SPECIAL FEATURE

From strategy to reality: 25 years of planning and progress in occupational injury research

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It is a challenge to identify an area other than occupational injuries that has such a tremendous impact on public health, and yet has had such a limited foundation of sound science to guide prevention. Although workplace safety issues have received attention for more than a century, it is only relatively recently that we have applied a scientific approach to occupational injury prevention, and begun to make progress in building that foundation.

Over the years, the direction of occupational injury research has been influenced by the application of the public health approach and by various, collective planning efforts. This article discusses the public health approach to occupational injury research, and reviews some of the past strategic planning efforts to highlight where we have gone and where we want to be.

In the 1930s and 1940s, the public health community began to realize that injuries, including those that occur at work, could be addressed using the same conceptual frameworks and analytic tools that were being used successfully against infectious and chronic disease. As early as 1937, Godfrey was calling for the application of the public health approach to injury research and prevention.[1] Half a century ago, in 1949, John Gordon wrote that injuries are "equally susceptible" to the public health approach as the communicable and chronic diseases of humans.[2] He said "accidents as a health problem of populations conform to the same biologic laws as do disease processes and regularly evidence a comparable behavior".[2]

The public health process identifies and addresses health problems, such as traumatic injuries to workers.[3] It consists of several clear steps, beginning with surveillance. Data collection and analysis enable us to pinpoint, prioritize, and monitor illness and injury incidence and develop hypotheses for further research. Analytic injury research enables us to identify, quantify, and prioritize risk and causal factors. Such analyses allow us to identify existing, or develop new, strategies for prevention and control and test their preventive effectiveness and cost effectiveness. Then, armed with information about the relative effectiveness of potential preventive strategies, we can disseminate and transfer that information and technology to the workers at risk, and to those whose decisions can affect that risk. Finally, after implementation of preventive strategies, we can evaluate the results of those strategies. In theory, the public health process is a straightforward, logical approach to preventing injury. In practice, it has rarely been used to its full extent, following each step from problem identification to implementation and evaluation in the workplace.

There are, however, barriers to the full application of the public health process to occupational injuries. These include the need for diverse disciplines to collaborate in research, which means understanding each other's methods and terminology, and learning how to work together; the scarcity of public health educational programs that specifically teach injury epidemiology; the challenge of collaborating with industry to evaluate prevention efforts in real work settings; and an historic lack of research funding commensurate with the scope and magnitude of workplace injuries.

With these barriers in mind, this article reviews some of the recommendations for occupational injury research and prevention that have resulted from national level planning efforts over the past few decades (see table 1). One objective is to illuminate a pattern that emerges among these recommendations—evidence of a consistent vision shared by different people in different eras that should serve to assure us of their importance and validity. Another objective is to point out that we are on the brink of a very promising era of occupational injury research and prevention.

The 1970s

A landmark event in the history of occupational safety and health in this country was the passage of the Occupational Safety and Health Act of 1970, the legislation that created both the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH) to address, from the national level, the problems of occupational injury and illness.[4] However, it was not until the mid-1970s that NIOSH focused its occupational injury research activities by creating the Division of Safety Research. This is the point of departure for this discussion, not because there had never before been a national level focus for occupational injury research, but because this new division began almost immediately to struggle with

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Table 1 An annotated timeline: the public health approach and strategic planning in occupational injury research and prevention

1937	Edward Godfrey's remarks to the annual meeting of the American Public Health Association and published in the *American Journal of Public Health* call for public health departments to take on the prevention of accidents, for the techniques of epidemiology to be applied to accidents, and for the emphasis on descriptive statistics to move toward an emphasis on prevention and control.
1949	John Gordon's remarks published in the *American Journal of Public Health* call for epidemiologic analysis as a means for better understanding and guiding prevention of accidents.
1970	The Occupational Safety and Health Act (OSH Act) of 1970 is promulgated, creating the Occupational Safety and Health Administration (OSHA) and the National Institute for Occupational Safety and Health (NIOSH).
1977	The NIOSH Division of Safety Research was created to serve as the focal point for the NIOSH occupational safety research program.
1979	NIOSH Division of Safety Research management outlines the division's safety research strategy in a *Professional Safety* article.
1980	In *Public Health Reports*, William Haddon claimed that the application of epidemiology to injury control had been largely ignored in the decades since the 1940s, but that "...as a public health problem, injuries may eventually command the attention from public health people that is more nearly proportionate to their prominence as the leading cause of death in the United States from the first year of life to middle age".
1985	The publication of *Injury in America*, which is notable for its recommendation to establish an injury prevention research center within the federal government and for evidencing that injury prevention and control was finally becoming a mainstream focus of the national public health community. Publication of the congressionally sponsored study, *Preventing Illness and Injury in the Workplace*, which produced a wide range of recommendations for preventing and controlling occupational injuries and illnesses.
1989	Publication of the NIOSH national strategies for preventing the leading 10 occupational illnesses and injuries, which includes a strategy for traumatic occupational injury, and called for the rigorous application of scientific methods and approaches, including epidemiology, to the study of occupational injury.
1992	Proceedings of *Setting the National Agenda for Injury Control in the 1990s* recommends development of a comprehensive surveillance system, increased emphasis on studying control technologies, and that NIOSH should conduct more research and intervention studies, and academic researchers should also focus on identifying risk factors and evaluating preventive strategies through analytic epidemiology.
1996	Publication of the *National Occupational Research Agenda (NORA)* by NIOSH and partners identifies 21 priority topic areas, including traumatic occupational injury.
1998	Publication of *Traumatic Occupational Injury Research Needs and Priorities* by the NORA Traumatic Injury Team which uses the public health model as a framework to identify the research needs and priorities in each phase of the public health process, from surveillance to communication and evaluation.

merging in a meaningful way, the application of the traditional safety sciences—safety engineering, safety management, industrial hygiene, and so on—with the public health approach to research and prevention, which emphasizes the methods of epidemiology. In fact, the occupational safety research community continues to struggle with this merger of perspectives and methods today.[3]

The management team of the new NIOSH division reported on the status of occupational safety research in a 1979 article in *Professional Safety* entitled "Occupational Safety Research—a NIOSH Strategy".[5] They pointed at several significant barriers to scientific advances in the field, including: inadequacies in data collection systems; the absence of information on cost effective prevention methods; employer and employee attitudes regarding occupational safety; the quantity and skills of occupational safety manpower; and the lack of sufficient funding for occupational safety programs.

The authors also made some significant recommendations, including: develop a national database on work injuries for research defining purposes and for program evaluation; formulate, test effectiveness, and demonstrate cost effectiveness of hazard control techniques; establish technology transfer mechanisms; and coordinate and collaborate with other agencies.

Interestingly, there is no mention of either epidemiology or public health in the 1979 article, although the authors do discuss steps that are roughly equivalent to steps of the Public Health Process.

At this time, despite a recognition four decades earlier of the promise that the public health approach held for injury prevention and control, injury had not become a priority of the public health community. In a 1980 article, William Haddon claimed that the application of epidemiology to injury control had been largely ignored in the decades since the 1940s, but that "...as a public health problem, injuries may eventually command the attention from public health people that is more nearly proportionate to their prominence as the leading cause of death in the United States from the first year of life to middle age".[6]

The 1980s

In the mid-1980s, there were three separate, but influential events that produced national strategies for injury research. One was the publication of *Injury in America*.[7] Another was the publication of the Office of Technology Assessment's *Preventing Injury and Illness in the Workplace*.[8] Finally, NIOSH convened two symposia to develop strategies for the 10 leading occupational illnesses and injuries, which included traumatic occupational injuries.[9]

Injury in America is notable for recommending the establishment of a center for injury control within the federal government. This became the Center for Injury Prevention and Control within the Centers for Disease Control and Prevention. It is also notable for other recommendations relating to injury research, including: develop effective injury surveillance systems; evaluate prevention strategies (including education, training and information programs; laws and regulations; and product designs and modifications); study barriers to implementing existing effective injury control measures; and study injury mechanisms through biomechanics and physiology.[7]

In the 1930s and 1940s injury was "theoretically" acknowledged as a public health problem amenable to the science of public health. By 1980, there was evidence that the public health community had begun to pay more attention to injury as a public health problem. *Injury in America* noted that, by the decade of the 1980s, the public health community had finally embraced injury as a compelling public health problem worthy of increased national attention and resources. However, there was still relatively little reference specific to occupational injuries.

At the request of the Chairman of the House Committee on Energy and Commerce, the

Congressional Office of Technology Assessment examined three main topics in a 1985 report, *Preventing Injuries and Illnesses in the Workplace*[8]: identification of occupational hazards (including the available data on injuries and illnesses); development of control technologies for reducing or eliminating workplace hazards; and incentives and imperatives that influence decisions to control hazards.

The authors of this report presented 31 "options for controlling workplace hazards". Of these 31, five dealt with surveillance, data collection, and data quality issues; and only two dealt directly with research issues. The research options addressed: investigations of fatal and non-fatal injuries (with the objective of developing information useful for preventive efforts); and research and demonstrations in control technologies. The other 24 options dealt with a wide range of topics, including: conducting education, training and dissemination; testing and certifying personal protective equipment; applying computer technology to collection and dissemination of occupational safety and health information; providing incentives, such as encouraging and publicizing voluntary efforts in private firms; increasing OSHA enforcement; assessing safety and health programs; and increasing funds for prevention efforts.

During the early to mid-1980s, NIOSH developed a list of 10 leading occupational diseases and injuries, one of which was traumatic occupational injuries. NIOSH convened expert panels to develop national strategies for preventing these leading diseases and injuries.

Its strategy for traumatic injuries included some long term efforts that were needed, such as: thoroughly describe and study occupational injury incidents using rigorous scientific methods (that is, epidemiology); and rigorously test and validate control technologies and administrative techniques for prevention.[9] The strategy also included a list of recommended "immediate actions" that consisted primarily of implementing already developed and accepted policies and practices such as increased training, increased regulatory compliance, better ergonomic design, and improved education of health and safety professionals.[9]

The 1990s

In 1991, the Third National Injury Control Conference was held in Denver, Colorado. The subtitle of this conference was "Setting the National Agenda for Injury Control in the 1990s". The authors of the national agenda for occupational injury prevention made recommendations that sound familiar.[10] In the surveillance area, they called for "a comprehensive, national occupational injury reporting system . . .one that would range from the plant and company level to the national level, and ... would include methods for identifying high risk populations not generally covered, such as small businesses, self employed, adolescents, and minority workers, and so forth".[10] In the research arena, they called for increased evaluation research and increased collaboration.[10] In particular, the authors contended that NIOSH should conduct more research and intervention studies, and that academic researchers should focus on identifying risk factors and evaluating preventive strategies through analytic epidemiology.[10]

Finally, in the mid-1990s, NIOSH, in conjunction with a broad array of partners in the public and private sector, developed the National Occupational Research Agenda or NORA.[11] Traumatic injury was one of 21 topic areas selected as priorities. NORA was also somewhat unusual in that it was not only a planning strategy, but included an implementation strategy. The implementation of NORA included assembling multiorganizational, multidisciplinary teams to address each of the priority areas, including traumatic occupational injury research.

As a result of the efforts of the NORA Traumatic Injury Team, NIOSH published this strategy in 1998, *Traumatic Occupational Injury Research Needs and Priorities*.[12] Using the public health model as a framework, this document identifies the research needs and priorities in each phase of the public health model, from surveillance to evaluation. Although many of the themes are now familiar, the NORA Traumatic Injury Team report reflects some changes in emphasis that highlight progress in several areas.

There are still recommendations to improve surveillance efforts, but no longer a plea for improved capability to better count the number of deaths and injuries. Reliable national surveillance data on traumatic occupational fatalities are available, as well as good estimates of lost workday injuries and injuries presenting in emergency departments. And we know the industries and occupations and demographics and causes of those injuries and deaths, and which groups are at highest risk. Surveillance recommendations are now focused on increasing the detail of information, on improving exposure data, on identifying new and unique worker populations, such as non-English speaking and temporal workers, and on coordinating and integrating surveillance systems.[12]

The needs and priorities for analytic research continue to emphasize the importance of bringing together the disciplines of epidemiology, engineering, social and behavioral sciences, etc, but also call for research efforts to move beyond the more obvious and traditional workplace risk factors to learn about organizational, socioeconomic, and cultural influences, and emerging issues associated with the changing organization of work in a global economy.[12]

The report places an emphasis on prevention and control activities, especially in developing engineering solutions to risks, an area in which activity has clearly increased. But we continue to see the familiar need for cost benefit analyses, an area only recently being addressed.

Much has been learned about communication and dissemination of risk and prevention information. Efforts have gradually moved from general broadcasting of information, toward targeted and tailored communications in multiple media. Additional work is needed

to influence the adoption of effective prevention strategies in the workplace. Injury research and prevention efforts need to integrate health communication, social marketing, technology transfer, and diffusion techniques.[12]

Despite progress in identifying problems and developing solutions, efforts to get knowledge and products into the workplace, and to evaluate their effectiveness, rigorously and scientifically, including their cost effectiveness, have fallen short.

Evaluation of intervention effectiveness remains the most underserved phase of the public health process of occupational injury research. Too frequently, intervention strategies, ranging from training, to policies and practices, to control technologies, are put into use with no scientific knowledge of their effectiveness. Injury researchers and prevention professionals must partner and collaborate with industry and labor in the evaluation of interventions in real work settings. There are now several successful examples of government-industry partnerships that demonstrate the win-win outcomes of such collaboration.

Of course, funding is always an issue, and it is certainly a barrier to evaluation research, which is often costly. With the success of NORA, however, traumatic injury research is benefitting from an overall expansion in resources applied to occupational safety and health in the United States. Partnerships and collaborations cultivated under NORA are expanding to leverage existing funds and create new funding sources. Thus, many of the barriers inhibiting the full application of the public health process to traumatic occupational injury are being overcome.

Summary

Injury as a major public health problem, although noted as early as the 1930s, was not widely accepted by the public health community until the 1980s. Over recent decades, there have been a number of strategic plans developed to prevent and control occupational injuries. These plans have been remarkably consistent in that many of the same recommendations surfaced despite different planners from different eras. The recommendations also generally align with the steps in the public health approach.

Although recognition of the relevance of the public health approach to traumatic occupational injury came decades ago, significant barriers have inhibited its full implementation. Today, these barriers are being overcome, due to improved surveillance, increased collaborations among disciplines, increasing partnerships with industry, improved prevention evaluation methods, cost analysis models, and increasing funding. Of course, many of the experiences in the United States are paralleled in other countries in the Western world, and even in some developing countries.

Substantial progress has been made in recent years in identifying problems and developing solutions, in addressing the recommendations of decades of planning, and of building the scientific foundation necessary to guide prevention. As a result, traumatic occupational injury research must begin to increase focus on bringing the public health process full circle, including the implementation and evaluation of preventive strategies and interventions. Now, the final steps of the process need our attention—evaluating the effectiveness of these solutions and then getting knowledge and products onto the shop floor, the construction site, and the farm, the convenience store, and the delivery truck; getting effective prevention into the workplace. Now is the time to close the loop, from science to prevention.

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