

# 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

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## 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.<sup>1–3</sup> Work-related injuries remain a significant

source of burden on workers and employers, accounting for 38% of nonfatal injuries among employed persons.<sup>4</sup> In 2016, about 31% of 2.9 million nonfatal work injuries/illnesses required time off work.<sup>5</sup> 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.<sup>6–8</sup> 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.<sup>8</sup>

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.<sup>9</sup> 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.<sup>10–12</sup> 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.<sup>13–15</sup> 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.<sup>9</sup> 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.<sup>16–21</sup> 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.<sup>22</sup> 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.<sup>9,23–28</sup> 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.<sup>29,30</sup>

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.”<sup>31</sup> 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;<sup>32</sup> they also include services such as preplacement health screening, workplace health promotion, job accommodation, workplace substance-abuse programs, and onsite first aid.<sup>31,33</sup> 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.<sup>32,34</sup> 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. <i>Health Serv Res.</i> 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. <i>Research methods in occupational epidemiology.</i> 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) <a href="https://www.aiha.org/about-aiha">https://www.aiha.org/about-aiha</a>
Occupational medicine	Diagnosis and treatment of work-related injuries and illnesses.	American College of Occupational and Environmental Medicine (ACOEM) <a href="https://acoem.org/Careers/What-Is-OEM">https://acoem.org/Careers/What-Is-OEM</a>
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) <a href="https://www.aohn.org/About/What-is-Occupational-and-Environmental-Health-Nursing">https://www.aohn.org/About/What-is-Occupational-and-Environmental-Health-Nursing</a>
Total worker health (TWH) <sup>®</sup>	TWH <sup>®</sup> 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 <sup>®</sup> approach seeks to improve the well-being of the US workforce by protecting their safety and enhancing their health and productivity. Using TWH <sup>®</sup> strategies benefits workers, employers, and the community.	National Institute for Occupational Safety and Health (NIOSH) <a href="https://www.cdc.gov/niosh/twh/default.html">https://www.cdc.gov/niosh/twh/default.html</a>
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. <i>Workplace health promotion and well-being.</i> 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.”<sup>35</sup> 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.”<sup>36</sup> 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;<sup>35</sup> the Donabedian model (structure/process/outcomes);<sup>32,34</sup> the stages of prevention (primary/secondary/tertiary);<sup>33</sup> the hierarchy of controls;<sup>37</sup> and the injury pyramid.<sup>38,39</sup> 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.<sup>38,40–42</sup> 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.<sup>16,31,43,44</sup> The knowledge base of HSR—which emerged as a distinct field in the 1960s<sup>45</sup>—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.<sup>31,44</sup> 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.<sup>44</sup> Under the expansive public health-oriented leadership of Dr. Linda Rosenstock (NIOSH Director from 1994 to 2000),<sup>46</sup> 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.<sup>31,47</sup> Both RWJF and NIOSH held conferences and technical meetings to train researchers and promote interest and information exchange in this emerging area.<sup>31,44</sup> 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.<sup>31,33</sup> 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.<sup>31,47</sup> 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.<sup>48</sup> 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,<sup>33,45,49–51</sup> 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.<sup>52</sup> 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.<sup>53,54</sup> 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.<sup>55</sup>

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.<sup>7,9,11,56–58</sup> 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.<sup>59–65</sup> There is burgeoning interest in topics related to both telehealth and telework, for which the COVID-19 pandemic provided an important impetus.<sup>66,67</sup> OHSR is useful for addressing topics related to burnout, work/life balance, and work-related stress, anxiety, and depression,<sup>68–70</sup> and can be used to evaluate individual and structural interventions to address these, including work redesign, which is high on the hierarchy of controls.<sup>59,71,72</sup> 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.<sup>73–79</sup> 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.<sup>25,26,28,80–82</sup>

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.<sup>83</sup> Many OHSR topics span all stages of prevention. For example, TWH<sup>®</sup> 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.<sup>49,84,85</sup>

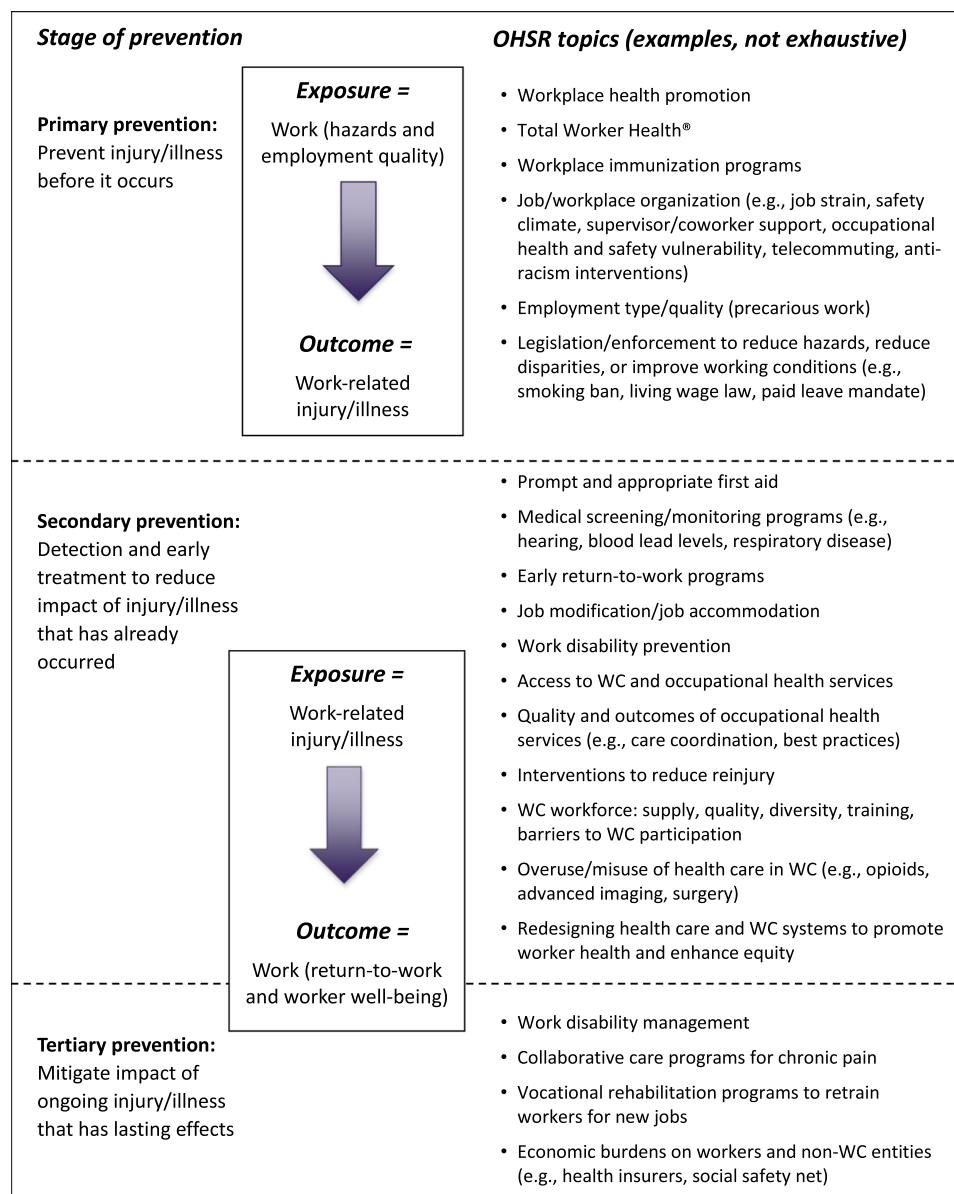
## 5 | OHSR TRAINING PROGRAMS

In 2000 and 2001, NIOSH awarded Education and Research Center (ERC)-based training grants that established four new academic doctoral-level OHSR training programs.<sup>44</sup> 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, health-care, 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.<sup>77</sup> WC, workers' compensation.

traditional WC-based administrative outcomes such as compensated time lost from work, healthcare costs, and permanent impairment.<sup>86</sup>

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.<sup>29,87</sup> 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.<sup>88–90</sup>

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 OEHP 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,<sup>91,92</sup> collaborating on health promotion efforts at Washington State agencies,<sup>93,94</sup> 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.<sup>95,96</sup> 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.<sup>97</sup>

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.<sup>73,98,99</sup> 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.<sup>100,101</sup> 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.<sup>74,102</sup> 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.<sup>103</sup>

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.<sup>104,105</sup> 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.<sup>17</sup>

## 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).<sup>106</sup> Descriptive summaries, histories, and research maps of HSR do not generally mention OHSR or worker/workplace health topics.<sup>45,107</sup> 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.<sup>29,45,60</sup>

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.<sup>61</sup> 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.<sup>62</sup> Growth in the number of health services researchers appears to be slowing, and minorities are underrepresented.<sup>63</sup> Limited funding for HSR trainees is a potential threat to the HSR workforce supply.<sup>63</sup> 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.<sup>61</sup> 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,<sup>108–112</sup> but despite calls to reignite this combined policy focus from a variety of perspectives (e.g., system efficiency,<sup>113</sup> injured worker rights,<sup>114</sup> human rights,<sup>115,116</sup> public health<sup>117–119</sup>), 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,<sup>56,120,121</sup> as well as from larger economic forces. Over time, the workforce has become more diverse and the conditions of work more precarious.<sup>23,122</sup> 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.<sup>13,58,123,124</sup> Monitoring burden is critically important, yet is impeded by numerous data limitations and gaps.<sup>9,56,58</sup> 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,<sup>3</sup> 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.<sup>9</sup>

## 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,<sup>18</sup> and could be substantially reduced via quality improvement in WC healthcare.<sup>20,125,126</sup> 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.<sup>7,9–11,58</sup> 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.<sup>14,23,24,56,58,124,127–132</sup> These issues were comprehensively described in a 2018 consensus report by the National Academies of Sciences, Engineering, and Medicine.<sup>56</sup> 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<sup>®</sup> 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.<sup>49</sup> 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.<sup>74,133,134</sup> 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.”<sup>31</sup> 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.<sup>135</sup> 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.

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