Received: 9 May 2023 | Revised: 9 August 2023 | Accepted: 14 August 2023

DOI: 10.1002/ajim.23532

HISTORICAL PERSPECTIVE

AMERICAN JOURNAL OF INDUSTRIAL MEDICINE WILEY

Development and maturation of the occupational health services research field in the United States over the past 25 years: Challenges and opportunities for the future

Jeanne M. Sears PhD, MS, RN[1,2,3,4] | Thomas M. Wickizer PhD, MPH[5] | Gary M. Franklin MD, MPH[1,2,6,7] | Deborah Fulton-Kehoe PhD, MPH[2] | Peggy A. Hannon PhD, MPH[1,8] | Jeffrey R. Harris MD, MPH, MBA[1,8] | Janessa M. Graves PhD, MPH[9] | Patricia M. McGovern PhD, MPH[10]

[1]Department of Health Systems and Population Health, University of Washington, Seattle, Washington, USA

[2]Department of Environmental and Occupational Health Sciences, University of Washington, Seattle, Washington, USA

[3]Harborview Injury Prevention and Research Center, Seattle, Washington, USA

[4]Institute for Work and Health, Toronto, Ontario, Canada

[5]Division of Health Services Management and Policy, The Ohio State University, Columbus, Ohio, USA

[6]Department of Neurology, University of Washington, Seattle, Washington, USA

[7]Washington State Department of Labor and Industries, Tumwater, Washington, USA

[8]Health Promotion Research Center, University of Washington, Seattle, Washington, USA

[9]College of Nursing, Washington State University, Spokane, Washington, USA

[10]Division of Environmental Health Sciences, University of Minnesota, Minneapolis, Minnesota, USA

Correspondence
Jeanne M. Sears, PhD, MS, RN, Department of Health Systems and Population Health, University of Washington, Box 357660, Seattle, WA 98195, USA.
Email: jeannes@uw.edu

Abstract

Work is an important social determinant of health; unfortunately, work-related injuries remain prevalent, can have devastating impact on worker health, and can impose heavy economic burdens on workers and society. Occupational health services research (OHSR) underpins occupational health services policy and practice, focusing on health determinants, health services, healthcare delivery, and health systems affecting workers. The field of OHSR has undergone tremendous expansion in both definition and scope over the past 25 years. In this commentary, focusing on the US, we document the historical development and evolution of OHSR as a research field, describe current doctoral-level OHSR training, and discuss challenges and opportunities for the OHSR field. We also propose an updated definition for the OHSR field: *Research and evaluation related to the determinants of worker health and well-being; to occupational injury and illness prevention and surveillance; to healthcare, health programs, and health policy affecting workers; and to the organization, access, quality, outcomes, and costs of occupational health services and related health systems*. Researchers trained in OHSR are essential contributors to improvements in healthcare, health systems, and policy and programs to improve worker health and productivity, as well as equity and justice in job and employment conditions. We look forward to the continued growth of OHSR as a field and to the expansion of OHSR academic training opportunities.

KEYWORDS

health services research, occupational health policy, occupational health services research, workers' compensation

1 | INTRODUCTION

US workers spend up to half of their waking lives at work or commuting, making work one of the most important social determinants of health.[1–3] Work-related injuries remain a significant source of burden on workers and employers, accounting for 38% of nonfatal injuries among employed persons.[4] In 2016, about 31% of 2.9 million nonfatal work injuries/illnesses required time off work.[5] Workers' compensation (WC) programs were developed to compensate workers for occupational injury/illness-related costs through a

no-fault insurance system that in turn gave employers immunity from tort litigation.[6–8] The National Commission on State Workmen's Compensation Laws (1970) described five basic goals of WC: (1) broad coverage of employees and work-related injuries and diseases; (2) substantial protection against interruption of income; (3) provision of sufficient medical care and rehabilitation services; (4) encouragement of safety; and (5) an effective system for delivery of benefits and services.[8]

Mounting evidence suggests that WC systems are not fully meeting their core objectives—workers, their families, social safety-net programs, and healthcare and insurance systems are increasingly bearing the financial burden of occupational injury/illness.[9] WC paid for only about 21% of the $250 billion direct (medical, wage replacement) and indirect (lost earnings, fringe benefits, home production) costs of occupational injury/illness in 2007; workers paid for 50% out-of-pocket, and the remainder was paid by other insurance or safety-net programs.[10–12] Recent growth in non-standard and precarious employment threatens to further decrease workforce coverage by WC—these jobs are often formally excluded from WC, and can also involve heightened WC claim-filing barriers and administrative burden compared to standard jobs.[13–15] Many workers use health insurance as an alternative to WC, but health insurance does not cover wage replacement or vocational rehabilitation, and may inadequately cover healthcare costs.[9] Suboptimal healthcare practices (e.g., unsafe opioid prescribing, overuse of advanced imaging, unnecessary surgery) contribute to work disability burden and strain the social safety net.[16–21] As of December 2021, there were about 7.9 million previously productive workers permanently out of work and enrolled in the Social Security Disability Insurance Program.[22] The burden of occupational injury/illness is exacerbated by socioeconomic disparities. Workers with more disadvantaged identities and situational vulnerability may be subject to more hazardous jobs, higher incidence of occupational injury/illness, lower rates of health insurance coverage, and greater financial burden, and may also face greater barriers to reporting injuries and navigating healthcare and WC processes.[9,23–28] Since the late 1980s, the field of occupational health services research (OHSR) has played a crucial role in measuring and addressing these substantial individual and social burdens and disparities, via policy-relevant research and evaluation.[29,30]

In their seminal article describing OHSR as an emerging research field, Deitchman et al. described the goal of OHSR as "to promote the adoption of policies and procedures that ensure that all injured workers have access to the best possible care with a goal of minimizing disability and maximizing functional status, employability, and quality of life."[31] The field of OHSR has undergone tremendous expansion in both definition and scope over the past 25 years; perhaps most notably with regard to expanding its focus to *all* workers, as opposed to just injured workers as originally described.

In this commentary, we document the historical development and evolution of OHSR as a research field, focusing on the US. Our goals are to propose a comprehensive definition of OHSR and to motivate the development and funding of new OHSR training opportunities, which have dwindled over time. The primary intended audience includes faculty and academic institutions that might consider adding OHSR training programs, as well as policymakers and funders that could provide support for such programs and for OHSR more generally. To this end, we cover a number of topics in this commentary. We begin by conceptualizing and defining OHSR in the context of related research fields, given that the meaning and scope of OHSR are not widely known. We next describe the historical development of the OHSR field, and its evolution and expansion. We then describe the history and current status of academic doctoral-level OHSR training programs. We provide examples of research translation and policy impact from Washington State to demonstrate the ongoing importance of OHSR. We close with a discussion of challenges and future opportunities for the field.

2 | DEFINING OHSR AND RELATED FIELDS

OHSR is inherently multidisciplinary, and researchers who conduct OHSR identify with a variety of disciplines/fields (e.g., health services research [HSR], health policy, occupational epidemiology, occupational hygiene/exposure science, occupational medicine, occupational health nursing, workplace health promotion/workplace wellness). The authors of this commentary have a distinct perspective—that of being (or having been) affiliated with an academic doctoral-level OHSR training program—situated within a school of public health—producing researchers and policymakers with the full complement of knowledge and skills necessary to conduct research and provide leadership in the field.

The term OHSR can be conceptualized in at least two ways: (1) occupational health services + research, or (2) occupational + HSR. The first conceptualization (occupational health services + research) implies that any research involving occupational health services qualifies as OHSR, and does not suggest a particular research field or approach. Occupational health services are not limited to occupational healthcare services (e.g., diagnosis and treatment of work-related injury/illness), although the two terms have sometimes been used interchangeably;[32] they also include services such as preplacement health screening, workplace health promotion, job accommodation, workplace substance-abuse programs, and onsite first aid.[31,33] However, conceptualizing OHSR as research focused on occupational health services doesn't suggest primary prevention or incorporate the higher-level health systems and policy work that is often inherent to both HSR and OHSR.

The second conceptualization (occupational + HSR) implies that OHSR is a subspecialty within the HSR field, and carries with it the connotation of systems-level research using the classic structure/process/outcomes framework.[32,34] In this regard, it is instructive to review the definition of HSR (see Table 1 for exemplar definitions of HSR and other fields related to OHSR). AcademyHealth, the professional home and leading national organization for health services researchers, defined HSR as "the multidisciplinary field of

TABLE 1 Definitions of occupational health services research (OHSR), and related fields.

Field	Definition (exemplars; most fields have multiple published definitions)	Source
Occupational health services research (OHSR)	Research and evaluation related to the determinants of worker health and well-being; to occupational injury and illness prevention and surveillance; to healthcare, health programs, and health policy affecting workers; and to the organization, access, quality, outcomes, and costs of occupational health services and related health systems.	Proposed in this commentary
Health services research (HSR)	The multidisciplinary field of scientific investigation that studies how social factors, financing systems, organizational structures and processes, health technologies, and personal behaviors affect access to healthcare, the quality and cost of healthcare, and ultimately our health and well-being. Its research domains are individuals, families, organizations, institutions, communities, and populations.	AcademyHealth Lohr KN, Steinwachs DM. Health services research: an evolving definition of the field. Health Serv Res. 2002;37(1):7-9.
Occupational epidemiology	The study of the distribution and causes of illness and injury that result from workplace hazards.	Checkoway H, Pearce NE, Crawford-Brown DJ. Research methods in occupational epidemiology. New York: Oxford University Press; 1989.
Occupational (industrial) hygiene/exposure science	The anticipation, recognition, evaluation, control, and confirmation of protection from those environmental stressors in, or arising from, the workplace that may result in injury, illness, impairment, or affect the well-being of workers and members of the community.	American Industrial Hygiene Association (AIHA) https://www.aiha.org/about-aiha
Occupational medicine	Diagnosis and treatment of work-related injuries and illnesses.	American College of Occupational and Environmental Medicine (ACOEM) https://acoem.org/Careers/What-Is-OEM
Occupational health nursing	The specialty nursing practice that provides for and delivers health and safety programs and services to workers, worker populations, and community groups. The practice focuses on promotion and restoration of health, prevention of illness and injury, and protection from work-related and environmental hazards.	American Association of Occupational Health Nurses (AAOHN) https://www.aaohn.org/About/What-is-Occupational-and-Environmental-Health-Nursing
Total worker health (TWH)®	*TWH*® is defined as policies, programs, and practices that integrate protection from work-related safety and health hazards with promotion of injury and illness-prevention efforts to advance worker well-being. The *TWH*® approach seeks to improve the well-being of the US workforce by protecting their safety and enhancing their health and productivity. Using *TWH*® strategies benefits workers, employers, and the community.	National Institute for Occupational Safety and Health (NIOSH) https://www.cdc.gov/niosh/twh/default.html
Workplace health promotion/workplace wellness	Workplace health promotion is the combined efforts of employers, employees, and society to improve the health and well-being of workers.	Andersen LL, Proper KI, Punnett L et al. Workplace health promotion and well-being. Scientific World Journal 2015.

scientific investigation that studies how social factors, financing systems, organizational structures and processes, health technologies, and personal behaviors affect access to healthcare, the quality and cost of healthcare, and ultimately our health and well-being. Its research domains are individuals, families, organizations, institutions, communities, and populations."[35] A more succinct definition—and one which emphasizes public health goals—was suggested in 2006: "the study of healthcare costs, quality, or access to contribute to population health by making health services more effective, equitable, or efficient."[36] However, AcademyHealth does not formally recognize OHSR as a subspecialty.

It may be most useful to conceptualize OHSR in yet a third way—as an amalgamation of the field of occupational health and safety and the field of HSR. This conceptualization effectively expands OHSR to include topics beyond occupational health services, such as work/employment as a social determinant of health, cost-shifting and externalization of the financial burden of work-related injury/illness, and the occupational health/WC healthcare workforce.

This conceptualization better reflects the OHSR field as it currently stands. OHSR has adopted (and adapted) numerous core HSR, occupational health, and public health frameworks, such as the HSR focus on organization, access, quality, cost and outcomes of health services;[35] the Donabedian model (structure/process/outcomes);[32,34] the stages of prevention (primary/secondary/tertiary);[33] the hierarchy of controls;[37] and the injury pyramid.[38,39] In some respects, OHSR has stretched HSR-based methodology beyond its usual scope—examples include investigation of the uses and limitations of clinical databases for work-related research/surveillance and novel ways of identifying work-related injuries and injury severity in clinical databases.[38,40–42] We propose an updated definition for the OHSR field: *Research and evaluation related to the determinants of worker health and well-being; to occupational injury and illness prevention and surveillance; to healthcare, health programs, and health policy affecting workers; and to the organization, access, quality, outcomes, and costs of occupational health services and related health systems.*

3 | HISTORICAL PERSPECTIVE

National interest in using HSR-based theory and methodology to study WC-related issues emerged in the 1990s—driven by mounting concerns about the high cost and poor outcomes of occupational healthcare, along with the goal of ensuring access to high-quality healthcare for injured workers.[16,31,43,44] The knowledge base of HSR—which emerged as a distinct field in the 1960s[45]—includes theory and methods from the disciplines of health services, biostatistics, epidemiology, policy analysis, economics, and other social and behavioral sciences. This multidisciplinary knowledge base, coupled with the HSR focus on organization, access, quality, cost, and outcomes of health services, made HSR a natural source of tools to address related concerns in the realm of WC and occupational health services. Both HSR and OHSR became more important in concert with increasing public and private focus on the delivery of effective and efficient healthcare and on the measurement of health outcomes.

Both the Robert Wood Johnson Foundation (RWJF) and the National Institute for Occupational Safety and Health (NIOSH) conducted major OHSR funding initiatives during 1995–2001.[31,44] The Workers' Compensation Health Initiative, a national program funded by the RWJF (1995–2002), was aimed at improving healthcare quality for work-related injuries/illnesses.[44] Under the expansive public health-oriented leadership of Dr. Linda Rosenstock (NIOSH Director from 1994 to 2000),[46] HSR was selected as one of the NIOSH National Occupational Research Agenda (NORA) priority areas in 1996, and NIOSH conducted major grantmaking initiatives in 1996 and 1999 to stimulate injured worker-related HSR.[31,47] Both RWJF and NIOSH held conferences and technical meetings to train researchers and promote interest and information exchange in this emerging area.[31,44] These early efforts were focused on improving healthcare provided to injured workers and on encouraging HSR related to WC, although some authors specifically noted the need to promote and integrate a prevention focus.[31,33] Responding to a widely perceived need for improved training in HSR to support NORA priorities, NIOSH led a major initiative to establish doctoral-level academic training programs for OHSR; training grant awards began in 2000.[31,47] In 2013, NIOSH established the Center for Workers' Compensation Studies to integrate NIOSH's traditional research efforts aimed at preventing worker injury and illness with WC efforts aimed at providing medical care and wage benefits to workers with a work-connected injury or illness.[48] OHSR fellowships, intermittently available, from the Oak Ridge Institute for Science and Education, have extended OHSR training programs to include post-graduate/professional training at the Center for Workers' Compensation Studies.

4 | EVOLUTION/EXPANSION OF OHSR

OHSR began with a focus on WC-based healthcare services for injured workers. This remains a critically important focus—one that merits a renewed infusion of resources for training and research. NIOSH continues to primarily conduct and fund primary prevention research, and HSR has faded from NORA priorities. However, the scope of OHSR has greatly evolved over time, expanding to include all workers (not solely injured workers) and an increasing breadth of research topics.

In particular, OHSR has expanded to include an increased focus on primary prevention topics, such as workplace health promotion and workplace wellness programs, precarious work, and modifiable workplace conditions (e.g., ergonomics, safety climate, and workplace violence), and on worker well-being as a central outcome. This expansion paralleled developments in HSR and various occupational health fields,[33,45,49–51] and was motivated by changes in the social, political, and economic environment, and by stakeholder preferences and pressures (i.e., public health and WC agencies, workers and labor representatives, employers, healthcare providers, grant funders, researchers, and graduate students).

Workplace health promotion/workplace wellness serves as a particular example of this expansion. As workplace-based health promotion programs came into favor as a business strategy to contain healthcare costs, the field of OHSR moved to strengthen the science underpinning these programs.[52] While health services researchers studied and evaluated workplace health promotion programs, NIOSH was expanding their worker health framework in a parallel fashion. NIOSH launched the Total Worker Health® (TWH®) program in 2011, which integrated occupational safety and health protection with workplace health promotion and disease prevention, and funded a number of TWH® Centers of Excellence.[53,54] Although TWH® provided a framework for linking workplace health promotion programs with occupational health and safety, TWH® is an exposure-focused paradigm, and initially lacked a conceptual model that included health systems research and long-term outcomes (although NIOSH did publish lists of issues relevant to TWH® that included health services and compensation systems). In 2018, NIOSH published a conceptual framework for worker well-being, which built on TWH® and resolved some of these gaps.[55]

Another developing aspect of OHSR involves identifying and exploring new clinical databases and surveillance methodologies, to improve surveillance of occupational injury/illness as well as surveillance of the substantial healthcare, disability, and indirect burdens of occupational injury/illness not covered by WC.[7,9,11,56–58] More recently, research topics such as precarious work, work arrangements, work organization, and employment quality have been incorporated into the broadening field of OHSR as important social determinants of worker health and well-being.[59–65] There is burgeoning interest in topics related to both telehealth and telework, for which the COVID-19 pandemic provided an important impetus.[66,67] OHSR is useful for addressing topics related to burnout, work/life balance, and work-related stress, anxiety, and depression,[68–70] and can be used to evaluate individual and structural interventions to address these, including work redesign, which is high on the hierarchy of controls.[59,71,72] The scope of OHSR also includes economic and cost-effectiveness research and evaluation of a wide variety of occupational health and safety policies and interventions; such research can and has been used to formulate business cases and motivate employers, government, and other stakeholders to reduce workplace risks and improve worker health.[73–79] Perhaps most importantly, equity concerns such as occupational health disparities, occupational health vulnerabilities in the workplace, structural racism, and racial capitalism are receiving a greater level of attention and incorporation into occupational health research fields, including OHSR.[25,26,28,80–82]

The OHSR field currently spans the gamut of primary, secondary, and tertiary prevention. Figure 1 contains a partial listing of OHSR topics, organized by stage of prevention, which serves as a useful continuum for thinking about focusing research and intervention efforts upstream to minimize ultimate harms and burdens.[83] Many OHSR topics span all stages of prevention. For example, TWH® was launched as a primary prevention strategy but could be harnessed to reduce workplace risk in secondary and tertiary prevention efforts (e.g., return-to-work by workers with permanent work-related impairments). Improvements to occupational injury/illness surveillance methodology can underpin planning for primary, secondary, and tertiary prevention programs. Equity and antiracism interventions, promoting occupational health best practices, and many other health system and policy topics have potential for impact across the full prevention spectrum. It is worth noting that many of the topics listed in Figure 1 (and elsewhere in this commentary) are likely to fall under the purview of a variety of occupational health fields, but the framing of the research question or methodological approach might differ. Transdisciplinarity is gaining traction as an approach that can maximize holistic and comprehensive approaches to complex research questions.[49,84,85]

5 | OHSR TRAINING PROGRAMS

In 2000 and 2001, NIOSH awarded Education and Research Center (ERC)-based training grants that established four new academic doctoral-level OHSR training programs.[44] Sites included the University of Washington (UW), University of Minnesota (UMN), Harvard University, and University of North Carolina/Duke University. The programs at the UW and UMN were renewed multiple times, but the UMN's program recently ended when the leadership retired in 2021. For many years, the UW and UMN programs collaborated in a joint distance-based journal club for their trainees. The two programs were each situated within their university's School of Public Health—important because of the multidisciplinary nature of the training needed. At the UMN, the Occupational Health Services Research and Policy training program was a collaboration between the Division of Environmental Health Sciences (codirector Pat McGovern) and the Division of Health Policy and Management (codirector Bryan Dowd). The UW-based ERC, the Northwest Center for Occupational Health and Safety, now hosts the sole currently active OHSR training program (codirectors Jeanne Sears and Gary Franklin). The UW OHSR training program is housed within the Department of Health Systems and Population Health (formerly named Department of Health Services), in collaboration with the Department of Environmental and Occupational Health Sciences. This sole remaining program is described in more detail below as an exemplar for potential development of additional OHSR training programs.

UW OHSR trainees are admitted to the Health Services PhD program and complete the required series of courses and exams that culminate in a PhD degree—typically in about 4 years. The UW OHSR program provides strong methodological training in HSR, coupled with substantive education related to occupational health. Trainees work with program faculty who are actively engaged in various areas of OHSR. Along with all other Health Services PhD students, OHSR trainees receive grounding in interdisciplinary theory and methods applied to HSR, drawing from health services, biostatistics, economics, epidemiology, policy analysis, and other social and behavioral sciences. Students complete a series of courses that use advanced methods from biostatistics and econometrics to solve problems commonly encountered in HSR (e.g., case mix adjustment, clustered data, longitudinal data analysis, missing data, selection bias, and testing causal models using observational data). The OHSR training program also includes content in relevant research and evaluation skills (e.g., performance measurement, program and policy evaluation, stakeholder analysis, surveillance methodology, and assessment of the organization, access, cost, quality, and outcomes of health promotion programs, health services, and health systems). It also includes content on social determinants of health, health promotion, antiracism, health disparities, social epidemiology, and organizational theory—all integral to developing skills needed to identify and mitigate socioeconomic disparities in work precarity, health, healthcare, and outcomes. As faculty, we have noted that graduate students' interests have shifted over time, and this has motivated change in the breadth of topics and methods covered in the OHSR training program. For example, qualitative methods and mixed methods have been increasingly utilized for dissertation research, supporting an increasing focus on worker-centered and self-reported outcomes (e.g., worker satisfaction and well-being), in addition to the

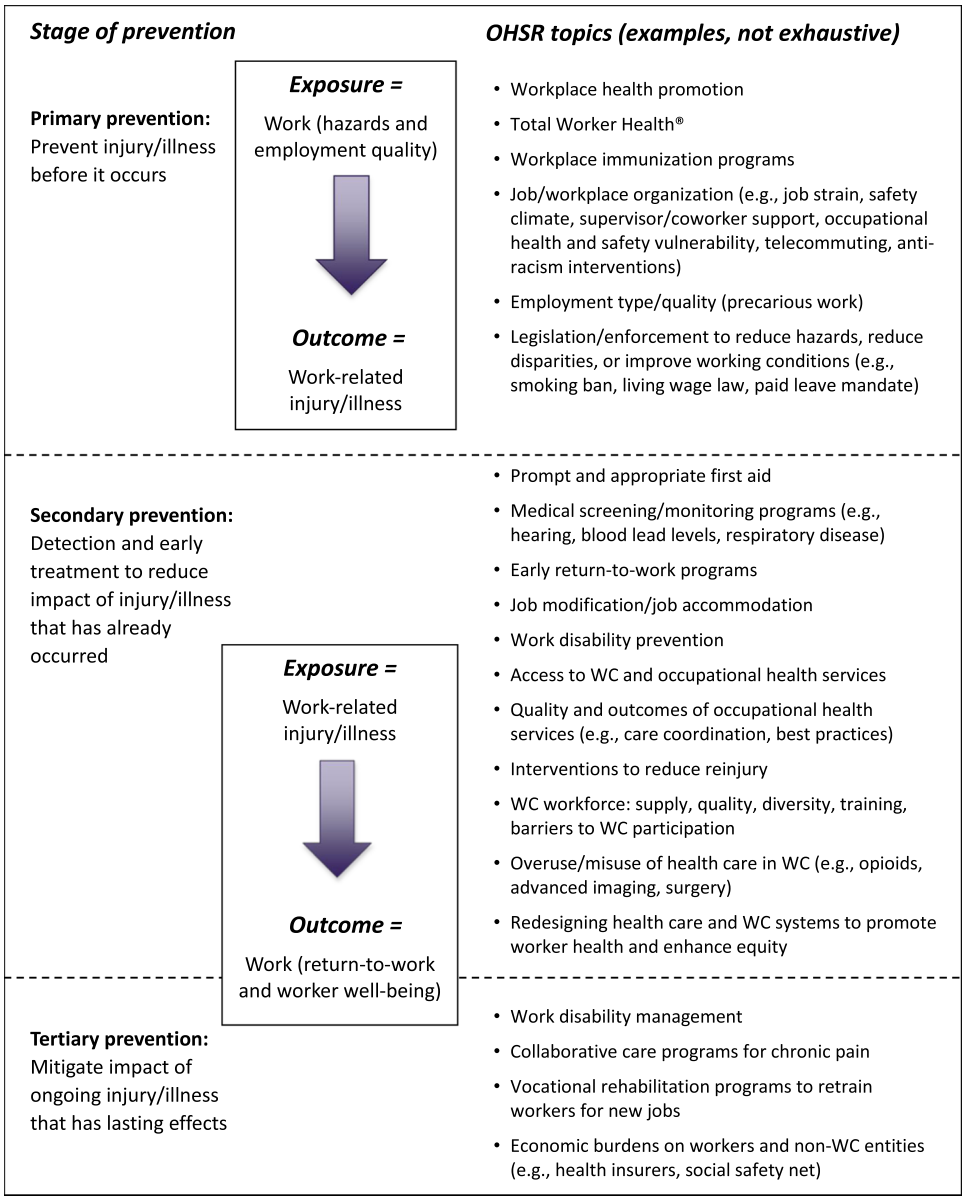

FIGURE 1 Occupational health services research (OHSR) topics (not intended as a complete list), by stage of prevention. Definitions of the stages of prevention align with those published by the Institute for Work and Health.[77] WC, workers' compensation.

traditional WC-based administrative outcomes such as compensated time lost from work, healthcare costs, and permanent impairment.[86]

In addition to numerous individual faculty research projects, the Department of Health Systems and Population Health hosts several internal research centers that are appropriate for dissertation research, for example, the Health Promotion Research Center. The OHSR training program also benefits from resources made available through the UW Occupational Epidemiology and Health Outcomes Program (OEHOP). OEHOP offers OHSR students mentoring, logistical, and financial support for dissertation research. The OHSR training program has developed partnerships with external organizations to support the program's training goals and provide field-based research opportunities, enhancing the depth and breadth of research by OHSR faculty and students. For example, two organizational units within the Washington State Department of Labor and Industries (L&I) have supported OHSR dissertation and other research projects: (1) the Office of the Medical Director; and (2) the Safety and Health Assessment and Research for Prevention program, which is nationally recognized for prevention-oriented research. Other agencies providing student mentorship and research projects have included the Harborview Injury Prevention and Research Center, Public Health Seattle King County, Washington State Department of Health, Washington State Health Care Authority, and Veterans Affairs Puget Sound. OHSR students and faculty have worked on research projects with scientists at the Workers Compensation Research Institute and the Toronto-based Institute for Work and Health. These collaborations have

resulted in numerous policy-relevant applied research and evaluation projects. Many OHSR graduates have secured key positions in academic institutions, public health agencies, and private industry, resulting in ongoing contributions to occupational health services policy and practice, improving occupational health surveillance, developing interventions to improve worker health and WC systems, and, in turn, training the next cohort of OHSR leaders.

6 | RESEARCH TRANSLATION AND POLICY IMPACT—EXAMPLES FROM WASHINGTON STATE

Conducting policy-relevant research is key to dissemination and implementation of OHSR, and thereby improving occupational health services, related health systems, and worker well-being.[29,87] Because OHSR often involves stakeholders with conflicting values and priorities, and policy issues can be politically contentious, successful research translation and policy impact can be dependent on effective stakeholder collaboration.[88–90]

One vital aspect of the often-successful policy impact of UW-based OHSR is the dual role that Gary Franklin has played as both L&I Medical Director and UW OEHOP Director. His work with WC and insurance payment systems is practical, policy-relevant, and continues to have statewide and national impact. More generally, Washington State has a broad reputation for being a state that values evidence-based health policy. The UW track record demonstrates that research translation and policy impact are feasible in an environment that respects evidence-based health policy and with the proper attention to building trust among academic researchers, state agencies, and other important stakeholders, including business and labor leaders. Below we describe a few examples of UW-based OHSR projects with major impact on worker health and health systems more broadly. OHSR trainees have been integral to conducting and disseminating many of these research and evaluation projects.

Several workplace health promotion research and implementation projects have had population-wide primary prevention impact. These projects have included developing and testing a worksite flu shot intervention for Seattle restaurant workers,[91,92] collaborating on health promotion efforts at Washington State agencies,[93,94] and helping businesses implement evidence-based chronic disease prevention programs—one such collaboration resulted in national dissemination of the Workplace Solutions program by the American Cancer Society. Over time, this work has shifted to focus more on small businesses in low-wage industries to address health disparities faced by these workers and the relative lack of health promotion in these worksites.[95,96] One such program, Connect to Wellness, is currently being disseminated via training local health department staff to deliver the program to small businesses in their communities.[97]

OHSR has also had significant secondary and tertiary prevention impact via evaluation of policies that affect the access, quality and outcomes of healthcare for injured workers, and by redesigning healthcare and WC systems to advance worker health. For example, an evaluation of pilot Washington State legislation resulted in nurse practitioners being permanently authorized as attending providers in the WC system—expanding access for injured workers.[73,98,99] In another example, an evaluation of L&I policy related to early nonevidence-based imaging for low back pain produced evidence to support policy adherence.[100,101] OHSR researchers led a successful effort to expand the Centers of Occupational Health and Education from a small pilot project through statewide implementation. These community-based centers improve work disability outcomes by training providers, facilitating care coordination, and promoting occupational health best practices.[74,102] As a result of this groundbreaking work, the US Department of Labor allocated national research funding toward preventing long-term work disability through early intervention programs; notably, these programs have a broader mission, not being restricted to occupational injury, and demonstrate generalizable impact of the interventions developed in Washington State.[103]

Beyond improving healthcare and outcomes specifically for injured workers, researchers trained in OHSR have transformed healthcare policy for the broader population. For example, based on WC and mortality data for injured workers, Gary Franklin was the first to note the epidemic of opioid deaths; he led a successful statewide effort to promulgate opioid prescribing guidelines beyond the WC system.[104,105] OHSR researchers have also spearheaded multiple effective innovations in healthcare delivery and evidence-based coverage; providing, for example, the evidence base necessary for the Washington State Health Technology Clinical Committee to conclude in 2016 that lumbar fusion for nonspecific low back pain should be a non-covered procedure for Washington State public agencies.[17]

7 | CHALLENGES

Despite the great expansion in scope and volume of OHSR over the past 25 years, OHSR as a field remains under-recognized and underfunded. In part, this is due to the burgeoning and welcome amount of OHSR conducted by researchers who don't formally align with OHSR as a field or use that terminology. In fact, OHSR as a phrase is rarely used in the literature—a PubMed search netted only a handful of instances. Further, OHSR has no distinct professional organization or dedicated journal. AcademyHealth does not formally recognize OHSR as a subspecialty or sponsor any interest group specifically related to occupational health or WC (though several interest groups have some overlap with topics of interest to OHSR, including the Disability Research Interest Group, Disparities Interest Group, Health Workforce Interest Group, Interdisciplinary Research Group on Nursing Issues, Public Health Systems Research Interest Group, and the State Health Research and Policy Interest Group).[106] Descriptive summaries, histories, and research maps of HSR do not generally mention OHSR or worker/workplace health topics.[45,107] Yet there continues to be significant need for doctoral-level health services researchers with specialized multidisciplinary training in innovating worker-focused healthcare delivery,

occupational health, surveillance methodology, work disability prevention, and workplace wellness.[29,45,60]

OHSR represents a small but crucial discipline; however, OHSR has not been addressed as a subspecialty in HSR workforce assessments, nor included in the 2011 National Assessment of the Occupational Safety and Health Workforce.[61] Employer surveys have assessed HSR workforce sufficiency more generally, reporting that finding candidates with specific, high-priority skills can be challenging, and that need for HSR will increase.[62] Growth in the number of health services researchers appears to be slowing, and minorities are underrepresented.[63] Limited funding for HSR trainees is a potential threat to the HSR workforce supply.[63] Finally, the ongoing need for doctoral-level training in OHSR is evidenced by the fact that our graduates have universally obtained positions in their interest area. This compares very favorably with reported percentages for the nine disciplines included in the National Assessment.[61] These factors make OHSR training programs central to maintaining a cadre of trained OHSR professionals, with a clearly defined identity. Yet, the UW Northwest Center for Occupational Health and Safety is the last remaining ERC with an OHSR training component. This is not due to the absence of need—rather, we would argue, it is for want of focus and initiative by schools of public health, as well as want of attention and funding by NIOSH and other relevant institutions (e.g., AcademyHealth, Agency for Healthcare Research and Quality).

Another challenge is the general "sidelining" of worker health from injury prevention and HSR. For example, work-related injuries are specifically excluded from the Injury Control Research Centers funded by the Centers for Disease Control and Prevention and are typically underrepresented in injury-focused research conferences (e.g., Society for the Advancement of Violence and Injury Research, the foremost injury-related association). Further, studying WC as a payer or health system of interest is often excluded from HSR and HSR training programs. There was a brief period in the late 1990s when healthcare reform policy efforts were tackling health systems and WC systems together,[108–112] but despite calls to reignite this combined policy focus from a variety of perspectives (e.g., system efficiency,[113] injured worker rights,[114] human rights,[115,116] public health[117–119]), none have fully taken hold.

Other challenges faced by OHSR and related fields include data limitations and surveillance problems, resulting from the overwhelmingly state-based nature of WC systems and WC policy,[56,120,121] as well as from larger economic forces. Over time, the workforce has become more diverse and the conditions of work more precarious.[23,122] These changes in employment conditions, work organization, and the workforce pose challenges to quantification of economic, health, and social burdens of work-related hazards and their sequelae.[13,58,123,124] Monitoring burden is critically important, yet is impeded by numerous data limitations and gaps.[9,56,58] On the other hand, certain challenges would be fairly easy to remedy with adequate motivation, such as more consistently including occupation, industry, work location (e.g., home vs. employer's facility), and other work-related variables in clinical databases,[3] or keeping WC as a distinct payer category, rather than collapsing it into a private-insurance or miscellaneous-payer category. Such preventable and seemingly minor data deficiencies can make it nearly impossible to identify work-related injuries/illnesses outside WC databases for surveillance or research purposes, or to conduct research on connections, interactions, and cost-shifting between general health systems and WC.[9]

8 | OPPORTUNITIES FOR THE FUTURE

Inadequate access to care, health disparities, high medical costs, lack of healthcare coordination, and nonevidence-based healthcare practices are challenges that largely define the nation's health policy agenda. These same issues—to an even greater degree—affect the WC system. The years of productive life lost due to disability experienced by injured workers are enormous,[18] and could be substantially reduced via quality improvement in WC healthcare.[20,125,126] Despite ongoing efforts, the prevention, management, and coverage of occupational injury/illness continue to pose substantial and complex challenges. Identifying effective approaches to limit work-related disability and improve worker health outcomes, and evaluating the effectiveness and costs of prevention programs, are critical activities for advancing NIOSH goals. Yet, in our opinion, NIOSH has expended few resources on concerns around improving healthcare delivery and disability prevention. These areas continue to merit substantial resources and attention. Perhaps interagency collaboration at the federal level (e.g., NIOSH, US Department of Labor, Social Security Administration, Agency for Healthcare Research and Quality, and National Institutes of Health) could provide support for major OHSR projects.

Occupational injury/illness surveillance is necessary for effective prevention planning, evaluation, and policy development, and is currently a high-profile area of pressing need. A related need for OHSR extends to surveillance of the enormous healthcare, disability, and indirect costs of occupational injury/illness not covered by WC.[7,9–11,58] Changes in the nature of work and the workforce, as well as increasing barriers to surveillance (e.g., under-reporting by workers, employers, and healthcare providers, constricting WC coverage, changes in employer reporting requirements, and changes in the covered workforce), have increased the difficulty of characterizing health, economic, and social consequences of occupational injury/illness, and new approaches are required.[14,23,24,56,58,124,127–132] These issues were comprehensively described in a 2018 consensus report by the National Academies of Sciences, Engineering, and Medicine.[56] Thus, a critical ongoing aspect of OHSR involves identifying and exploring new data sources—including clinical databases—and surveillance methodologies, to improve surveillance efforts. Furthermore, policies aimed at reducing work-related injury and noninjury burdens must be developed, implemented, and evaluated.

We have learned that research translation and policy impact are dependent on a setting that values evidence-based health policy and has adequate leadership to pursue these goals. The examples provided in the *Research Translation and Policy Impact* section demonstrate the importance of building relationships between

academic researchers and state agencies. More attention must be paid to developing these linkages state-by-state, nationwide, and internationally, on both the structural and individual levels. Although we focused herein on examples from Washington State, there are other prominent institutions actively conducting and disseminating OHSR, including the Ontario-based Institute for Work and Health, the Massachusetts-based Workers Compensation Research Institute, and NIOSH itself, to name a few.

To continue to progress in these areas and others, OHSR needs and deserves increased visibility as a field. Accomplishing this demands more conscious and frequent use of the term OHSR and increased attention to defining and promoting the field. Addressing the need to train qualified occupational health services researchers is of pressing concern and deserves renewed focus and resources by NIOSH and by schools of public health. OHSR must also solidify intentional linkages with its parent fields (i.e., occupational health and safety, HSR). Content and policy alignment with these two fields should facilitate such linkages, but more deliberate leverage may need to be applied. With respect to occupational health and safety, although NIOSH has made strides toward defining an expanded focus on TWH® and worker well-being, OHSR seems to have largely been set aside in planning and funding priorities. For example, in their recent published commentary arguing for a systems-level approach (and stressing pertinent topics such as economic risk factors and work as a social determinant of health), no mention was made of OHSR or HSR.[49] With respect to HSR, WC-based research findings often have relevance to healthcare more broadly; two important examples—among many—are (1) the evaluation and dissemination of effective best practices delivered by the Centers of Occupational Health and Education and (2) advances in safer opioid-prescribing practices.[74,133,134] OHSR with findings relevant to general healthcare should more often be published beyond the usual occupational health journals and promoted to broader HSR and public health audiences.

9 | CONCLUSIONS

In 2001, the goal of OHSR was described as "to promote the adoption of policies and procedures that ensure that all injured workers have access to the best possible care with a goal of minimizing disability and maximizing functional status, employability, and quality of life."[31] We now need to acknowledge the expansion of that goal from "all injured workers" to "all workers." In this commentary, we have proposed the following definition for OHSR: *Research and evaluation related to the determinants of worker health and well-being; to occupational injury and illness prevention and surveillance; to healthcare, health programs, and health policy affecting workers; and to the organization, access, quality, outcomes, and costs of occupational health services and related health systems.*

There is an ongoing critical need for the systems-level research perspective offered by OHSR and for worker health-focused research more generally, despite the many remaining challenges and barriers to conducting such research. Researchers trained in OHSR are essential contributors to improvements in healthcare, health systems, and policy and programs to improve worker health and productivity, as well as equity and justice in job and employment conditions. We look forward to the continued growth of OHSR as a field. To that end, we recommend that OHSR researchers more consciously use the phrase OHSR in their research communications and manuscript key words, publish beyond the usual occupational health journals to intentionally reach broader HSR and public health audiences, and advocate for field recognition and research funding by AcademyHealth, NIOSH, and other relevant agencies. In particular, we hope new OHSR training opportunities are created and that this commentary motivates existing or forthcoming ERCs to consider creating new NIOSH-funded OHSR training programs. In our collective experience, key aspects of a successful OHSR training program would include: (1) being situated in an academic department of public health that contains faculty with research interests in both occupational health and HSR, and in adequate numbers to enable leadership transitions when needed; (2) partnerships with internal and external research and policy centers, to provide research and training opportunities for students; (3) ties with the relevant state and federal WC insurers to facilitate data access for health policy and outcomes evaluation; and (4) partnerships between researchers and state agencies more generally, to enable research translation and policy impact (If interested, please contact author J. M. S., who would be happy to share the syllabus of the OHSR Methods graduate course, and additional details of the OHSR training content and core competencies).

OHSR presents an abundance of opportunity to experience the joys of policy-relevant applied research. As Hanney et al.[135] cogently stated, "Engaging in useful research produces benefits for researchers in terms of satisfaction that one's work has been noticed and has contributed to policy formation or practice improvement." This has certainly been our experience.

AUTHOR CONTRIBUTIONS

Jeanne M. Sears conceived of and drafted the initial manuscript. All authors participated in revising it critically for important intellectual content, gave final approval of the version to be published, and agreed to be accountable for all aspects of the work.

CONFLICT OF INTEREST STATEMENT

The authors declare that there are no conflicts of interest.

DISCLOSURE BY AJIM EDITOR OF RECORD

John Meyer declares that he has no conflict of interest in the review and publication decision regarding this article.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no data sets were generated or analyzed during the current study.

ORCID

Jeanne M. Sears http://orcid.org/0000-0002-7325-1279
Gary M. Franklin http://orcid.org/0000-0002-1355-4091

REFERENCES

1. Ahonen EQ, Fujishiro K, Cunningham T, Flynn M. Work as an inclusive part of population health inequities research and prevention. *Am J Public Health*. 2018;108:306-311.
2. US Department of Health and Human Services. Healthy people 2020: occupational safety and health. Accessed August 22, 2023. http://www.healthypeople.gov/2020/topics-objectives/topic/occupational-safety-and-health
3. Steege AL, Silver S, Mobley A, Sweeney MH. Work as a key social determinant of health: the case for including work in all health data collections. *NIOSH Science Blog*; 2023. Accessed March 31, 2023. https://blogs.cdc.gov/niosh-science-blog//02/16/sdoh/
4. Smith GS, Wellman HM, Sorock GS, et al. Injuries at work in the US adult population: contributions to the total injury burden. *Am J Public Health*. 2005;95:1213-1219.
5. US Department of Labor, Bureau of Labor Statistics. Injuries, illnesses, and fatalities. Accessed July 17, 2018. http://www.bls.gov/iif/data.htm
6. Dworsky M, Broten N. *How Can Workers' Compensation Systems Promote Occupational Safety and Health? Stakeholders Views on Policy and Research Priorities*. RAND Corporation; 2018.
7. Spieler EA, Burton Jr. JF. The lack of correspondence between work-related disability and receipt of workers' compensation benefits. *Am J Ind Med*. 2012;55:487-505.
8. US Department of Labor. Does the workers' compensation system fulfill its obligations to injured workers? 2016.
9. Sears JM, Edmonds AT, Coe NB. Coverage gaps and cost-shifting for work-related injury and illness: who bears the financial burden? *Med Care Res Rev*. 2020;77:223-235.
10. Leigh JP. Economic burden of occupational injury and illness in the United States. *Milbank Q*. 2011;89:728-772.
11. Leigh JP, Marcin JP. Workers' compensation benefits and shifting costs for occupational injury and illness. *J Occup Environmental Med*. 2012;54:445-450.
12. Social Security Administration. *Annual Statistical Supplement to the Social Security Bulletin, 2009*. Social Security Administration; 2009.
13. Foley M, Ruser J, Shor G, Shuford H, Sygnatur E. Contingent workers: workers' compensation data analysis strategies and limitations: contingent workers. *Am J Ind Med*. 2014;57:764-775.
14. Quinlan M, Mayhew C. Precarious employment and workers' compensation. *Int J Law Psychiatry*. 1999;22:491-520.
15. Weil D. *The Fissured Workplace: Why Work Became So Bad for So Many and What Can Be Done to Improve It*. Harvard University Press; 2014.
16. Dembe AE, Himmelstein JS, Stevens BA, Beachler MP. Program report: improving workers' compensation health care. *Health Aff*. 1997;16:253-257.
17. Franklin GM, Wickizer TM, Coe NB, Fulton-Kehoe D. Workers' compensation: poor quality health care and the growing disability problem in the United States: workers' compensation health care and the US disability problem. *Am J Ind Med*. 2015;58:245-251.
18. Fulton-Kehoe D, Franklin G, Weaver M, Cheadle A. Years of productivity lost among injured workers in Washington state: modeling disability burden in workers' compensation. *Am J Ind Med*. 2000;37:656-662.
19. Reville RT, Schoeni RF. The fraction of disability caused at work. *Soc Secur Bull*. 2003;65:31-37.
20. Wickizer TM, Franklin G, Plaeger-Brockway R, Mootz RD. Improving the quality of workers' compensation health care delivery: the Washington State Occupational Health Services Project. *Milbank Q*. 2001;79:5-33.
21. Guo X, Burton Jr. JF. The growth in applications for social security disability insurance: a spillover effect from workers' compensation. *Soc Secur Bull*. 2012;72:69-88.
22. Social Security Administration. *Annual Statistical Report on the Social Security Disability Insurance Program, 2021. SSA Publication No. 13-11826*. Social Security Administration, Office of Research, Evaluation, and Statistics; 2022.
23. Azaroff LS, Lax MB, Levenstein C, Wegman DH. Wounding the messenger: the new economy makes occupational health indicators too good to be true. *Int J Health Serv*. 2004;34:271-303.
24. Azaroff LS, Levenstein C, Wegman DH. Occupational injury and illness surveillance: conceptual filters explain underreporting. *Am J Public Health*. 2002;92:1421-1429.
25. Lipscomb HJ, Loomis D, McDonald MA, Argue RA, Wing S. A conceptual model of work and health disparities in the United States. *Int J Health Serv*. 2006;36:25-50.
26. McClure ES, Vasudevan P, Bailey Z, Patel S, Robinson WR. Racial capitalism within public health-how occupational settings drive COVID-19 disparities. *Am J Epidemiol*. 2020;189:1244-1253.
27. Nicholson VJ, Bunn TL, Costich JF. Disparities in work-related injuries associated with worker compensation coverage status. *Am J Ind Med*. 2008;51:393-398.
28. Rebecca Smith JD. Immigrant workers and worker's compensation: the need for reform. *Am J Ind Med*. 2012;55:537-544.
29. Franklin GM, Wickizer TM, Fulton-Kehoe D, Turner JA. Policy-relevant research: when does it matter? *NeuroRx*. 2004;1:356-362.
30. Franklin GM, Fulton-Kehoe D. Outcomes research in Washington state workers' compensation. *Am J Ind Med*. 1996;29:642-648.
31. Deitchman S, Dembe AE, Himmelstein J. Advent of occupational health services research. *Am J Ind Med*. 2001;40:291-294.
32. Pransky G, Benjamin K, Dembe AE. Performance and quality measurement in occupational health services: current status and agenda for further research. *Am J Ind Med*. 2001;40:295-306.
33. Rudolph L, Deitchman S, Dervin K. Integrating occupational health services and occupational prevention services. *Am J Ind Med*. 2001;40:307-318.
34. Donabedian A. Evaluating the quality of medical care. *Milbank Mem Fund Q*. 1966;44(suppl):166-206.
35. Lohr KN, Steinwachs DM. Health services research: an evolving definition of the field. *Health Serv Res*. 2002;37:7-9.
36. Phillips CD. What do you do for a living? Toward a more succinct definition of health services research. *BMC Health Serv Res*. 2006;6:117.
37. National Institute for Occupational Safety and Health. Hierarchy of controls. Accessed November 1, 2022. https://www.cdc.gov/niosh/topics/hierarchy/default.html
38. Sears JM, Bowman SM. State trauma registries as a resource for occupational injury surveillance and research: lessons from Washington State, 1998-2009. *Public Health Rep*. 2016;131:791-799.
39. World Health Organization (WHO). Injuries and violence: the facts. Accessed June 7, 2016. http://whqlibdoc.who.int/publications/2010/9789241599375_eng.pdf?ua=1
40. Sears JM, Bowman SM, Blanar L, Hogg-Johnson S. Industrial injury hospitalizations billed to payers other than workers' compensation: characteristics and trends by state. *Health Serv Res*. 2017;52:763-785.
41. Sears JM, Bowman SM, Rotert M, Blanar L, Hogg-Johnson S. Improving occupational injury surveillance by using a severity threshold: development of a new occupational health indicator. *Inj Prev*. 2016;22:195-201.
42. Sears JM, Bowman SM, Silverstein BA, Adams D. Identification of work-related injuries in a state trauma registry. *J Occup Environmental Med*. 2012;54:356-362.
43. Himmelstein J, Buchanan JL, Dembe AE, Stevens B. Health services research in workers' compensation medical care: policy issues and research opportunities. *Health Serv Res*. 1999;34:427-437.

44. Dembe AE, Fox SE, Himmelstein JS. The RWJF workers' compensation health initiative: findings and strategies. *Health Aff*. 2002;21:251-255.
45. Whicher D, Rosengren K, Siddiqi S, Simpson L, eds. *The Future of Health Services Research: Advancing Health Systems Research and Practice in the United States*. National Academy of Medicine; 2018.
46. Blosser F. NIOSH director named dean of UCLA School of Public Health. NIOSH. 2000. Accessed November 7, 2022. www.cdc.gov/niosh/updates/dirdean.html
47. National Institute for Occupational Safety and HealthNORA: National Occupational Research Agenda. DHHS (NIOSH) Publication No. 2000-143. Centers for Disease Control and Prevention; 2000.
48. National Institute for Occupational Safety and Health. About the center for workers' compensation studies. Accessed November 2 2022. www.cdc.gov/niosh/topics/workercomp/cwcs/about.html
49. Schulte PA, Delclos G, Felknor SA, Chosewood LC. Toward an expanded focus for occupational safety and health: a commentary. *Int J Environ Res Public Health*. 2019;16:4946.
50. Stout NA. Occupational injury prevention research: progress and priorities. *Inj Prev*. 2002;8(suppl 4):9iv-14iv.
51. Wegman DH. Challenges for occupational epidemiology in the 21st century: observations and opportunities. *Occup Environ Med*. 2014;71:739-741.
52. Lichiello P, Harris JR. *Disease Prevention: A Job for Employers? Safe Table Forums, Number 15*. Resource Center for Health Policy and University of Washington; 2005.
53. Schill AL, Chosewood LC. The NIOSH total worker health program: an overview. *J Occup Environmental Med*. 2013;55:S8-S11.
54. Sorensen G, McLellan D, Dennerlein JT, et al. Integration of health protection and health promotion: rationale, indicators, and metrics. *J Occup Environmental Med*. 2013;55:S12-S18.
55. Chari R, Chang CC, Sauter SL, et al. Expanding the paradigm of occupational safety and health: a new framework for worker well-being. *J Occup Environmental Med*. 2018;60:589-593.
56. National Academies of Sciences, Engineering, and Medicine. *A Smarter National Surveillance System for Occupational Safety and Health in the 21st Century*. The National Academies Press; 2018.
57. Schulte PA. Characterizing the burden of occupational injury and disease. *J Occup Environ Med*. 2005;47:607-622.
58. Schulte PA, Pana-Cryan R, Schnorr T, et al. An approach to assess the burden of work-related injury, disease, and distress. *Am J Public Health*. 2017;107:1051-1057.
59. Lovejoy M, Kelly EL, Kubzansky LD, Berkman LF. Work redesign for the 21st century: promising strategies for enhancing worker well-being. *Am J Public Health*. 2021;111:1787-1795.
60. O'Connor A, Peckham T, Seixas N. Considering work arrangement as an "exposure" in occupational health research and practice. *Front Public Health*. 2020;8:363.
61. Edmonds AT, Sears JM, O'Connor A, Peckham T. The role of nonstandard and precarious jobs in the well-being of disabled workers during workforce reintegration. *Am J Ind Med*. 2021;64:667-679.
62. Quinlan M, Mayhew C, Bohle P. The global expansion of precarious employment, work disorganization, and consequences for occupational health: placing the debate in a comparative historical context. *Int J Health Serv*. 2001;31:507-536.
63. Quinlan M, Mayhew C, Bohle P. The global expansion of precarious employment, work disorganization, and consequences for occupational health: a review of recent research. *Int J Health Serv*. 2001;31:335-414.
64. Macdonald LA, Harenstam A, Warren ND, Punnett L. Incorporating work organisation into occupational health research: an invitation for dialogue. *Occup Environ Med*. 2008;65:1-3.
65. Doubleday A, Baker MG, Lavoué J, Siemiatycki J, Seixas NS. Estimating the population prevalence of traditional and novel occupational exposures in Federal Region X. *Am J Ind Med*. 2019;62:111-122.
66. Beckel JLO, Fisher GG. Telework and worker health and well-being: a review and recommendations for research and practice. *Int J Environ Res Public Health*. 2022;19:3879.
67. Le VT, Fulton-Kehoe D, Sears JM, et al. Trends and disparities in the use of telehealth among injured workers during the COVID-19 pandemic. *J Occup Environmental Medi*. 2022;64:e249-e256.
68. Sears JM, Schulman BA, Fulton-Kehoe D, Hogg-Johnson S. Workplace organizational and psychosocial factors associated with return-to-work interruption and reinjury among workers with permanent impairment. *Ann Work Expo Health*. 2021;65:566-580.
69. O'Connor AW, Helfrich CD, Nelson KM, Sears JM, Singh H, Wong ES. Changes in electronic notification volume and primary care provider burnout. *Am J Manag Care*. 2023;29:57-63.
70. O'Connor AW, Wong ES, Nelson KM, Sears JM, Helfrich CD. Patient enrollment growth and burnout in primary care at the Veterans Health Administration. *J Gen Intern Med*. 2023;38:1689-1696.
71. Punnett L. Response to NIOSH request for information on interventions to prevent work-related stress and support health worker mental health. *NEW SOLUTIONS: J Environmental Occup Health Policy*. 2022;32:223-229.
72. Sears JM, Edmonds AT, Hannon PA, Schulman BA, Fulton-Kehoe D. Workplace wellness program interest and barriers among workers with work-related permanent impairments. *Workplace Health Saf*. 2022;70:348-357.
73. Sears JM, Wickizer TM, Franklin GM, Cheadle AD, Berkowitz B. Nurse practitioners as attending providers for injured workers: evaluating the effect of role expansion on disability and costs. *Med Care*. 2007;45:1154-1161.
74. Wickizer TM, Franklin G, Fulton-Kehoe D, et al. Improving quality, preventing disability and reducing costs in workers' compensation healthcare: a population-based intervention study. *Med Care*. 2011;49:1105-1111.
75. Tompa E, de Oliveira C, Dolinschi R, Irvin E. A systematic review of disability management interventions with economic evaluations. *J Occup Rehabil*. 2008;18:16-26.
76. Verbeek J, Pulliainen M, Kankaanpää E. A systematic review of occupational safety and health business cases. *Scand J Work Environ Health*. 2009;35:403-412.
77. Tompa E, Dolinschi R, de Oliveira C, Amick 3rd BC, Irvin E. A systematic review of workplace ergonomic interventions with economic analyses. *J Occup Rehabil*. 2010;20:220-234.
78. Lahiri S, Latif S, Punnett L. An economic analysis of a safe resident handling program in nursing homes. *Am J Ind Med*. 2013;56:469-478.
79. Lahiri S, Markkanen P, Levenstein C. The cost effectiveness of occupational health interventions: preventing occupational back pain. *Am J Ind Med*. 2005;48:515-529.
80. Smith CK, Bonauto DK. Improving occupational health disparity research: testing a method to estimate race and ethnicity in a working population. *Am J Ind Med*. 2018;61:640-648.
81. Smith PM, Saunders R, Lifshen M, et al. The development of a conceptual model and self-reported measure of occupational health and safety vulnerability. *Accident Analysis Preven*. 2015;82:234-243.
82. Topete L, Forst L, Zanoni J, Friedman L. Workers' compensation and the working poor: occupational health experience among low wage workers in federally qualified health centers. *Am J Ind Med*. 2018;61:189-197.
83. Institute for Work and Health. Primary, secondary and tertiary prevention. Accessed November 1, 2022. https://www.iwh.on.ca/what-researchers-mean-by/primary-secondary-and-tertiary-prevention

84. Choi BC, Pak AW. Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness. *Clin Invest Med*. 2006;29:351-364.
85. Choi BCK, Pak AWP. Multidisciplinarity, interdisciplinarity, and transdisciplinarity in health research, services, education and policy: 2. Promotors, barriers, and strategies of enhancement. *Clini Investig Med*. 2007;30:224.
86. Pransky G, Himmelstein J. Outcomes research: implications for occupational health. *Am J Ind Med*. 1996;29:573-583.
87. Boden LI. Policy evaluation: better living through research. *Am J Ind Med*. 1996;29:346-352.
88. Franche RL, Baril R, Shaw W, Nicholas M, Loisel P. Workplace-based return-to-work interventions: optimizing the role of stakeholders in implementation and research. *J Occup Rehabil*. 2005;15:525-542.
89. Sears JM, Hogg-Johnson S. Enhancing the policy impact of evaluation research: a case study of nurse practitioner role expansion in a state workers' compensation system. *Nurs Outlook*. 2009;57:99-106.
90. Young AE, Wasiak R, Roessler RT, McPherson KM, Anema JR, van Poppel MNM. Return-to-work outcomes following work disability: stakeholder motivations, interests and concerns. *J Occup Rehabil*. 2005;15:543-556.
91. Graves MC, Harris JR, Hannon PA, et al. Promoting influenza vaccination to restaurant employees. *Ame J Health Promotion*. 2016;30:498-500.
92. Parrish AT, Graves MC, Harris JR, Hannon PA, Hammerback K, Allen CL. Influenza vaccination status and attitudes among restaurant employees. *J Public Health Manag Pract*. 2015;21:E10-E15.
93. Hammerback K, Kava CM, Passey DG, et al. Development and pilot test of an online training to engage managers to support workplace wellness. *J Occup Environmental Med*. 2021;63:794-799.
94. Passey DG, Hammerback K, Huff A, Harris JR, Hannon PA. The role of managers in employee wellness programs: a mixed-methods study. *Am J Health Promotion*. 2018;32:1697-1705.
95. Linnan L, Bowling M, Childress J, et al. Results of the 2004 National Worksite Health Promotion Survey. *Am J Public Health*. 2008;98:1503-1509.
96. Linnan LA, Cluff L, Lang JE, Penne M, Leff MS. Results of the workplace health in America Survey. *Am J Health Promotion*. 2019;33:652-665.
97. Brown MC, Kava C, Bekemeier B, et al. Local health departments' capacity for workplace health promotion programs to prevent chronic disease: comparison of rural, micropolitan, and urban contexts. *J Public Health Manag Pract*. 2021;27:E183-E188.
98. Sears JM, Wickizer TM, Franklin GM, Cheadle AD, Berkowitz B. Nurse practitioners as attending providers for workers with uncomplicated back injuries: using administrative data to evaluate quality and process of care. *J Occup Environmental Med*. 2007;49:900-908.
99. Sears JM, Wickizer TM, Franklin GM, Cheadle AD, Berkowitz B. Expanding the role of nurse practitioners: effects on rural access to care for injured workers. *J Rural Health*. 2008;24:171-178.
100. Graves JM, Fulton-Kehoe D, Jarvik JG, Franklin GM. Early imaging for acute low back pain: one-year health and disability outcomes among Washington State workers. *Spine (Phila Pa 1976)*. 2012;37:1617-1627.
101. Graves JM, Fulton-Kehoe D, Jarvik JG, Franklin GM. Impact of an advanced imaging utilization review program on downstream health care utilization and costs for low back pain. *Med Care*. 2018;56:520-528.
102. Wickizer TM, Franklin GM, Mootz RD, et al. A community-wide intervention to improve outcomes and reduce disability among injured workers in Washington State. *Milbank Q*. 2004;82:547-567.
103. Office of Disability Employment, US Department of Labor. Request for information on potential stay-at-work/return-to-work demonstration projects. Accessed November 25, 2018. https://www.federalregister.gov/documents/2017/09/29/2017-20338/request-for-information-on-potential-stay-at-workreturn-to-work-demonstration-projects
104. Franklin GM, Mai J, Turner J, Sullivan M, Wickizer T, Fulton-Kehoe D. Bending the prescription opioid dosing and mortality curves: impact of the Washington State opioid dosing guideline. *Am J Ind Med*. 2012;55:325-331.
105. Franklin G, Sabel J, Jones CM, et al. A comprehensive approach to address the prescription opioid epidemic in Washington State: milestones and lessons learned. *Am J Public Health*. 2015;105:463-469.
106. AcademyHealth. Interest groups. Accessed October 30, 2022. https://academyhealth.org/professional-resources/interest-groups/page/interest-groups
107. Zengul FD, Oner N, Ozaydin B, et al. Mapping 2 decades of research in health services research, health policy, and health economics journals. *Med Care*. 2022;60:264-272.
108. Himmelstein J, Rest K. Working on reform. How workers' compensation medical care is affected by health care reform. *Public Health Rep*. 1996;111:12-24.
109. Farley DO, Greenberg M, Nelson C, Seabury S. *Assessment of 24-Hour Care Options for California*. RAND Corporation; 2004.
110. Dembe AE. Preserving workers' compensation benefits in a managed health care environment. *J Public Health Policy*. 1998;19:200-218.
111. Ballen DT. The sleeper issue in health care reform: the threat to workers' compensation. *Cornell Law Rev*. 1994;79:1291-1302.
112. Kennedy EM. Health care reform: workers beware. *Public Health Reports*. 1996;111:11.
113. McCluskey MT. Reforming insurance to support workers' rights to compensation. *Am J Ind Med*. 2012;55:545-559.
114. Lax MB. Workers' compensation reform requires an agenda and a strategy. *NEW SOLUTIONS: J Environmental Occupl Health Policy*. 2010;20:303-309.
115. Boden LI. Reexamining workers' compensation: a human rights perspective. *Am J Ind Med*. 2012;55:483-486.
116. Hilgert JA. Building a human rights framework for workers' compensation in the United States: opening the debate on first principles. *Am J Ind Med*. 2012;55:506-518.
117. Dunn ML. Workers' compensation reform policy. *NEW SOLUTIONS: J Environmental Occup Health Policy*. 2010;20:397-404.
118. Davis L, Souza K. Integrating occupational health with mainstream public health in Massachusetts: an approach to intervention. *Public Health Rep*. 2009;124(suppl 1):5-15.
119. LaDou J. Occupational and environmental medicine in the United States: a proposal to abolish workers' compensation and reestablish the public health model. *Int J Occup Environ Health*. 2006;12:154-168.
120. Dembe AE. How historical factors have affected the application of workers' compensation data to public health. *J Public Health Policy*. 2010;31:227-243.
121. Utterback DF, Schnorr TM, Silverstein BA, Spieler EA, Leamon TB, Amick BC. Occupational health and safety surveillance and research using workers' compensation data. *J Occup Environmental Med*. 2012;54:171-176.
122. Occupational Safety and Health Administration. Adding inequality to injury: the costs of failing to protect workers on the job. Accessed July 17, 2018. http://www.dol.gov/osha/report/20150304-inequality.htm

123. Felknor SA, Schulte PA, Schnorr TM, Pana-Cryan R, Howard J. Burden, need and impact: an evidence-based method to identify worker safety and health research priorities. *Ann Work Expo Health*. 2019;63:375-385.
124. Howard J. Nonstandard work arrangements and worker health and safety. *Am J Ind Med*. 2017;60:1-10.
125. Wickizer TM, Franklin G, Fulton-Kehoe D, Turner JA, Mootz R, Smith-Weller T. Patient satisfaction, treatment experience, and disability outcomes in a population-based cohort of injured workers in Washington State: implications for quality improvement. *Health Serv Res*. 2004;39:727-748.
126. Wickizer TM, Franklin G, Gluck JV, Fulton-Kehoe D. Improving quality through identifying inappropriate care: the use of guideline-based utilization review protocols in the Washington State Workers' Compensation System. *J Occup Environ Med*. 2004;46:198-204.
127. US House of Representatives Committee on Education and Labor. Majority staff report: hidden tragedy: underreporting of workplace injuries and illnesses. Accessed January 17, 2023. http://www.cste.org/resource/resmgr/OccupationalHealth/HouseEdLaborCommReport061908.pdf
128. Friedman LS, Forst L. The impact of OSHA recordkeeping regulation changes on occupational injury and illness trends in the US: a time-series analysis. *Occup Environ Med*. 2007;64:454-460.
129. Cryer C, Langley J. Developing indicators of injury incidence that can be used to monitor global, regional and local trends. Accessed January 17, 2023. http://psm-dm.otago.ac.nz/ipru/ReportsPDFs/OR070.pdf
130. Sears JM, Bowman SM, Hogg-Johnson S. Using injury severity to improve occupational injury trend estimates. *Am J Ind Med*. 2014;57:928-939.
131. Guo X, Burton Jr. JF. Workers' compensation: recent developments in moral hazard and benefit payments. *ILR Rev*. 2010;63:340-355.
132. Stephenson S, Langley J, Cryer C. Effects of service delivery versus changes in incidence on trends in injury: a demonstration using hospitalised traumatic brain injury. *Accident Analysis Prevention*. 2005;37:825-832.
133. Sears JM, Haight JR, Fulton-Kehoe D, Wickizer TM, Mai J, Franklin GM. Changes in early high-risk opioid prescribing practices after policy interventions in Washington State. *Health Serv Res*. 2021;56:49-60.
134. Wickizer TM, Kopjar B, Franklin G, Joesch J. Do drug-free workplace programs prevent occupational injuries? Evidence from Washington state. *Health Serv Res*. 2004;39:91-110.
135. Hanney SR, Gonzalez-Block MA, Buxton MJ, Kogan M. The utilisation of health research in policy-making: concepts, examples and methods of assessment. *Health Res Policy Syst*. 2003;1:2.

How to cite this article: Sears JM, Wickizer TM, Franklin GM, et al. Development and maturation of the occupational health services research field in the United States over the past 25 years: challenges and opportunities for the future. *Am J Ind Med*. 2023;66:996-1008. doi:10.1002/ajim.23532