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Medical Student Education for Injury Prevention: Closing the Gap

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Abstract

Introduction: Injury is a major public health issue in the United States (U.S.). In 2017, unintentional injury was the leading cause of death for ages 1 through 44. Unfortunately, there is evidence that the sciences of injury prevention and control may not fully and widely integrated into medical school curriculum. This paper describes a novel injury prevention and control summer program that was implemented in 2002 and is ongoing.

Methods: The main component of the Series includes at least seven injury-related lectures and discussions designed to provoke students' interest and understanding of injury as a biopsychosocial disease. These lectures are organized in a seminar fashion and are two-to-four hours in duration. Kirkpatrick's four-part model guides evaluation specific to our four program objectives. Trainee satisfaction with the program, knowledge, and outcome (specific to career goals) is evaluated using several mixed-methods tools.

Results: A total of 318 students have participated in the Series. Evaluation findings show an increase in knowledge of injury-related concepts as well as an increase in interest in pursuing injury-related research topics in the future.

Implications: The Series is a novel and innovative program that provides training in injury and injury prevention and control-related topics to medical students, as well as undergraduate, graduate, and pharmacy students. We hope that by increasing students' knowledge and understanding of injury prevention and control we are contributing to a physician workforce

that understands the importance of a public health approach to injury prevention, that implements public health principles in practice, and that advocates for policies and practices that positively impact injury prevention and control to help make our communities healthier and safer.

Keywords

medical education; injury prevention; public health

INTRODUCTION

Injury is a major public health issue in the United States (U.S.). In 2017, unintentional injury was the leading cause of death for ages 1 through 44, and suicide was the second leading cause of death for individuals ages 10 through 44.³ Despite their burden, however, injuries are both predictable and preventable.

In 1966, the historic publication from the National Research Council defined injury as the “Disease of Modern Society.” Directly from this publication, there was a call for physicians to strengthen trauma care, emergency medical services (EMS) grants became available, and emergency medicine was “born”. The National Highway Transportation Agency was established in 1968 and eventually the CDC established the National Injury Prevention and Control Center. Both of these federal agencies have been led by physicians.

According to the Centers for Disease Control and Prevention, injury is defined as “...any unintentional or intentional damage to the body resulting from acute exposure to thermal, mechanical, electrical, or chemical energy or from the absence of such essentials as heat or oxygen.”¹

Physicians have a unique opportunity to engage in injury prevention and control through their clinical practice and through advocacy for injury prevention programs and policies. They may engage in injury-related research and are well-positioned to educate patients and other clinicians on the principles of injury prevention and control. Unfortunately, there is evidence that the sciences of injury prevention and control may not fully and widely integrated into medical school curriculum. A recent (2019) meta-analysis revealed a knowledge-gap in the incidence and/or effectiveness of injury prevention and control curriculum in medical school programs.⁴ Similarly, a systematic literature review demonstrated a lack of firearm safety education programs in medical education settings.⁵ This is concerning, given the burden of firearm-related injury in the United States.

Medical education programs can address this gap by adding structured injury prevention and control curriculum to the traditional medical school curriculum. Initial research shows that these types of programs can increase knowledge of injury-related topics among future medical providers. A 2010 evaluation of an injury prevention curriculum within a pediatric residency program found a significant increase in knowledge gain and sustaining of knowledge among the participating pediatric residents.⁶ In addition, a multidisciplinary course on injury prevention for fourth-year medical students demonstrated high levels of satisfaction among participants and increased participants’ understanding of the physician’s role in injury prevention and policy.⁷ Accordingly, given the large burden of injury in the

patient population and insufficient educational opportunities for learners, there is much work to be done.

We wish to introduce and describe a novel injury prevention and control summer program (Summer Student Injury Series, or “Series”) that was implemented in 2002 and is ongoing. Information on course development, course structure, and course curriculum is presented, along with evaluation results. As summer research programs, including wet lab and basic science programs, are supported by major funders, including NIH, we wish to summarize our experience so that others may consider adoption.

METHODS

The implementing body for the Series is the Comprehensive Injury Center at the Medical College of Wisconsin (CIC-MCW). The CIC was established in 1998 as a comprehensive institutionally funded injury control research center to address the burden of injury locally and nationally. The goals of the CIC are to advance injury control and prevention science through rigorous research, to translate injury research into clinical practice, to train the next generation of injury prevention and control researchers and practitioners, and to strengthen injury prevention and control through authentic community engagement. Partnerships with faculty and departments from across the institution and community provide a wealth of opportunities for growth and education. Therefore, the CIC offers the ideal environment to provide mentorship and guidance for injury research.

Developing and nurturing new injury researchers and innovative projects is key to the CIC’s mission. The CIC’s Education Collaborative, which is comprised of several faculty members from multiple departments at MCW, has hosted the Series as part of its mission since 2002. In addition to the students (second year medical students) who participate with the support of a T35 grant from the National Institutes of Health’s National Institute on Aging, the Series also welcomes students from our campus’ graduate and pharmacy schools. Students are selected from the Medical School Summer Research Program (MSSRP) who have a specific focus on injury prevention and control for their summer research project. Several of the mentors of the summer students also teach in the summer program.

The objectives of the Series include:

- Introducing medical students to clinical and population health research;
- Providing training in the concept of injury as a preventable biopsychosocial disease; and
- Offering students an opportunity to apply research methods, organize presentations, and interpret injury-related study outcomes.

Students are also invited to reflect on how their research directly relates to the various seminar topics through informal discussions following the scheduled seminar. Through hands-on research with a faculty mentor, students learn about the scope, consequences, and burden of injury as a public health issue which affects patients, families, and communities. Students also articulate physician roles as patient advocates in injury prevention and control,

explain differences in philosophy and prevention approaches, and demonstrate ability to effectively interpret, communicate, and present research to a variety of local, regional and national audiences. Several students who have participated in the Series have presented these research findings at national conferences.

The Series builds off a prior MCW program which implemented a multidisciplinary course on injury prevention and control for fourth-year medical students. This month-long program included real-time tracking of traumatically injured patients, small-group discussions, and a learning focus on an injury topic of the students' choice. Other activities included patient interviews and visits to a vehicle crash laboratory.⁷ As compared with the prior program, the Series provides students with exposure to injury prevention and control topics earlier in their medical student education and broadens the reach to include graduate and pharmacy school students as well. In addition, the Series added the mentored research project and presentation of findings to peers. This provides opportunities for further dissemination of research findings and fosters the development and practice of effective presentation skills.

The main component of the Series includes at least seven injury-related lectures and discussions designed to provoke students' interest and understanding of injury as a biopsychosocial disease. These lectures are organized in a seminar fashion and are two-to-four hours in duration. The Series begins with a presentation on injury as a biopsychosocial disease and also provides students with information on how to properly frame a research question. Other topics for the lectures span injury-related topics such as falls, motor vehicle crash, interpersonal violence, and firearm-related injury. A sample core curriculum is listed in Table 1.

In addition to the Series sessions, students are provided with background reading materials throughout the summer to augment learning gained during discussions and lectures. Students are also invited to participate in other opportunities on campus to learn about injury research.

Systems of Care Experience

A highlight of the Series is the Systems of Care Experience, a half-day interactive session that takes learners on a journey through an injured patient's experience. Typically, the virtual patient scenario involves a young adult who is injured by gun violence in the community. The participants begin the experience in the flight-for-life air transport helicopter, then visit the trauma bay in the emergency department, the operating room, the intensive care unit, and the rehabilitation floor. At each location in the hospital, specialists including emergency medical systems dispatchers, physicians, nurses, technicians and therapists explain their role in the care of the injured patient. The main objective for this session is for students to gain an understanding of all the resources that go into the care of a firearm injury patient. After the experience there is a debriefing and the learners frame the event within Haddon's Matrix (see Figure 1) to dissect all elements of the injured patient and environment and discuss strategies to prevent or mitigate injury at every level. The presentation of Haddon's Matrix provides a framework for students to understand and conceptualize injury as a disease, which allows them to advocate for appropriate prevention and treatment of injured patients.

This session was recorded in 2018 to be made available to students on campus who are unable to attend the presentation in person.

Evaluation Methods

Kirkpatrick's four-part model⁸ guides evaluation specific to our four program objectives. This model, which emphasizes *satisfaction, knowledge transfer, and outcomes/results* provides a coherent framework for conducting and reporting our evaluation findings. Trainee satisfaction with the program, knowledge, and outcome (specific to career goals) is evaluated using several mixed-methods tools.

1. Institutional Program Evaluations

- a. Trainee Evaluations. Trainees complete questionnaires during the program orientation and at the conclusion of the summer. The questionnaires cover several areas relevant to the training, including:
1) the degree of the trainee's experience with experimental procedures, 2) the degree to which experimental procedures, problem solving and scientific techniques should be included in the experience, 3) the primary influences on the trainee's career goals, 4) the factors influencing the trainee's decision to apply for the summer fellowship, and 5) in the post-training questionnaire, the trainee's level of satisfaction with the experience and suggestions for future content.
- b. Preceptor Evaluations Between the first and second weeks of the training and again at the close of the training period the preceptors complete questionnaires evaluating their trainee's scientific preparedness and identifying the degree to which experimental procedures, problem solving, and other research techniques will (or were) included in the experience. Pre- and post-training suggestions are solicited for improving the application process, content, or other aspects of the program. Preceptors are also asked to provide updated descriptions about new or completed investigations.

2. CIC Series Evaluation

- a. The CIC uses a pre- and post-test questionnaire to assess each student's satisfaction with the program and to measure changes in the students' knowledge and attitudes about injury prevention and control and a "biopsychosocial approach" to research, clinical care, and injury control efforts, including the ability to identify the special risks, needs, and circumstances of injured patients. Satisfaction is assessed using a seven-point Likert scale-style score, and assessment of knowledge is based on an agree/disagree response. Qualitative information is also gathered by asking open-ended questions, including: "What were the highlights of the CIC Summer Student Injury Series?" and "What suggestions do you have for improving the Series?"

- b. Student performance is measured through assessment of their products. Students present a brief, formal podium presentation to peers and faculty/mentors at the final CIC Seminar, and, if funded through the National Institute on Aging (NIA), to the Geriatrics Division Research Meeting at the end of the summer experience, structured in the format of a professional meeting (e.g., 15 minutes, including Q&A). Quality of the presentation and the research are assessed using a structured rating and feedback tool. Further, students present a poster two months later at a poster session, which is reviewed and judged by faculty reviewers.
- c. Long-term follow-up occurs through annual surveys of graduates, an author search of several databases (e.g., Pub-Med) and a web search using current search engines. An annual e-survey is utilized to ask for career updates, research involvement including an emphasis on injury and geriatrics, and their “geriatric-injury approach” to the patient, therapy, and/or research. Program staff maintain a trainee relational database that includes all products (e.g., publications, presentations, career decisions including fellowships in geriatrics), career intentions (e.g., grant application, research fellowship, Med-Ger residency slot), and contact information for trainees by year. Aggregated data by trainee year is reported annually as part of the progress reports and disseminated nationally through peer reviewed presentations and publications specific to our program objectives.

RESULTS

The Series has been implemented on an annual basis since its inception in 2002. A total of 318 students have participated in the Series (mean: 18 students per year). Although the Series was designed for medical students entering their second year, a number of undergraduate, graduate, and pharmacy students have attended the Series as well. In 2017, the Series welcomed its first high school student, who participated as part of an MCW high school research program.

Pre-/post-quiz results demonstrate that the number of students interested in pursuing injury research after medical school increases after attending Series sessions (increase of 2 [13%] in 2017, 7 [50%] in 2018, and 8 [44%] in 2019). An increased number of students are able to complete Haddon’s Matrix after the Series (73% in 2017, 79% in 2018, and 72% in 2019). After completing the Series, students also note that there is too little injury-related information provided in medical school. Further, students are able to discuss the role that physicians play in reducing the burden of injury. Responses include:

- Treatment of the injured patient
- Education of patients on injury-related topics
- Prevention of injury
- Advocacy for injury prevention and control-related policy

In addition, knowledge of injury-related topics increases. Specifically, the 2019 cohort learned that many injuries are not the result of “accidents” which are defined as events that happen by chance that are without apparent cause (+7 students, 39%), and that the leading cause of unintentional injury-related death in America for adults is poisoning (+5 students, 28%).

Scores reveal relatively high mean satisfaction across several questions. The mean score to the question, “Were the Series sessions well planned?” was 6.9 (out of 7). The mean score for the question, “Were the Series session topics valuable for your project work?” was 6.6. The mean score for the question, “Did the Series enhance your research skills?” was 5.9. In terms of applicability of the Series to future education and practice, students note that, “It [the Series] has enhanced my understanding of public health...” and, “I learned much more about epidemiology and the importance of treating injury as a biopsychosocial disease, and I hope to continue working in injury prevention as a physician.”

Additional results reveal overall satisfaction with the Series. Student responses include, “It was really eye-opening to learn about the scope of injury. I will definitely consider aspects of injury prevention and treatment...in the future.” “The weekly presenters and final presentations opened my eyes to areas of concern for physicians that aren’t always addressed.” “Overall I feel more informed about areas of health care that I didn’t think were important to my career prior to this summer.” “My attitude on physician advocacy has definitely changed. I want to provide what information I can to help implement change.” In addition, students provide suggestions for improving the program. Some of these suggestions include providing trauma shadowing opportunities to further witness how injury impacts patients in real-time and including sessions on behavioral health injury topics. Other suggestions include the integration of clinical medicine, case reports, and management of injury into the Series.

DISCUSSION

The Summer Student Injury Series is an innovative educational program that is meant to address the gap in injury prevention and control-related curricula in medical school programs. This program provides a foundation for medical students to learn about and appreciate public health, to engage in mentored research, and to consider an academic, community health-minded career. The Series has demonstrated that medical students have interest in learning information about injury prevention and control and that learning about these concepts increases as a result of these sessions. A next step would be to consider full integration of injury prevention and control into medical school curriculum. In addition, this program prompted students to consider how they might apply public health principles of injury prevention and control in their future clinical practice and advocacy.

The Series has been agile and has continued to evolve since its inception. In the earlier years of the Series, sessions were much more focused on research-based topics, including presentation skills, statistical analysis, and the ethical treatment of human subjects. As the Series has progressed, more specific injury topics have been introduced. Over the past few years, there also has been more of a focus on opioid-related injury as well as firearm-related

injury. One addition to the Series starting in 2013 was a faculty panel on gun violence. One of the regular presenters on this panel is a survivor of gun violence, who recounts her experience in the trauma system after being injured, and session evaluations have demonstrated that this session has been particularly impactful for students. The program will continue to evolve based on changing injury-related research priorities, and also based on the injury-related interests of students.

The CIC will offer lessons learned to other institutions who are interested in offering this type of opportunity through channels like the American Association of Medical Colleges and through conference presentations. We will continue to adapt our curriculum to ensure that we are engaging students in emerging injury-related topics. In order to sustain our work, the CIC and its affiliated faculty also plan to apply for an additional five years of funding from the NIA. Institutional funding will also continue to provide support for this program into the foreseeable future.

CONCLUSION

The Series is a novel and innovative program that provides training in injury and injury prevention and control-related topics to medical students, as well as undergraduate, graduate, and pharmacy students. We hope that by increasing students' knowledge and understanding of injury prevention and control we are contributing to a physician workforce that understands the importance of a public health approach to injury prevention, that implements public health principles in practice, and that advocates for policies and practices that positively impact injury prevention and control to help make our communities healthier and safer.

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REFERENCES:

- Centers for Disease Control and Prevention. Definitions for WISQARS Nonfatal - NCIPC. <https://www.cdc.gov/ncipc/wisqars/nonfatal/definitions.htm>. Accessed December 12, 2019.
- Xu J, Murphy SL, Kochanek KD, Bastian B, Arias E. Deaths: Final Data for 2016. Vol 67.; 2018. <https://www.cdc.gov/>. Accessed September 26, 2019.
- Centers for Disease Control and Prevention. 10 Leading Cause of Death by Age Group, United States - 2017.; 2017.
- Schmitz E, Figueira S, Lampron J. Injury Prevention in Medical Education: A Systematic Literature Review. *J Surg Educ*. 2019;76(3):700–710. doi:10.1016/j.jsurg.2018.10.009 [PubMed: 30466883]
- Puttagunta R, Coverdale TR, Coverdale J. What is Taught on Firearm Safety in Undergraduate, Graduate, and Continuing Medical Education? A Review of Educational Programs. *Acad Psychiatry*. 2016;40(5):821–824. doi:10.1007/s40596-016-0490-6 [PubMed: 26911492]
- Gittelman MA, Pomerantz WJ, Schubert CJ. Implementing and Evaluating an Injury Prevention Curriculum Within a Pediatric Residency Program. *J Trauma Inj Infect Crit Care*. 2010;69(Supplement):S239–S244. doi:10.1097/TA.0b013e3181f1ed63
- Webb T, Winthrop A, Klingbeil F, et al. A Multidisciplinary Course on Injury Prevention and Control for Medical Students. *Wis Med J*. 2011;110(4):234–239.
- Bates RA critical analysis of evaluation practice: The Kirkpatrick model and the principle of beneficence. *Eval Program Plann*. 2004;27(3):341–347. doi:10.1016/j.evalprogplan.2004.04.011

	HOST	AGENT	ENVIRONMENT	
			PHYSICAL	SOCIAL
PRE-EVENT				
EVENT				
POST-EVENT				

Figure 1:
Haddon's Matrix

Table 1:

Sample Series Curriculum

Topic	Session Goals and Sample Readings
Overview: Injury is a Disease and How to Frame a Research Question	<ol style="list-style-type: none"> 1 Summarize the framing of injury as a biopsychosocial disease 2 Develop an injury-related research question 3 Discuss the role of physicians in injury prevention and control <p>Sample reading: Reducing the Burden of Injury: Advancing Prevention and Treatment http://www.nap.edu/catalog.php?record_id=6321</p>
Physician Advocacy for Injury Prevention	<ol style="list-style-type: none"> 1 Describe how physicians can advocate for injury prevention and control policy 2 Review one example of how a local physician advocated for state-level injury control policy <p>Sample reading: Out of Unspeakable Tragedy Comes Progress in Bleeding Control http://bulletin.facs.org/2017/06/out-of-unspeakable-tragedy-comes-progress-in-bleeding-control/#.Wunqzk2Wzkg</p>
Systems of Care Experience (see below*)	*see below
Preventing Falls Across the Lifespan	<ol style="list-style-type: none"> 1 Understand the burden of injury from falls among pediatric and geriatric populations 2 Distinguish unique fall risk between pediatric and geriatric populations 3 Discuss fall prevention activities in which clinicians can participate <p>Sample readings: Pediatric Injuries Attributable to Falls from Windows in the United States in 1990–2008 https://pdfs.semanticscholar.org/fdcc/29ca0a7ad814ac73673a317b70b21f2159bb.pdf Prevention of Falls in Community-Dwelling Older Adults: US Preventive Services Task Force Recommendation Statement http://annals.org/article.aspx?articleid=1305528</p>
Interpersonal Violence Across the Lifespan	<ol style="list-style-type: none"> 1 Summarize the burden of injury from interpersonal violence in pediatric and geriatric populations (child abuse and elder abuse-related injuries) 2 Distinguish unique risk for and signs of interpersonal violence-related injury between pediatric and geriatric populations 3 Determine how clinicians can prevent interpersonal violence-related injury <p>Sample reading: Managing Child Abuse: General Principles http://pedsinreview.aappublications.org/cgi/reprint/31/2/47</p>
Preventing Poison-Related Injury Across the Lifespan/Medication Complications and Opioids	<ol style="list-style-type: none"> 1 Understand the history of the opioid epidemic in the United States 2 Summarize policies that have been implemented to address the opioid epidemic 3 Discuss the Prescription Drug Monitoring Program as a resource for clinicians <p>Sample reading: A Multistep Approach to Address Clinician Knowledge, Attitudes, and Behavior Around Opioid Prescribing Kohlbeck, S., Akert, B., Pace, C., & Zosel, A. (2018). A Multistep Approach to Address Clinician Knowledge. <i>WMI</i>, 38.</p>
Preventing Firearm-Related Injury	<ol style="list-style-type: none"> 1 Summarize the burden of firearm injury in the United States 2 Discuss community-based firearm injury prevention strategies 3 Detail how clinicians and hospital systems play a role in firearm injury prevention <p>Sample reading: Implementing a Public Health Approach to Gun Violence Prevention: The Importance of Physician Engagement http://annals.org/article.aspx?articleid=1569946</p>
Student Research Presentations	<ol style="list-style-type: none"> 1 Demonstrate the ability to generate a research question and to conduct an injury-related research study 2 Present results of research study to colleagues and mentors 3 Evaluate injury-related research projects of colleagues