SPECIAL FEATURE

Competency-based strategies for injury control and prevention curriculums in undergraduate medical education

Mary Beth Phelan, Mark E Falimirski, Deborah E Simpson, Mary L Czinner, Stephen W Hargarten

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Injury, including unintentional injury and intentional injury, is the leading cause of death in people aged ≤ 44 years. Doctors often treat acute injuries, assist in the rehabilitation process and provide injury prevention guidance to patients. Current undergraduate medical school curriculums lack content and consistency in providing training in this area. A matrix to show the integration of injury control and prevention principles into existing undergraduate medical school curriculums is proposed.

Injury is the leading cause of death among people aged <44 years, and the fifth leading cause of death among people of all ages in the US.¹ In 2003, 158 493 people died as a result of unintentional and intentional injury. Most (69%) died from unintentional injuries such as motor vehicle crashes, falls or drowning, and a substantial number died from intentional injuries such as homicide (11%) and suicide (20%). These numbers remain consistent with 2001 data.^{2–3} The consequences of injury account for 30% of all lost years of productive life before age 65 years, exceeding the years of productive life lost from heart disease, cancer and stroke combined.³ The economic effect of injury is staggering. In 1995, the cost of healthcare and lost wages combined approached US\$260 billion.⁴ Wage losses, medical expenses, property damage, employer costs, fire losses and other expenses related to fatal and non-fatal injuries cost Americans an estimated US\$586.3 billion in 2002, equating to approximately 57 cents of every dollar spent on food in the US.⁵

The reduction of morbidity and mortality from intentional and unintentional injury is a principal goal of Healthy People 2010. Understanding that both unintentional and intentional injuries are preventable public health issues is considered to be a key challenge to this goal.⁶

Approaching injury and injury prevention as a public health issue, similar to other preventable diseases, is a crucial mission for the National Center for Injury Prevention and Control (NCIPC) at the Centers for Disease Control and Prevention (CDC).⁷ This includes defining the problem of injury, targeting risk factors for injury as well as host, environmental or behavioral characteristics that are associated with protection from injury. The NCIPC has also identified the development and testing of injury prevention strategies, as well as the extensive incorporation and implementation of those strategies found to be effective as important objectives.⁷

Although doctors are intuitively natural allies in meeting the CDC NCIPC goals and objectives, they face a number of challenges. Our current system of trauma care has considerably reduced death and disability from traumatic injury; however, acute care intervention only begins to consider the burden of injury-related issues.⁸ The American College of Surgeons and others have reported that further reductions in morbidity and mortality secondary to injury must involve increased efforts in the area of injury prevention and control.^{9–13} Additionally, professional societies such as the American College of Emergency Physicians and the American College of Surgeons, and most recently the Association of American Medical Colleges (AAMC), have called for the concepts of injury prevention and control to be part of undergraduate and resident medical education.¹⁴ The education of healthcare professionals who are strategically positioned to implement injury prevention and control practices must be at the foundation of these efforts.¹⁵ Physician involvement at many level (screening, anticipatory guidance, patient education, community involvement, collaborative research, legislative support) can affect both individuals as well as entire populations, and has had a positive effect with respect to injury reduction.^{9–11, 13–19}

Additionally, as medical students enter the practice of medicine, progressive injury prevention policies will affect their daily practice of medicine. One example is that injury prevention policies for level I trauma center designations are mandatory.

The burden of injury as a disease, with its associated morbidity, mortality and economic effects, as well as the potential for its reduction, through prevention and control, validate the inclusion of injury in the medical school curriculum. However, the integration of injury prevention concepts into existing undergraduate medical curriculums remains a challenge for US medical schools.

CURRENT STATE OF INJURY PREVENTION AND CONTROL IN UNDERGRADUATE MEDICAL EDUCATION

The accreditation standards for medical education programmes leading to the Doctorate of Medicine established by the Liaison Committee on Medical Education mandate that curriculums emphasize

Abbreviations: AAMC, Association of American Medical Colleges; CDC, Centers for Disease Control and Prevention; CurrMIT, Curriculum Management and Information Tool; NCIPC, National Center for Injury Prevention and Control

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See end of article for authors' affiliations

Correspondence to: Dr M B Phelan, Medical College of Wisconsin, 8701 Watertown Plank Road, Milwaukee, WI 53226, USA; mbphelan@mcw.edu

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“the understanding of disease and the effects of social needs and demand on care” and include prevention and preventive medicine and behavioral and socioeconomic subjects.^{20, 21} A review of the literature shows that undergraduate medical education inadequately deals with the important public health issues of injury, injury control and injury prevention relative to the emphasis given to equivalent health issues, including cardiovascular disease or cancer.^{12, 13} A national survey of US medical schools conducted by Wright and Litaker¹² found that less than half of the schools included injury prevention information in their core curriculum, less than one third provided electives on this subject and few students chose these offerings. Two thirds of schools required curriculums in preventive medicine; however, these schools were no more likely to include injury prevention in their required or elective curriculums over those that did not require preventive medicine education. In summary, the published literature shows that many medical schools have incorporated instruction focused on selected areas of injury prevention and control (eg, detection/prevention of child abuse/neglect, intimate partner violence, elder abuse). This approach targets only a limited subset of topics related to injury and fails to consider the topic of injury prevention and control as a preventable disease process that can be greatly influenced by primary and secondary prevention procedures undertaken by practising doctors.

The AAMC Curriculum Management and Information Tool (CurrMIT)²² was searched using 20 keywords associated with injuries (table 1). CurrMIT is a curriculum information and management tool managed by the AAMC. This password-protected, online database offers a full array of support services designed to help medical schools manage and report on the medical student curriculum. As a database, CurrMIT can be used to obtain detailed comparisons of curriculums among US and Canadian medical schools; to analyze trends in medical education; and to gather information about teaching and learning sites, contact hours devoted to specific topics and assessment techniques. The latter functionality is what the authors used to obtain information on injury.

No CurrMIT-indexed US medical school had courses or curriculum content specific to the keywords “injury control” or “injury prevention”, and less than one third of the medical schools in the CurrMIT database reported courses associated with any of the injury-related keywords. A more detailed examination of the courses that did report a “session element” dedicated to injury ascertained that 57% (89/155) of the course citations were related to cellular and nerve injury, rather than to external mechanisms of injury.

A review of the literature focused on medical students’ perception regarding the inclusion of injury prevention and control content in undergraduate medical education corroborates the formal curriculum review data. As early as 1998, more than half of fourth-year medical students, at six medical schools surveyed regarding injury curriculum, reported <5 h of instruction on injury prevention and control during their education.¹³ Students perceived that they had minimal exposure to injury control and prevention. Although students were able to identify rotations where injury control/prevention was discussed more often (such as pediatrics), students did not identify injury as an important and preventable medical problem as compared with other medical problems, such as high-fat diets, tobacco use, AIDS and coronary artery disease.

Medical students’ perception regarding injury control and prevention in the medical school curriculum was obtained from the annual AAMC Senior Medical School Graduation Questionnaire, which is completed by about 85% of graduating medical students.²³ The graduation questionnaire was reviewed to identify items associated with injury and to obtain the learners’ perspective regarding the degree to which students believed they were prepared to deal with injury control and prevention. The graduation questionnaire does not specifically deal with injury prevention/control, although two injury prevention and control-related areas were specified that learners identified as appropriately/excessively covered. These were family/domestic violence and health promotion/disease prevention.

The concept of injury as a preventable-disease process is not a new one. In the early 1960s, William Haddon, the principle physician scientist who established our modern scientific understanding of injury, argued that injury should be viewed as a disease that has an at-risk host, an agent/vector and a set of environmental factors.^{10, 24} When motor vehicle crash injuries are examined in the context of a preventable disease, the host is the at-risk driver (sober or intoxicated, focused or distracted, old or young), the agent is kinetic energy “carried by a vector (is the vehicle large or small, restraint systems in place?), coupled with environmental factors (types of roads, time of day). Any or all of these factors might be altered to eliminate or mitigate the likelihood or effect of a crash and injury.²⁴

By reframing injury as a disease process, opportunities emerge to weave injury concepts within and across the Liaison Committee on Medical Education-mandated contemporary content of core disciplines (eg, anatomy, biochemistry, physiology, pathology) and clinical experiences associated with a variety of medical specialties (eg, family medicine, internal medicine, obstetrics and gynecology, emergency medicine,

Figure 1 Result of CurrMIT query. The AAMC represents 125 accredited US MD-granting medical schools.

pediatrics, orthopedics, neurosurgery, psychiatry and general surgery).²⁵ This provides the basis for doctors to not only work to treat injuries but also to advocate for injury prevention.

INCORPORATING INJURY CONTROL AND PREVENTION INTO AN EXISTING CURRICULUM

Competencies and curriculum structure

Designing education initiatives begins with defining the core competencies associated with the topic, delineating associated objectives specific to each competency and then creating or modifying a curriculum structure in which to deliver the associated education.^{21 25 26} As medical student education provides the foundational knowledge and skills for injury prevention training during residency, we have framed our medical student injury prevention/control curriculum using the six Accreditation Council for Graduate Medical Education competencies (patient care, medical knowledge, interpersonal and communication skills, professionalism, practice-based learning and improvement and systems-based practice).²⁷ These competencies provide a structure for developing and integrating a comprehensive set of injury prevention objectives as they span the knowledge and skills needed for injury prevention and control for both the individual patient and populations of patients.

For example, using cases of children at risk for injury while riding bicycles without helmets, instruction in anatomy and physiology can focus on head injury and how bicycle helmets prevent or diminish changes in anatomy and physiology in the event of head trauma (medical knowledge). This medical knowledge is then applied when students provide acute care for the child with head injury during a clinical rotation (patient care, practice-based learning and improvement), as well as when providing anticipatory guidance to patients and families during well-child visits (interpersonal and communication skills, professionalism). Instruction pertinent to prevention and population-based medicine can be dealt with during biostatistics and epidemiology courses, using evidence-based medicine findings to emphasize that bike helmet use among children and adults results in a 63–85% reduction in head injuries in these populations (practice-based learning and improvement).²⁸ Instruction in preventive medicine and/or medicine in society courses could focus on the role of the doctor in advocacy/policy at a local, state or national level (system-based practice). In combination, this provides medical students with a solid and practical foundation of injury prevention on which to build during residency.

Injury curriculum matrix

Building on the example of prevention and control for bicycle-related injuries, each doctor (MBP, MEF, SWH) was assigned to investigate one of the three selected injury topics as it related to the individual patient encounter) and population-based strategies for injury reduction/control. Each author delineated the objectives for each topic, framed the objectives within the Accreditation Council for Graduate Medical Education competencies and then analyzed the traditional components of a block curriculum structure (eg, courses in basic sciences and clerkships) and identified potential locations for integration of the topic by competency(ies)/objective(s). The results are presented in an injury curriculum matrix that shows, by the competencies and course/clerkship in traditional curriculum block structure, each topic's patient-specific and population-specific foci.

Preclinical training

Injury prevention at an individual patient point of care may be emphasized as part of the history and physical examination during training before medical student clerkships. Problem-based learning or clinical correlation cases could include

prompts for medical students to take into account anticipatory guidance questions and focused injury inquiry when appropriate. Any objective structured clinical examination (OSCE) could provide the students an opportunity to practice their injury prevention skills and the skills required to minimize the effect of injuries that have occurred.

Additional elective clerkships

Additional elective clerkships can be developed to further expand on basic science and clinical course teachings. For example, the Medical College of Wisconsin, Wisconsin, USA, has an integrated selective (elective fourth-year medical student clerkship) titled "Injury Prevention and Control". Multiple objectives are met during the clerkship, stemming from exposures to acute care, chronic and rehabilitative care, crash investigation and forensic pathology. Experts from multiple disciplines such as geriatrics, pediatrics, trauma surgery, emergency medicine, and physical medicine and rehabilitation provide didactic lectures regarding selected injury prevention and control topics. Students then participate in non-clinical patient management, reviewing injury prevention-related aspects and applying these to the developed injury control matrix presented in this paper. Students spend time at the medical examiners office identifying injury patterns and applying injury prevention perspectives to individual cases. Students also participate in an external rotation with SAFE KIDS, a nationally recognized community service organization that maintains a focus on injury prevention for minors. This aspect of the rotation introduces medical students to the possibility of collaborating with community partners to develop injury prevention programs.

EMBED INJURY TEACHING IN HOSPITAL SETTINGS

Cook *et al*²⁹ present an excellent example of the potential for injury control at a population-based level in an article that shows the utilization of state-wide motor vehicle crash and hospital discharge data. These authors were able to identify distinct motor vehicle crash patterns (older drivers had twice as many left-turn crashes than younger drivers). They also noted a higher rate of injury, death and the need for longer periods of healthcare assistance after hospital discharge in the older drivers. Building on the success of brief bedside interventions in patients sustaining/causing injury while intoxicated, teaching doctors how to incorporate anticipatory guidance to older adults and their families regarding driving and/or working with the hospital social worker to arrange for transportation for the older adult are illustrative of hospital-based point-of-care educational interventions.^{30–32} When medical students are exposed to preventive interventions in the context of emergency department or inpatient care, they are able to link injury control at the individual level (having the knowledge to warn older drivers about this risk in their age group and suggesting interventions) and at population-based levels (having the knowledge to suggest change at a state level, such as further peripheral visual testing for older drivers).

CONCLUSIONS

Nearly all doctors will encounter acutely injured persons or treat the aftermath of injury in their practice. At the point of individual patient care, doctors are often the first healthcare providers. They provide care for acute injuries, mitigate further insult from sustained injuries and are an integral part of the rehabilitation process after an injury. Furthermore, doctors are respected sources of information regarding health issues and have many opportunities to provide information on primary and secondary injury prevention to patients.

Improving the health of individuals is an important role of the doctor, as is the injury prevention potential that doctors can

and do have with respect to populations of patients. Doctors collaborating with communities and federal agencies have enormous potential to effect injury control and prevention through collaboration with research, education and policy-making agencies such as National Highway and Traffic Safety Administration, the CDC's NCIPC and selected National Institutes of Health institutes such as National Institute on Alcohol Abuse and Alcoholism.²⁹ First-hand exposure to preventable death and disability as a result of potentially preventable injuries, uniquely positions doctors to advocate for change in individual patient behaviors, for populations of patients and at product development or legislative levels.

However, curriculum audits and student perception data show only limited emphasis on injury as a disease process. The injury curriculum matrix visually shows how injury prevention and control can be woven into a traditional block curriculum structure. Our purpose in presenting the injury curriculum matrixes is to stimulate discussion about how to incorporate educational objectives for injury, the fourth leading cause of death in the US, into our medical student curriculum, at both the individual (the faculty member, course director) and population (medical school curriculum committees, M1 course committees) levels.

Curriculum change is one of many strategies and initiatives that must be implemented if we are to deal with the burden of injury. Showing how injury can be incorporated into multiple disciplines and specialties is the power behind this curriculum approach. Through educational reform, beginning at the medical student level, the pervasiveness and effect of injury as a new type of disease model can be learnt and understood by today's medical students who are tomorrow's future practising doctors, policy makers and healthcare opinion leaders.

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Authors' affiliations

Mary Beth Phelan, Department of Emergency Medicine, Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Deborah E Simpson, Department of Academic Affairs, Medical College of Wisconsin, Milwaukee, Wisconsin, USA

Mark E Falimirski, Department of General Surgery, Indiana University, Indianapolis, Indiana, USA

Stephen W Hargarten, Injury Research Center, Medical College of Wisconsin, Milwaukee, Wisconsin, USA

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