive care may occur at specialized trauma centers, the initial care after injury begins in the field and may continue at a hospital

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without trauma specialization. Because of the time critical nature of severe injury, it is important that providers across the various domains of care have training and experience in trauma management.

In the latter portion of the 20th century, and especially over the past 15 years, educational gaps and needs in trauma management have been recognized. This gap has spawned the development of multiple educational products, each targeting a specific aspect of trauma care. This article describes selected trauma educational courses, including the educational gap being filled, the target audience for each, and an assessment of effectiveness. Preference has been given to describe courses that are relevant for physicians, especially surgeons.

Advanced Trauma Life Support

Advanced Trauma Life Support (ATLS) has become the worldwide gold standard for trauma education. The story of the genesis of ATLS is well-known.¹ Dr James Styner, an orthopedic surgeon in Lincoln, Nebraska, was involved in a private plane crash on February 17, 1976. Although his wife was killed in the crash, he and his 4 children survived and first received treatment at a rural hospital. Believing that the initial care was not adequate, Dr Styner observed, “When I can provide better care in the field with limited resources than my children and I received at the primary facility, there is something wrong with the system and the system has to be changed.” Modeled after Advanced Cardiac Life Support, ATLS was then born.

The pilot ATLS course was presented in Auburn, Nebraska, in 1978.² After this pilot program, the ATLS course was taken up by the American College of Surgeons to promulgate the course with the intent of teaching physicians an approach to the initial care of an injured person. After 37 years, ATLS has literally spanned the globe. Presently in the 9th edition, with the 10th edition set for release in 2017, more than 1 million students have been educated in more than 60 countries worldwide.³

ATLS is a 2- or 3-day course (most commonly 2 days) that teaches knowledge and techniques for evaluating and managing injured persons.⁴ The program is presented through a combination of interactive lectures, surgical skill instruction (surgical airway, chest tube placement, focused assessment with sonography for trauma, optional diagnostic peritoneal lavage), case-based skill stations, and small group discussions. It provides a common language and approach, allowing providers—whether they frequently or infrequently treat trauma patients—to have a shared mental of the organization of the care. Specifically, the course aims to enable participants to³:

1. Demonstrate the concepts and principles of the primary and secondary assessment
2. Establish management priorities
3. Initiate primary and secondary management
4. Demonstrate the skills necessary to assess and manage critically injured patients

Efforts to examine the effectiveness of the ATLS education have looked at 2 areas: retention of knowledge (educational outcome) and improvement in patient outcomes (trauma mortality). Hundreds of papers have been published in this regard. The educational impact is undeniable. Participants have improvement in knowledge and organization of trauma management, practical skills, and identification of management priorities.⁵ Retention in knowledge seems to decrease after 6 months, reaching a nadir at 2 years. The gained understanding of organizational skills and management priorities persists for up to 8 years.

There are many contributing components to mortality after injury, so it is difficult to precisely study the specific effect of ATLS education. A Cochrane Database review⁶

attempted to examine randomized controlled trials, controlled trials, and before-and-after studies assessing the effectiveness of ATLS training. After reviewing 3109 citations, no studies existed that met these inclusion criteria. Thus, there is only a poor evidence base supporting an improvement in mortality outcome attributable to ATLS. There is also no evidence concluding that such education efforts are not valuable. It is this author's opinion that, given the near universal acceptance of ATLS, high-quality controlled trials related to ATLS education are unlikely to be conducted.

Despite the lack of high-level evidence from controlled trials, overwhelming expert opinion is that the impact of ATLS is undeniable, both in terms of provider knowledge and patient outcome. ATLS has influenced trauma education throughout the world. Past American College of Surgeons President, Dr L.D. Britt, has said, "There has been no program that has been as effective as ATLS in saving lives and decreasing morbidity of injuries. It is one of the greatest medical innovations—worldwide—in the last 75 years."² For more information, see <https://www.facs.org/quality-programs/trauma/atls>.

Trauma Evaluation and Management

The Trauma Evaluation and Management (TEAM) course is another educational offering from the American College of Surgeons Committee on Trauma. This course was originally designed as an abbreviated version of ATLS, essentially an expanded version of the ATLS lecture on "Initial Assessment and Management."⁷ TEAM was meant to be used for medical student education, recognizing that undergraduate medical curricula was frequently lacking in exposure to trauma.

The TEAM program is modular in design and it introduces the evaluation and management of trauma for medical students. Instruction begins with a video demonstrating a trauma resuscitation where there are multiple errors in management. There is then a discussion, followed by a lecture on the principles of the initial assessment. A second video follows that demonstrates a properly conducted trauma evaluation. Finally, there are case scenarios for small group discussion.

The TEAM course seems to be effective in teaching the principles of trauma evaluation and management to senior medical students.^{8,9} One report demonstrated that senior medical students had significant improvement in their knowledge of trauma resuscitation after the TEAM program.⁹ Expectedly, the demonstrated knowledge improvement did not reach that required to pass the full ATLS course, emphasizing that TEAM cannot serve as a replacement for ATLS. However, because of the impracticality of providing ATLS for undergraduate medical students, TEAM seems to be an ideal method of teaching this group of learners.

The TEAM course has recently been reinvigorated as a potential resource for basic trauma education in developing areas of the world where the full ATLS program is not practical (personal communication). For more information, see <https://www.facs.org/quality-programs/trauma/atls/team>.

Rural Trauma Team Development Course

In the late 1990s, members of the ad hoc Rural Trauma Subcommittee of the American College of Surgeons recognized that there was a gap between the principles being taught to doctors in the ATLS course and the application of these concepts by a team working at smaller facilities, where resources, personnel, and experience may be limited. This began a grass roots effort to develop an educational product to address the needs of providers in rural communities. The result of this effort is the Rural Trauma Team Development Course (RTTDC).

The RTTDC is an interactive, 8-hour course that teaches a team approach to the initial care of a severely injured person. It emphasizes the early detection and treatment of critical injuries and avoidance of delay in transferring the patient to a higher level of care. Now in its fourth edition, the course is highly interactive with lectures, small group discussions, and team-based management scenarios. It includes instruction about teamwork and communication skills.¹⁰ The course has been promulgated throughout the United States and Canada, with translations into French and Spanish. There has also been international promulgation in several locations, most recently to the Ukraine.

There are a couple of important differences between RTTDC and ATLS. First, the course is designed to be presented at the local facility. Thus, the instructors come to the participants at their location, rather than the other way around. Second, the course is intentionally designed to be flexible to meet the unique needs of the providers at the local facility. Finally, participation in RTTDC is for everyone who may be a part of the initial care of the injured person at the rural facility. A typical class includes medical providers (doctors, nurse practitioners, and physician assistants), nurses, emergency medical service personnel, radiology technicians, and laboratory workers. Administrators and clerical personnel also participate.

There is emerging evidence of the effectiveness of RTTDC.^{11–14} A consistent finding is that facilities where the RTTDC course has been presented have shorter times until the decision to transfer is made^{11,13} and shorter total duration of stay before transfer.¹² A mortality benefit has not yet been demonstrated. Participant satisfaction has been found to be high and improvement in knowledge has been shown.¹⁴

An unanticipated, although possibly most important, benefit of RTTDC has been the opportunity for positive relationship building that occurs when experienced trauma providers and educators leave the trauma center to teach the course in the rural community. This opens lines of communication and fosters good relationships between facilities. As such, RTTDC is a good resource to be used by trauma centers for education and outreach. For more information, see <https://www.facs.org/quality-programs/trauma/education/rttdc>.

Prehospital Trauma Life Support

Just as ATLS has become the gold standard for initial physician trauma education, the Prehospital Trauma Life Support (PHTLS) course is so for prehospital providers. Because this course is intended for nonphysicians, only a limited overview is provided.

The PHTLS originated in parallel with ATLS. Because ATLS was developed as a course for physicians, PHTLS arose to meet the trauma educational needs of prehospital providers.¹⁵ The first pilot courses were held in 1982 and 1983; the course is now in its eighth edition. It is developed and administered by the National Association of Emergency Medical Technicians with medical oversight from the American College of Surgeons Committee on Trauma.¹⁶ New editions of the PHTLS follow each updated edition of the ATLS to maintain consistency in the educational offerings.¹⁷ PHTLS has worldwide promulgation, now offered in more than 50 countries. Like ATLS, conventional opinion is that the educational impact is meaningful. However, also like ATLS, scientific support for improved patient outcomes is limited.¹⁸ For more information, see <http://www.naemt.org/education/PHTLS/phtls.aspx>.

Advanced Trauma Operative Management

One consequence of the declining incidence of penetrating trauma in the United States and the increased nonoperative management of blunt injuries is that surgical resident trainees and practicing surgeons have fewer operative trauma cases. The

Definitive Surgical Trauma Care course is a 2-day course that has been implemented in a number of countries but has not gained a foothold in the United States. The Advanced Trauma Operative Management (ATOM) course evolved from the Definitive Surgical Trauma Care course¹⁹ and focuses on the operative management of penetrating injury. The ATOM course is intended for senior surgical residents, trauma fellows, and fully trained surgeons (including military surgeons and those who may have infrequent exposure to patients with penetrating injury).

ATOM was established in 1998 and came under the direction of the American College of Surgeons in 2008.²⁰ It is an 8-hour course that begins with 6 interactive didactic sessions covering the principles of trauma laparotomy and management of abdominal and thoracic injuries.¹⁹ The remainder of the day is spent in the surgical laboratory using a live, anesthetized 50-kg porcine model, which simulates a human operative experience. A single instructor works with a single student to create and manage multiple standardized scenarios that teach operative repair of penetrating injury to the stomach, duodenum, small intestine, kidney, ureter, bladder, pancreas, spleen, liver, inferior vena cava, and heart.

Participants in the ATOM course demonstrate improvement in knowledge and surgical confidence, both at the completion of the course¹⁹ and at 6-month follow-up.²¹ The course is offered at more than 2 dozen locations in the United States and has had international promulgation including Canada, Africa, the Middle East, and Japan.

One limitation of the traditional ATOM course is the use of 1 animal for each student, which also means that 1 instructor is required for each student. If 1 instructor could teach 2 students using 1 animal, this would increase the number of students each course could accommodate, reduce the cost per participant, and maintain sensitivity regarding efficient use of the live animal model. The 2-student to 1-instructor model has been evaluated and found to be feasible.²² The educational experience for students seems to be maintained, and perhaps even strengthened because of the opportunity for each student to both perform and assist with each type of repair. However, this arrangement creates more difficulties with animal physiology. Presently, the 2-student ATOM teaching model is limited to selected locations. For more information, see <https://www.facs.org/quality-programs/trauma/education/atom>.

Advanced Surgical Skills for Exposure in Trauma

As noted, exposure to operative trauma for both surgical trainees and practicing surgeons has become more limited. This includes operations for major vascular repair. In 2005, the American College of Surgeons Committee on Trauma established a Surgical Skills Committee to develop a standardized course that could be used to train surgeons in the operative exposure of vital structures. This resulted in the Advanced Surgical Skills for Exposure in Trauma (ASSET) course.²³

ASSET is a cadaver-based course that is completed in 1 day. Unlike most other courses, there is not a classroom component to the course. Instead, the course is conducted in the anatomy laboratory with unpreserved (fresh) human cadavers. Scenarios are presented and instructors provide a focused bedside instruction, including high-quality narrated videos, on the key aspects of the requisite operative exposure. Four students then work with 1 instructor to perform the surgical dissection on the cadaver. Using the case scenarios, students learn exposure of structures in the extremities (axillary artery, brachial artery, femoral artery, popliteal artery, and both forearm and lower leg fasciotomy), neck (carotid artery and esophagus), thorax (pulmonary hilum, subclavian artery, thoracic aorta, and heart), and abdomen and

pelvis (iliac artery, aorta, left and right visceral rotation, liver, inferior vena cava, and the technique of preperitoneal pelvic packing).²³

The target audience for the ASSET course is senior surgical residents, trauma fellows, and practicing surgeons, and the course has been shown to be valuable. Overwhelmingly, participants report gaining knowledge and learning new techniques and feel better prepared to care for injured patients.^{23,24} Additionally, they nearly universally would recommend the course to colleagues.

The ASSET course is offered by more than 40 centers in the United States and Canada and has some limited additional international promulgation. One persisting challenge is the availability and cost of unpreserved (fresh) cadavers. For more information, see <https://www.facs.org/quality-programs/trauma/education/asset>.

Basic Endovascular Skills for Trauma

A relative newcomer to the educational courses in surgical skills for trauma, the Basic Endovascular Skills for Trauma (BEST) course recognizes that endovascular procedures are increasingly used in care of the trauma patient. Specifically, the technique of resuscitative endovascular balloon occlusion of the aorta is a life-saving maneuver than can be used to temporize noncompressible hemorrhage. The BEST course is a 4-hour course that, using a combination of lectures, simulators, and fresh cadavers, teaches participants the resuscitative endovascular balloon occlusion of the aorta procedure.^{25,26}

The BEST course is new and evidence of effectiveness is just starting to emerge. One report demonstrated that participants were able to acquire the endovascular skill and that the mean time to accomplish the procedure improved with the repetitions during the course.²⁶ Additionally, all participants found the course to be beneficial and 85% felt ready to perform the procedure on their next call.

The BEST course is presently offered at 3 locations (the University of Maryland's RA Cowley Shock Trauma Center, the Texas Trauma Institute/University of Texas at Houston, and the University of California at Davis) and registration is open only for trauma surgeons.²⁵ For more information, see <https://www.facs.org/quality-programs/trauma/education/best>.

Simulated Trauma and Resuscitation Team Training

The RTTDC teaches that trauma management is not an individual endeavor; rather, teamwork is required. This is something that is not taught in ATLS. A newer course is the Simulated Trauma and Resuscitation Team Training (STARTT). This course recognizes that most critical errors are not a result of a knowledge deficit or technical inability; instead, they result from nontechnical skills, such as situational awareness, team leadership, and communication. Developed in Canada, STARTT brings the principles taught in Crisis Resource Management into the realm of trauma resuscitations.²⁷

STARTT is an 8-hour course focused on reducing and mitigating human error in trauma resuscitations. It includes lectures that teach the principles of Crisis Resource Management.²⁸ The participants (physicians, nurses, and respiratory therapists) are then divided into teams who rotate through 4 standardized, high-fidelity trauma simulations. Each simulation experience lasts for 60 minutes, with 15 minutes of simulation and 45 minutes of debriefing. The course emphasizes communication and leadership skills, effective use of resources, situational awareness and problem solving, and how to enhance completion of tasks.^{29,30}

The STARTT course has yet to gain a foothold of promulgation in the United States. It offers a promise, however, of filling a critical educational gap for American surgeons

that is not met by the more widespread trauma educational offerings. Participant satisfaction with the course is high and it improves participant attitudes toward Crisis Resource Management training,²⁷ although improved patient outcomes have not yet been evaluated. The course has also demonstrated flexibility to include prehospital providers and simulation of a mass casualty event.²⁹ For more information, see <http://www.traumacanada.org/page-1811219>.

Summary

Over the past 4 decades, and especially in the last 15 years, multiple high-quality trauma educational products have been developed. These courses provide a standardized approach to the instruction of how to care for the injured person through development of knowledge, technical skills, and teamwork. Each has been developed to address an educational gap and most began as a grass roots effort after recognition of the need. The courses have been met with positive perception from participants and are widely seen as promoting improvements in patient outcomes. Although they are all found to be educationally effective, demonstrating significant improvements in patient outcome has been elusive. There are still aspects of care of the injured patient where structured and standardized education has not been developed; hospital care (after the initial assessment), rehabilitation from injury, and trauma system development are among these. It is the opinion of this author that, as injury is increasingly recognized as a public health burden, there will continue to be development of educational products to assist teaching the various components of the comprehensive care of trauma patients. For more information regarding all of these educational offerings, see [Table 1](#).

INJURY PREVENTION

Public Health

The junior surgical resident on the trauma service is presenting patients at morning report: Mr A Doe, a 25-year-old man status post motor vehicle accident with a

Course	For More Information
Advance Trauma Life Support (ATLS)	https://www.facs.org/quality-programs/trauma/atls
Trauma Evaluation and Management (TEAM)	https://www.facs.org/quality-programs/trauma/atls/team
Rural Trauma Team Development Course (RTTDC)	https://www.facs.org/quality-programs/trauma/education/rttdc
Prehospital Trauma Life Support (PHTLS)	http://www.naemt.org/education/PHTLS/phtls.aspx
Advanced Trauma Operative Management (ATOM)	https://www.facs.org/quality-programs/trauma/education/atom
Advanced Surgical Skills for Exposure in Trauma (ASSET)	https://www.facs.org/quality-programs/trauma/education/asset
Basic Endovascular Skills for Trauma (BEST)	https://www.facs.org/quality-programs/trauma/education/best
Simulated Trauma and Resuscitation Team Training (STARTT)	http://www.traumacanada.org/page-1811219

traumatic brain injury, Mrs B Doe, a 65-year-old woman had an “accident” at home falling down the stairs with multiple rib fractures, and Mr. C Doe, a 38-year-old man had an accident at work having his arm traumatically amputated by an auger.

An accident is “an unfortunate incident that happens unexpectedly and unintentionally, typically resulting in damage or injury,” or “An event that happens by chance or that is, without apparent or deliberate cause.” These are some of the definition that Google provides for the definition of accident. Synonyms include the words mishap, mischance, and misfortune. This implies that the event was unavoidable, leading us to believe that nothing can be done to prevent this outcome. When viewed as an accident, the motor vehicle collision, the fall, and the event at work simply become reportable statistics. If we examine these events from a public health perspective, we then change the statistical into a preventable outcome. The Centers for Disease Control and Prevention define public health as “the science of protecting and improving the health of families and communities through promotion of healthy lifestyles, research for disease and injury prevention and detection and control of infectious diseases.”³¹ Using the public health perspective opens an entirely new opportunity dimension to a given event, with opportunity for research, implementation of policies, and room for public awareness and education.

Trauma

Trauma continues to be the leading cause of death in individuals 1 to 46 years of age, and is the third leading cause of death overall across all age groups, claiming the lives of up to 200,000 individuals annually. In the United States, it accounts for 41 million emergency department visits annually, and results in 2.3 million hospital admission. It leads to 30% of the total life-years lost annually, ahead of both cancer and heart disease, which account for 16% and 12%, respectively. Given the uniqueness of this disease process in that all age groups are implicated, the life-years lost to trauma are equal to those lost owing to cancer, heart disease, and human immunodeficiency virus infection combined. It also costs up to \$671 billion annually in health care costs and losses to productivity owing to disability.³² Worldwide, 973 million people were injured by trauma requiring some health care, and 4.8 million of those succumb to their injuries, making this a global issue.

It is not until we delve deeper into these statistics that we truly understand what these numbers mean. On the global front, injury leads to 247.6 million disability-adjusted life-years annually, with 210.8 million and 36.8 million of those coming from years loss to life and years of live with disability, respectively.³³ Deeper dissection into the data reveals that the largest contributors to this phenomenon are unintentional injuries such as falls, drownings, and poisonings; transport-related injuries; and intentional injuries such as self-harm and interpersonal violence.³³ This information empowers public health experts by highlighting potential areas for further research and intervention.

Injury Prevention Initiatives

Some of the earliest work in injury prevention comes from Dr William Haddon in the 1970s. He proposed a matrix to assess events that led to injury by dividing them into separate factors that may have contributed to the incident including human factors, vehicle and equipment factors, and environmental factors. He further examines the crash in 3 phases: the precrash, the crash, and the postcrash phases, that have led to the incident at hand³⁴ (Table 2). By examining each event in this manner, we can identify modifiable factors at different phases of the unwanted event, be it a crash, fall, abuse, or fire. The Haddon Matrix is actively used by public health researchers to help identify points of potential intervention.

Table 2
Basic matrix for classification of road loss factors in each of the 3 phases of interactions that lead to the end result in energy-damaged people and property

Phases	Factors		
	Human	Vehicle and Equipment	Environment
Pre-crash			
Crash			
Post-crash			
Results →			

Adapted from Haddon W Jr. A logical framework for categorizing highway safety phenomena and activity. *J Trauma* 1972;12:206; with permission.

Injury prevention strategies can be either passive or active. A passive intervention is one that does not require the user to make conscious modifications to their behavior to protect them from the event, and are most effective. Interventions such as this include safety caps on medication bottles, leading to the reduction in poisoning in children. An active intervention is labeling on the medication bottle with warning that inform the user of safeguarding the medication from children. These interventions are seen as less effective.³⁵

Motor Vehicle and Traffic Safety

Although the number of people driving motorized vehicles has dramatically increased since the mid 1920s leading to the total number of miles traveled annually to be 10 times higher, the death rate has declined from 18 per 100 million vehicle miles traveled in 1925, to 1.7 per 100 million vehicle miles traveled in annually in the United States in 1997.³⁶ The road to these dramatic changes was paved years ago.

In 1966, the dramatic increase in the number of fatalities owing to motor vehicle crashes, accounting for up to 41% of all unintentional injuries in the United States, caught the attention of congress. Public Works Chairman, George Fallon, with strong support from then-President Lyndon B. Johnson, shepherded the Highway Safety Act in an attempt to empower and force each state to implement a highway safety program. The legislation addressed driver education, traffic control, accident prevention, and emergency services. Given the importance of the matter, the legislation had strong bipartisan support in the House of Representatives, which led to its passing into law on September 9, 1966.³⁷ This later gave birth to the National Highway Safety Bureau, which is today known as the National Highway Traffic Safety Administration. Under the leadership of Dr Haddon, the National Highway Safety Bureau led the task-force that would pioneer and revolutionize automotive safety, as a whole.

Automobiles

Using the Haddon matrix, the team studied crashes identifying areas to be addressed, with the goal of minimizing injury and death. This included changes to vehicles' safety features, such as the implementation of head rests and shatter-resistant windshields. Increased lighting on roadways and reflectors on the roads, and breakaway signs and utility poles, along with the implementation of strict seatbelt laws and speed limits are the injury prevention initiatives that have led to thousands of lives being saved.³⁶

Fifty years later, although the numbers are better, motor vehicle crashes remain the number 1 cause of death for those aged 5 to 24 and the number 2 cause of death for

toddlers and adults 25 years and older. The most recent insult to injury is the increased use of electronic devices while driving, referred to as distracted driving. Since the advent of text messaging in 1992, and later the evolution and popularization of so-called smartphones, the use of cell phones while driving has become problematic.³⁸ It is reported that 22% of all motor vehicle crashes can be directly attributed to driving while manipulating a mobile device. Simulation studies have shown that manipulating a cell phone while driving is equated to driving under the influence of alcohol, leading to delayed braking time, a 140% increase in missed lane changes, and a 6-fold increase in crashes. Currently, 54% of adults reported talking on the phone while driving, and 50% admitted to texting while driving.³⁸ Based on a review by members of the Injury Control Prevention Committee of the Eastern Association for the Surgery of Trauma, they recommended that all drivers should not text, and that all young drivers should not use cell phones or any messaging system while driving.³⁸ At this time in the United States, laws against cell phone use while driving are not standardized across all states, an opportunity for intervention.

Motorcycles

Motorcycles are referred to as “a hazardous means of transportation, with death rates per 100 million person-miles of travel reaching more than 35 times that of cars.”³⁵ In the United States, motorcycles account for less than 1% of the vehicle miles traveled, yet claim the lives of up to 14% of those killed on roads.³⁹ Injuries to the head after motorcycle collision is one of the main causes of morbidity and mortality in this patient population.⁴⁰ A Cochrane review examining the literature surrounding the effectiveness of helmets in protecting patients involved in motorcycle collisions demonstrated that wearing a helmet reduced head injuries by 69% and death by 42%.⁴⁰ Implementing mandatory helmet laws has consistently led to an increase in helmet use, and has led to decrease in the incidence of head injuries by 34% and 22% in California and Nebraska, respectively. The risk of death was also reduced by 12% and 26%, respectively.³⁵ A study that reviewed the effects of repealing helmet laws in Arkansas showed that patients not wearing helmets had significantly higher Abbreviated Injury Scale head injury scores, longer durations of stay in the intensive care unit and hospital in general, and posed an increased economic burden on the system owing to nonreimbursement.⁴¹ This shows the positive impact that such injury prevention programs can have on a population, and the negative impact of repealing such measures as well.

Bicycles

Bicycling is an excellent source of exercise, and a great mode of transportation; it also leads to 1.2 million emergency department visits—500,000 injuries and 900 fatalities—with a total productivity loss of approximately \$10 billion annually.⁴² Children 5 to 14 years of age are the most affected by this mechanism of injury. One of the main issues with bike safety involves the use of helmets, or the lack thereof. Helmet use has proven to be effective in minimizing serious injuries as a consequence of a crash while on a bicycle. One study demonstrated that the use of helmets decreased the risk of head injury and traumatic brain injury by 85% and 88%, respectively.⁴³ Legislative action and educational interventions have led to increased helmet use in this population by up to more than 50%, leading to a reduction in head injury in users.⁴⁴

Other Interventions

Injury prevention is not only focused on traffic-related events. It is a needs-based process. Using data from institutes such as the Centers for Disease Control and Prevention, one can identify the needs of a given community and address the issues related

to that specific community as they arise. A systematic literature review and metaanalysis published in the *Journal of Adolescent Health* demonstrated that injury prevention initiatives successfully decreased sports-related incidence of injuries in adolescents.⁴⁵ The use of training plus education and the use of safety equipment was the culprit in reducing the number of unwanted incidences.⁴⁵

Community-based injury prevention programs are not all the same. In a review of the effectiveness of 16 injury prevention programs, the author found programs that had statistically significant improvements in outcomes, and those that had no impact. One of the factors cited that helped to improve the successful implementation of a program was community cohesion, which could be effected by cultural homogeneity. The lack of the latter can lead to a loss of cohesion, and failure of the program implementation. Before the implementation of a program, knowledge of the community's cultural needs and diversity will help to address this factor. Another cited factor was the structure of the program, and how long it was implemented. Time is needed within a community to allow for successful adoption of new behaviors, and thus needs to be factored into the program. Last, certain projects may benefit more from passive interventions versus active interventions, depending on the intervention at hand.⁴⁶

Summary

This is an ever-evolving field of health care that must adapt to the ongoing changes in the environment. In the 1970s, cell phone use in automobiles was not a contributor to unintentional collisions; rather, the lack of safe roadways and cars without proper safety mechanisms in place to protect its occupants was paramount. With the implementation of newer technologies in vehicles, some cars are now capable of identifying pedestrians in its path, alerting the driver of the potential collision, or applying the brakes automatically. There has also been the development of self-deploying helmets that inflate before impact, protecting the bicycle rider from serious head injuries. The number of tools at our disposal to help minimize morbidity and mortality are increasing. This is only possible through ongoing research and development, and continuously monitoring trends and statistics that we can truly have a positive impact on the overall well-being of our population. This is possible through the eyes of public health.

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