December 2013 • Volume 55 • Number 12S

www.joem.org

JOEM

Journal of Occupational and Environmental Medicine

American College of Occupational and Environmental Medicine

Total Worker Health Supplement

Guest Editor: James A. Merchant, MD, DrPH

Wolters Kluwer Health | Lippincott Williams & Wilkins

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2012 Total Worker Health™ Symposium

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Foreword

The University of Iowa College of Public Health, Healthier Workforce Center for Excellence, was pleased to host the first Total Worker Health™ (TWH) Symposium—Safe, Healthy and Cost-Effective Solutions—on November 30 and December 1, 2012. The goals of the Symposium were to bring together investigators from the four National Institute for Occupational Safety and Health (NIOSH) Centers of Excellence to Promote a Healthier Workforce, NIOSH TWH investigators and administrators, other national TWH leaders who serve as Center advisors, and Iowa practice and policy leaders, to present, and discuss TWH research, practice, and policy. One hundred twenty participants from 18 states and Washington, DC, participated in the Symposium.

The Symposium was organized into six sessions, each with a plenary presentation by a senior investigator addressing a major TWH theme. Each session also included a research and research-to-practice presentation, and in the final session, a policy panel presentation—all intended to be consistent with the content covered by the plenary presentation. Those submitting abstracts for presentation at the Symposium not selected for a platform presentation by the Symposium Program Committee, composed of the four TWH Center directors, were invited to present posters of their work. Not all presenters submitted manuscripts, and not all manuscripts were accepted for publication after peer review.

Gathering together many of the national leaders in developing the national TWH agenda offered an opportunity to gain candid perspectives from NIOSH Director John Howard and 17 other senior participants on how they individually define TWH, how TWH can make a difference in the workplace, and the value or return-on-investment of TWH. Their comments compose an interesting commentary on TWH as NIOSH continues to implement this promising, but still young, national program intended to provide the research foundation to assist employers and employees realize the tremendous opportunity for a healthier and more productive workforce.

James A. Merchant, MD, DrPH
Professor and Director
Healthier Workforce Center for Excellence
College of Public Health
The University of Iowa

Jennifer L. Hall, EdD, MCHES
Associate Director for Outreach
Healthier Workforce Center for Excellence
College of Public Health
The University of Iowa

DOI: 10.1097/JOM.0000000000000047

Opening Comments

Welcome to the 2012 Total Worker Health™ Symposium: Safe, Healthy and Cost-Effective Solutions. Thank you, Dr Merchant and everyone at the University of Iowa, for bringing us all together. I want to briefly talk to you about worker health and well-being—research, programs, laws and regulations. There are 311 million Americans in the United States and 155 million of those Americans are workers. Even though many of us who work have health insurance, there are some workers who have no health insurance and these are perhaps the most vulnerable of all workers. Many workers without health insurance work in the riskiest occupations, and they are assigned the riskiest work. Often their employment is very precarious. They suffer injury, illness, and death at a greater proportion than other workers—those more like the folks in this room—myself included, who are blessed with employer-sponsored health insurance. But whether you are in one group or the other, you are in a medical care system that is unsustainable. If you look at the percentage of the gross domestic product that the American health care system expends every year, and you project the current rate to 2030, such spending becomes economically unsustainable. It is impossible to run a country when 27% to 30% of the gross domestic product is tied up in health care.

So, there is a problem. We all know it. There are still differing opinions about how to solve it, even today, even after the Congress passed the Patient Protection and Affordable Care Act in 2010 (ACA), even after the Supreme Court reviewed and upheld it, and even after a presidential election occurred in which one candidate said he would repeal it and another candidate said he would go forward with it. It is a fact that the ACA is something that all of us, if we truly believe in Total Worker Health™, need to integrate into our thinking, our concepts, our programs, and our research.

The unsustainability of the medical care system is something that the ACA attempts to attack—head on. Critics say not enough, but it is a start. When you look at the cost-containment strategy within the Act, you can sum it up in one word: prevention. Prevention is the cost-containment strategy embedded in the ACA, and prevention is something that we in occupational safety and health do all the time. It is something that employers care very much about, workers care very much about, and workers' families care about. When a worker is not at work, whatever the reason—whether the cause is occupational or nonoccupational—that worker is losing money, the worker's family is adversely affected, the worker's employer is adversely affected, the productivity of the enterprise in which the worker is involved is adversely affected, the regional economic output is adversely affected, and the nation's economic output is adversely affected. Occupational health—Total Worker Health™—has a role to play in the cost-containment strategy that is at the heart of the ACA. After all, occupational health is economic health.

Just this past week, three regulations were published jointly by the Department of Health and Human Services, the Department of Treasury, and the Department of Labor. You need to read them, understand them, comment on them, and integrate them into your efforts to bring the concept of Total Worker Health™ to every worker and employer in the United States. The first regulation prohibits insurers from discriminating against Americans with preexisting conditions. Premiums can only be based on age, family size, geography, and history of tobacco use (a prevention strategy embedded within premium pricing). The second regulation establishes requirements for essential health benefits. *All* health insurance has to provide 10 essential benefits. Regional spottiness in health benefits will be a thing of the past. The third regulation concerns two types of employee wellness programs—participatory wellness programs and health-contingent wellness programs. We all need to read that regulation and integrate it into our forward thinking about how we achieve Total Worker Health™—how we integrate occupational safety and health protection with disease prevention and health promotion.

We are in a new world now. On October 1, 2013, those who have no health insurance can start signing up for health insurance through their state's health insurance marketplaces, formerly called "state exchanges." For those states that decline to operate a health insurance marketplace, the Department of Health and Human Services will operate one for the state.

There is much to come. The world will change in 2014 and 2015 for all of us who care about the health of the worker and the economic health of the nation. You need to understand that to make prevention work as cost containment depends on what you do, the research that you generate, on the Total Worker Health™ programs and demonstration projects that you launch. We need to show, in the next few years, that prevention does work. We need to show that it works from the worker perspective, the employer perspective, and the national perspective. We need to show that occupational health is economic health.

People in Washington talk about "bending curves." For example, the First Lady's initiative to prevent obesity in children sets out to bend the curve of the childhood obesity epidemic. Health care costs are rising, and we all have to work to bend that curve. You have a role to play in bending that curve. We have to take our old twentieth-century idea of *work-related* injury and illness, and transform it into *worker* injury and illness. We have to move in a new direction because the past is unsustainable.

Your research, your demonstration projects, and your interventions—all have a great role to play. We need to know the answers to what works in Total Worker Health™ and what does not work. You need to inform all of us, both from the practice perspective and the economic perspective. You need to show the nation that Total Worker Health™ is a strategy that can help fulfill the ACA promise of disease prevention and health promotion.

Thank you very much for all the work you do and all the work you are going to do after getting new ideas from this Symposium. At NIOSH, we want to support this effort as much as we can in an austere budget era. Total Worker Health™ is vital to the health of working men and women, private enterprise, and the nation's economy.

Thank you very much and have a great Symposium!

John Howard, MD
Director, NIOSH

Commentary: A Conversation on Total Worker Health

The benefits of workplace programs, policies, and practices that enhance employee well-being have been gaining recognition and approval over the past two decades. In 2004, NIOSH implemented the WorkLife Initiative to focus national attention on integration of health protection and health promotion programs. The WorkLife Initiative Center for Excellence Program was begun in 2006 and expanded in 2011, the same year that it became the Total Worker Health™ (TWH) Program. Yet, TWH, and its underlying concept of integration of employee health protection and health promotion programs, is not widely understood—especially among smaller employers. Several participants in the TWH Symposium share their views about TWH, how successful programs make a difference, and the return on investing in TWH.

What Is TWH?

It is integrating the traditional occupational safety and health protection that we have been doing since the Occupational Safety and Health Act was passed, with health promotion. What we are trying to do is broaden the spotlight that we have had for 43 years on work-related injury and illness to an expanded view of human capital. So TWH means that we are talking about what affects the worker as a whole, rather than dividing "occupational" from "nonoccupational." We need to be more holistic in the twenty-first century.

–John Howard, MD
Director, NIOSH

Congress passed a law that was called the Occupational Safety *and* Health Act, not the Occupational Safety *or* Health Act. Whether we are talking about safety versus disease, it is the same lifestyle, the same risk factors at work.

–Wesley Alles, PhD
Senior Research Scientist, Stanford University

"Integrating" was the word we used for our 2005 IOM report "Integrating Employee Health," referring to the sum of the components intended to make workers healthier, safer, more productive, and more resilient. The model we developed for that report encompassed not only traditional occupational health and safety but also behavioral health programs such as Employee Assistance Programs for substance abuse or depression, health information portals (increasingly electronic), incentive programs, access to exercise facilities, access to good primary care, and a number of other components. Even more important than the "integration" definition is asking: "Do workers have these services?" "And are they benefiting from them?" Those are the challenges we face as researchers, to document answers to these questions and measure their impact.

–James A. Merchant, MD, DrPH, Director,
Healthier Workforce Center for Excellence (HWCE)
University of Iowa College of Public Health

Our definition is multifaceted, and our best bet is to keep it multifaceted. We can do TWH in many different ways.

–Leslie Hammer, PhD
Associate Director, Oregon Healthy WorkForce Center
Director, Occupational Health Psychology,
Portland State University

At the level of professionals who work in occupational health and safety and in worksite health promotion, TWH can mean making people with different skill sets aware of what others can contribute. But we need to remember those professional disciplines have little meaning to individual workers. They experience their job and their work environment without putting them into bins labeled "physical workload," "psychosocial stress," "work schedule," "unfriendly supervisor," and, hopefully, some positives as well.

–Laura Punnett, ScD
Co-Director, Center for the Promotion of Health in the
New England Workforce
University of Massachusetts-Lowell

In a broad sense, TWH is keeping people healthy, making them healthier, and allowing them to achieve their aspirations at work. People spend a lot of time at work, and being in that environment for as long as they are, they have a lot of exposures to everything from the environment to relationships with people to interaction with tools and machines. They have to eat, and they share stories. To the extent that you can use those as opportunities to create and reinforce things that are good for people's health, you can have an enormous influence that spills over to every other aspect of people's lives.

–Martin Sepulveda, MD, FACP
IBM Fellow and Vice President

There is the workplace component. Occupational safety and health has entered the general thinking of the work environment. We can go into workplaces that are fairly difficult in terms of pay or hours, but yet there is attention to exposure and often to engaging the workforce in health and safety related to exposure. Our view is that the same thing can be done around health issues, so we think in individual terms, of people being able to make mediations. And ultimately we recognize that people do have to take responsibility—that is called health self-efficacy.

–Martin Cherniack, MD, MPH
Co-Director, Center for the Promotion of Health in the
New England Workplace
University of Connecticut

TWH means fitness and performance for whatever an employee wants to do.

–Michael Parkinson, MD, MPH, FACPM
Senior Medical Director, UPMC (University of Pittsburgh Medical Center) Health Plan and UPMC WorkPartners

How Can TWH Make a Difference?

Our aim is to enhance individual well-being for the benefit of both the person—they feel better in their home life, their work life—and the employer, whose employees will be more productive and engaged in their work. And we are hoping TWH also spills over to families and the community.

–Anita Schill, PhD, MPH,MA
Senior Science Advisor, NIOSH

Using a TWH approach makes a difference for the worker because this integrated approach addresses their overall health and safety. It makes a difference for the employers because it creates efficiencies in their program, and the effects are greater as a whole.

–Jack Dennerlein, PhD
Co-Director, Center for Work, Health, and Wellbeing
Harvard School of Public Health

Anytime you can increase the collaboration and cooperation among the silo-ed parts of an organization, you are going to be better off. You will increase communication, and you will have a better way to manage change and to introduce new programs or ways of manufacturing.

–L. Casey Chosewood, MD
Senior Medical Officer, NIOSH

I think there are gaps in many worksite health promotion programs that can be remedied by a better understanding of the impact of working conditions on people.

–Laura Punnett

It will force us to take a more employee-centric view, rather that defining programs by disease or injury or medical versus mental (or by cost). If we can share with employees a common vision of what a "best place" to work looks and feels like, we can align incentives, infrastructure, and the workplace environment so that healthier behaviors, prevention of illness and injury, and safe work practices become the norm.

–Michael Parkinson

There is a law of economics that says the more people that work in a country, the more vital the economy of that country. So we are trying to apply that at the enterprise level. Let us keep all your employees as healthy as they can be, so they can flourish, their families can flourish, your enterprise can flourish, and the economy can flourish. We are essentially saying that traditional occupational health, married with the health promotion, is economic health.

–John Howard

My focus is young workers. If we could help them start off with this safety–health balance, by having it integrated from the get-go, they will be thinking about how to stay healthy and safe at work because that is all they know. Another important population for us to focus on is vulnerable workers, such as immigrants or low-wage workers. We can also help them to have resources.

–Diane Rohlman, PhD
Associate Director, Principal Investigator, HWCE
University of Iowa College of Public Health

What Does a Successful TWH Program Look Like?

At the programmatic level—what workers see—messages would acknowledge the shared effects of the work environment and health behaviors. At the level of policies that set the stage for worker health outcomes, those policies would also be linked. For example, an organization might adopt a policy around respiratory health, which would include both the reduction of potential exposures on the job and a tobacco use policy.

–Glorian Sorensen, PhD
Director, Center for Work, Health, and Wellbeing
Harvard School of Public Health

A successful program is well designed, has specific aims laid out, a written plan of intervention—essentially the elements of quality improvement, meaning understanding where you are at baseline, setting a target, defining the intervention, and tracking the performance. Another piece that is critical is engaging the workers themselves in the design, evaluation, and monitoring of the program. Programs that are "top-down" are not going to be as successful as ones that engage the people who are going to be affected.

–Neil Kohatsu, MD, MPH
Medical Director, California Department of Health Care Services

It respects the worker as a whole human, thinking about their family, their health, and their contribution to the work environment.

–Jack Dennerlein

The first thing you need is participation—a certain critical mass. Then you need to "sell" the program. And get everyone involved in health appraisals; people have to know their numbers. And finally you need to *keep* people involved. Employers start on the road, and then participation drops off, enthusiasm wanes. You are trying to change people's lifestyle, the way they think and live, and that is not easy. One of the reasons that we have funded centers is that we need to show *where* TWH works (and not only in large employment settings but medium-sized and small ones), *how* it works, and *what* does and does not work. So when an employer says, "I want to give health club memberships . . . ," we can say "Here's what our research shows. Here's how you should give them."

–John Howard

It can look so many different ways in different companies, but generally it is a company figuring out what can be put in place to make the environment more conducive to health, and then bringing into that mix the motivation of individual workers to be engaged participants.

–Nico Pronk, PhD
Vice President and Health Science Officer, HealthPartners Research Foundation

Safety and a culture of concern for safety is the foundation on which to build opportunities for people to adopt healthy behaviors that transcend the workplace and begin to affect the choices they make in communities where they live, in their families with their children, in their schools, their churches. You begin to see the extraordinary payoffs of things that can be catalyzed by what employers do.

–Martin Sepulveda

What Is the Value to an Employer of a TWH Program? Is There a Return On Investment?

A few years ago, we were at a meeting of companies that had gotten awards for progressive programs—for worker engagement, flex scheduling, a variety of things. A number of CFOs and CEOs were present, and *none* of them said that return on investment was their motivation. They all felt that this was an ethical, human issue; they felt some connection to the workforce; they knew people had discontents and they thought they could manage them. The economic arguments came later, once they had programs in place and were trying to evaluate them.

–Martin Cherniack

The kind of return that you are going to see is quality and performance. People need to be in a place where they can use their skills, feel like they are making an impact on their job, and are happy to come to work every day. If those things are true, the employer

is going to get a lot of productivity from their employees. It is also going to make the organization look good!

–Suzanne Nobrega, MSW
Outreach Director, Co-Director, Center for the Promotion of Health in the New England Workforce
University of Massachusetts-Lowell

We have clear indicators that worksite health promotion has a very strong return on investment. And we also have indicators around occupational safety and health. We still need an ongoing evaluation of how those come together in terms of economic outcomes. That research is ongoing, but it is very promising.

–Glorian Sorensen

What is stimulating the "late adopter" employers to use TWH is the realization that without this approach, people default to behaviors in other environments and can become unhealthy. And employers begin to see the results, the most obvious being that people are not at work, and when they are not at work, employers have to figure out how to keep up the outputs in the absence of a vital production component. The other result is people are at work but they are not well. So they do not perform as well, and again employers have to figure out how to keep the same number of widgets coming out the back end with a weak link in the chain. And there is the result that is really compelled all of these changes: if employers provide health care coverage, employees begin to use massive amounts of it, and it is incredibly expensive. In fact, it has become the single most expensive component of labor cost that is not wages, and that has really caught the attention of employers.

–Martin Sepulveda

Small employers are going to be the biggest beneficiaries because TWH is about efficient programs. By integrating the approaches, you have a more efficient way of implementing all the elements.

–Jack Dennerlein

We have been keeping a very large database on our population the whole time we have been doing this program. We have decreased our workers compensation rate by 80%. We have decreased our long-term disability rate by an equivalent amount. Our medical trend is about 2% a year, and we have relatively low turnover for a call center environment. So yes, there is definitely a return, but you have to be prepared to invest in the tools you need to be able to show it.

–Peter Wald MD, MPH
VP, Enterprise Medical Director
USAA

What Advice Would You Give an Employer—Especially a Small Business Owner—Who Wants to Start a TWH Program?

I would advise them to start with health and safety. Once you have got a safe environment, you build on it by bringing wellness in. They are complementary programs; they can use the same resources, and that is where the cost savings come. And you can share skill sets.

–W. Kent Anger, PhD
Director, Oregon Healthy Workforce Center

I study work–life integration, work–family integration, and how organizations can better support working families. So I would encourage employers to increase work flexibility and supervisor support, with the idea of increasing workers' control around work and family, which will enable them to have more time to focus on being healthy.

–Leslie Hammer

An important early step would be an assessment of your employees. You can get information from your health plan and your records related to absenteeism and worker compensation—and just by saying to your employees, "Here's a range of health and safety programs that we could offer. What are you most interested in? What would be most valuable to you?

Small employers can do most of the things large employers can do, but there is this sense that "we don't have the resources to do that . . . " You can do things by finding resources in the community. You do not have to build a gym; there are gyms or fitness centers in the community. You do not have to have an expert in nutrition—you may not even have a cafeteria at the workplace—but there are places where people eat, and you can teach employees to make good choices. And if you do that with collaborators, with other small businesses, it is a wonderful way to share resources and get shared benefits.

–Wesley Alles

It is not an "either/or." It has steps along a continuum. Even adopting some preliminary steps—maybe it is not full coordination or integration, but at least creating communication across those sectors is a step in the direction of enhancing their overall functioning in the organization.

–Glorian Sorensen

A lot of things in your built environment send messages, and it is important to think about the message you are sending. For example, our cafeteria—if you walked into our cafeteria with $3, the message we were sending was that all you could eat was burgers and fries, and that was not the message we wanted to send. So we reengineered the way we present food, with the healthy items at eye level (and we have made them a little less expensive). There are a lot of simple things that you can do. We are also part of a business group in San Antonio that is relatively new, and part of our mission is knowledge transfer from the larger to the smaller employers. So I would say find a large-employer mentor or join a business group that can help you.

–Peter Wald

The "*why* to do it" is that there is benefit on both the employer and employee sides, and a win-win situation is more likely to have a good outcome. The "*how* to do it" is the challenge. First, think big. Then start smart: figure out what you can do tomorrow, the easy "wins" you can put into place quickly that show everyone involved that this is do-able. Make those decisions transparent to your workers and involve them in the discussion. And then expand over time. You have your broad vision because you thought big to start with, so then you ask, "What do we need to do to get to that vision?"

–Nico Pronk

Smaller employers, those who employ fewer that 50 people—and that constitute 97% of the employers in Iowa—have a tougher time figuring this out. Where do they get information? The NIOSH Centers for Excellence can be "destination sites" for information. We also have the responsibility to convene the experts, which is what we did with this TWH Symposium. We brought together the

most knowledgeable people in the country who are doing most of the research in this area, and all of it will be available to employers on-line.

–James A. Merchant

The most important thing is the top person's leadership—the commitment and genuine caring of the leader. That dictates the success of the program. Another element would be to allow employees to have as much decision making as possible. People need to feel good about themselves and their work, and that is all about having choices and the ability to decide how to do their work, so they can apply their full skill set. That instills a sense of control and well-being, which helps reduce stress. Having a mentally healthy place to work is as important as physical aspects of the workplace.

–Suzanne Nobrega

We are getting inquiries from small businesses around the country about how to get started, and one of the first things we say is, "Look at what you're already doing." You may have somebody with HR responsibilities, someone with safety responsibilities, people responsible for health promotion activities, or for health benefits—hopefully these are not all the same person! Have these people sit down together and talk about their goals and activities, because what it boils down to is that their goals are all the same—to have healthy workers who are at work, who are contributing, and who thrive in the workplace.

–Anita Schill

James A. Merchant, with John Howard, Wes Alles, Leslie Hammer, Laura Punnett, Martin Sepulveda, Martin Cherniack, Michael Parkinson, Anita Schill, Jack Dennerlein, Casey Chosewood, Diane Rohlman, Glorian Sorenson, Neil Kohatsu, Nico Pronk, Suzanne Nobrega, Peter Wald, and Kent Anger

Acknowledgments: We recognize and thank Kim Merchant, writer/editor for the HWCE, for framing these questions and giving the 18 interviews, and Lamia Zia for videotaping the interviews cited above. We also thank Del Bonney, writer/editor for the Department of Occupational and Environmental Health, for transcribing, formatting, and editing these comments.

PROGRAM AGENDA

2012 Total Worker Health™ Symposium: Safe, Healthy and Cost-Effective Solutions

The Marriott Hotel in Coralville, Iowa
November 29 to 30, 2012

Thursday, November 29

8:15 to 8:30 AM: Welcoming Comments
James A. Merchant, MD, DrPH, Director, University of Iowa College of Public Health,HWCE
John Howard, MD, Director, NIOSH

8:30 to 8:55 AM: Plenary Session 1
Total Worker Health: Innovative Approaches to Promoting and Protecting Worker Health
Glorian Sorensen, PhD, Director, Harvard School of Public Health Center for Work, Health and Wellbeing

9:00 to 10:00 AM:
Examining National Trends in Worker Health with the National Health Interview Survey
Sara Luckhaupt, MD, MPH, NIOSH
Making the Business Case for Integrated Worksite Health Promotion/Protection Interventions,
One Intervention at a Time
Suzanne Nobrega, MS, Outreach Director, CPH-NEW
The Value of Social Media in Reaching and Engaging Employers in Total Worker Health
Heidi Hudson, MPH, CHES, Coordinator, NIOSH TWH™ Program
Jennifer L. Hall, EdD, MCHES, Outreach Director, HWCE

10:30 to 10:55 AM: Plenary Session 2
Participatory Ergonomics as a Model for Integrated Programs to Prevent Musculoskeletal Disorders
Laura Punnett, ScD, Co-Director, Center for the Promotion of Health in the New England Workforce (CPH-NEW)

11:00 to 12:00 PM:
An Economic Analysis of a Safe Resident Handling Program in Nursing Homes
Supriya Lahiri, PhD, CPHNEW
Physically Demanding Work and Physical Activity in Health Care Workers: Developing Key
Messages for Integrated Interventions
Jack Dennerlein, PhD, Harvard Center for Work, Health, and Wellbeing
Effect of Participatory Ergonomics Training on Non-Ergonomist Ratings of Ergonomics Exposures
Nathan Fethke, PhD, HWCE

12:00 to 1:30 PM: Luncheon Speaker
Helping Companies and Organizations to Grow: An Employer Health and Productivity Roadmap
Mike Parkinson, MD, MPH, FACPM, Senior Medical Director, UPMC Health Plan and WorkPartners

1:30 to 1:55 PM: Plenary Session 3
Engaging Employees: Qualitative Findings from Be Hipp (Be Engaged: Help Integrate Promotion/Protection)
Linda Snetselaar, PhD, RD, LD, UI Nutrition Center, HWCE

2:00 to 3:00 PM:
Assessing Occupational and Personal Risk Factors in Illness and Injury—Basic Approaches and Beyond
Sudha Pandalai, MD, PhD, Medical Officer, NIOSH
PUSHing Young Employees to Total Worker Health™: How Focus Groups Go Online
Diane Rohlman, PhD, Oregon Healthy Workforce Center
UChoose: A Collaboration of the University of Iowa's Academic and Hospital Campuses to Promote Healthy Eating
Megan Hammes, MS, ATC, MCHES, Manager, UI Wellness

3:30 to 3:55 PM: Plenary Session 4
Workplace Interventions and Approaches to Reduce Work-Life Stress
Leslie Hammer, PhD, Associate Director, Oregon Healthy Work-Force Center (ORhwc);
Director, Occupational Health Psychology, Portland State University

4:00 to 5:00 PM:
Shift Work and Associated Health Outcomes in Police Officers
Penelope Baughman, PhD, Epidemic Intelligence Service Officer, NIOSH
Correction Officers: Rapid Onset of Musculoskeletal Symptoms With Job Tenure
Martin Cherniack, MD, CPH-NEW
BeWell Employee Incentive Program Creates a Culture of Wellness at Stanford
Wes Alles, PhD, Stanford Prevention Research Center

Friday, November 30

8:00 to 8:15 AM: Senator Tom Harkin, D-Iowa (via video)
8:15 to 8:30 AM: Governor Terry Branstad (via video)

8:30 to 9:30 AM: Plenary Session 5

Integrated Health Programs, Outcomes and Return on Investment
Nico Pronk, PhD, Health Partners, EAC member of UI and Harvard

Integrated Health Programs, Outcomes and Return on Investment: Measuring Worksite Health Promotion and Integrated Program Effectiveness
Martin Cherniack, MD, University of Connecticut and Co-PI, CPH-NEW

9:30 to 10:00 AM:

NIOSH Total Worker Health™ Program
Anita L. Schill, PhD, MPH, MA, Senior Science Advisor, NIOSH
L. Casey Chosewood, MD, Senior Medical Officer for TWH™, NIOSH

10:30 to 11:00 AM: Plenary Session 6

From Worker Health to "Citizen Health": Roles of Health Care Delivery, Public Health and Big Data Transformations
Martin Sepulveda, MD, MPH, IBM Fellow

11:05 to 11:25 AM:

Key Trends From the 2012 Iowa Employer Benefits Study
David P. Lind, David P. Lind Benchmark

11:30 to 12:30 PM: Panel Presentation

Providing Affordable Health Care to Iowa Workers and Employers
Senator Jack Hatch
Ron Reed, CEO, Mercy Hospital Iowa City
Cliff Gold, CoOportunity Health
Dan Kueter, Provicare, LLC

Poster Presentations

A Mixed Methods Approach to Understanding Leisure-Time Physical Activity and Musculoskeletal Pain Among Construction Workers: Findings From a Pilot Study
Alberto Caban-Martinez, Harvard Center for Work, Health, and Wellbeing

A Qualitative Assessment of Nutrition Experiences
Kim Merchant, MA, UI Nutrition Center, HWCE

Practical Tools for Implementing Worksite Wellness-Be Engaged: Help Integrate Promotion/Protection (Be Hipp)
Donna Hollinger, MS, RD, LD, UI Nutrition Center, HWCE

Company-Instituted Wellness Programs and Nursing Home Employees' Health
Gabriela Kernan, CPH-NEW

Differences Among Nursing Homes in Outcomes of a Safe Resident Handling Program
Alicia Kurowski, CPH-NEW

Effects of Program Structure on Group Facilitation in a Participatory Health Protection/Health Promotion Program
Bora Plaku-Alakbarova, University of Connecticut, CPH-NEW

Evaluating Stress Resilience: A Worksite Intervention to Reduce Stress and CVD Risk Factors in Police
Sandra Ramey, HWCE, University of Iowa

Evaluating the Impact of a Health Risk Management (HRM) Program on Employees' Health Risks, and Workers' Compensation
Kaylan Stinson, MSPH, University of Colorado, Aurora, CO

Food Service Audits: A Tool for Improving Nutrition Environments in the Worksite
Lois Ahrens, UI Nutrition Center, HWCE

Healthy Workplaces? A Survey of Massachusetts Employers
Patricia Tremblay, CPH-NEW

Paid Sick Leave and Nonfatal Occupational Injury
Abay Asfaw Getahun, NIOSH

Methodology for Modeling Normative Three-Dimensional Strength
John M. Looft, University of Iowa

Modeling Localized Muscle Fatigue during Intermittent Tasks as a Function of Intensity and Duty Cycle
John M. Looft, University of Iowa

Research Based Wellness Innovation at ACT
Tracy K. Tunwall, Mount Mercy University and ACT

Shift Work and Cancer Screening: Do Women Who Work Alternative Shifts Undergo Recommended Cancer Screening?
Rebecca Tsai, NIOSH

Team-Based Challenge Delivers More Than Cost Savings
Erin Litton, MA, CHES, ACSM-HFS, Consultant, UI Wellness

Total Worker Health™ Plus—Including Environmental Health to Meet the Sustainability Challenge
Rick Yoder, PE, Chief Sustainability Officer, University of Nebraska at Omaha

Worksite Wellness in Small Businesses: A Systematic Review of Perceived Barriers and Evidence for Intervention Effectiveness
Kaylan Stinson, MSPH, University of Colorado, Aurora, CO

Hosted by the University of Iowa College of Public Health, Healthier Workforce Center for Excellence.

Sponsored by the NIOSH Total Worker Health™ Program.

Cosponsored by David P. Lind Benchmark, CoOpportunity Health, Corridor Business Journal, Grinnell Mutual Reinsurance, Heartland Center for Occupational Health and Safety, Iowa Association of Business and Industry, Iowa Academy of Family Physicians, Iowa Business Council, Iowa Hospital Association, Iowa Medical Society, State Public Policy Group, the University of Iowa Labor Center, Wellness Council of Iowa, and WorkSafe Iowa.

The NIOSH Total Worker Health™ Program

An Overview

Anita L. Schill, PhD, MPH, MA and Lewis Casey Chosewood, MD

Objective: The objective of this article was to provide an overview of the National Institute for Occupational Safety and Health (NIOSH) Total Worker Health™ (TWH™) Program that was launched by the institute in 2011. **Methods:** This article describes the TWH™ concept, relevant issues, and the NIOSH Program. Examples of the concept are provided. **Results:** Total Worker Health™ is a strategy integrating occupational safety and health protection with health promotion to prevent worker injury and illness and to advance health and well-being. **Conclusions:** The NIOSH TWH™ Program responds to demands for information and practical solutions to the health, safety, and well-being challenges that workers and their employers face. It also addresses issues related to the nation's need to sustain a globally competitive workforce.

In June 2011, the National Institute for Occupational Safety and Health (NIOSH) launched the Total Worker Health™ (TWH™) Program. This program is the natural evolution of NIOSH efforts that began in 2003 with the creation of the Steps to a Healthier US Workforce Initiative. One of the key events of this early initiative was the 2004 Steps to a Healthier US Workforce Symposium. With the enthusiastic support of NIOSH stakeholders, the "Steps" initiative grew into the WorkLife Initiative, and a second symposium was convened in 2007.

During these formative years, NIOSH focused on funding extramural Centers of Excellence to Promote a Healthier Workforce. Beginning in 2006 and 2007, centers were funded at the University of Iowa's College of Public Health, the University of Massachusetts Lowell/University of Connecticut, and the Harvard School of Public Health. A fourth Center was funded at the Oregon Health and Sciences University in 2011.

With the launch of the TWH™ Program, NIOSH reaffirmed its commitment to the concept of integration of occupational safety and health protection with health promotion and disease prevention activities in the workplace. In addition to continued extramural support, NIOSH turned its attention to intramural research projects and activities with the aim of incorporating TWH™ concepts into the NIOSH portfolio.

This article describes the TWH™ concept as envisioned by NIOSH, key issues related to TWH™, examples of TWH™ in the workplace, and current NIOSH program efforts to advance TWH™.

THE TWH™ CONCEPT

In a typical company, employee health, safety, and well-being are managed in a fragmented arrangement of departments that often operate in independent silos. Examples include traditional safety organizations, group health and disability programs, workers' compensation departments, employee assistance programs, health promotion programs and activities, and occupational health programs. The TWH™ approach is to assure a systematic and organizational linkage of all of these departmental functions to form an integrated whole, with a unified charge—protecting and promoting the *total* health, safety, and well-being of workers. Thus, TWH™ is a strategy integrating occupational safety and health protection with health promotion to *prevent* worker injury and illness and to *advance* health and well-being. This approach eliminates the either/or proposition, overcomes the disconnectedness that exists in many organizations, and provides comprehensive tools and approaches to creating environments where employees thrive.

Since the introduction of the NIOSH TWH™ Program, NIOSH has noted increasing visibility and adoption of the words *total worker health*. NIOSH actively encourages the use of these words to describe workplace strategies that are consistent with the integration of health protection and health promotion—the foundational element of the TWH™ concept. To overcome concerns that these same words might be used by some to describe programs or activities that lacked any level of integration or that focused solely on health protection or solely on health promotion, NIOSH chose to trademark these words, thus helping establish a specific and enduring meaning to the concept of TWH™. The intention of the trademark is not to prevent others from developing their own TWH™ Programs but rather to ensure a clear and consistent approach to preventing occupational injury and illness while advancing the overall health and well-being of workers.

ISSUES RELEVANT TO TWH™

To illustrate the broad scope of issues that NIOSH believes are relevant to TWH™, an "issues graphic" was created for at-a-glance impact. Issues relevant to TWH™ can be arranged in three categories: workplace, employment, and workers (see Figure 1). The examples in each of these categories represent critical areas of importance to worker health and well-being, but the lists are not meant to be exhaustive. Indeed, the breadth and reach of this program will evolve as the health and safety challenges of workers, the nature of work itself, and the needs of the global economy evolve.

The first group of issues relevant to a TWH™ perspective relates specifically to the workplace and to protecting worker health and safety. Workplace-related issues can be subcategorized as follows: control of hazards and exposures; prevention of injuries, illness, and fatalities; promoting safe and healthy work; and risk assessment and control. Control of hazards and exposures relates to both persistent and emerging challenges. These range from traditional chemical, physical, and biological hazards to the more pervasive, modern-day exposures related to the psychosocial work environment and the organizational demands of work. Prevention of injuries, illness, and fatalities and promotion of safe and healthy work are both issues related to protecting workers in the workplace. Risk assessment and control are tools for identifying and mitigating risks.

The relevance of TWH™ to today's workplace begins to crystallize when current employment-related issues and trends are considered, including new employment patterns, health and productivity, and health care and benefits. The global economy and competition for workers, products, services, and knowledge have created labor

From the National Institute for Occupational Safety and Health (Dr Schill), Washington, DC; and the National Institute for Occupational Safety and Health (Dr Chosewood), Atlanta, Ga.

The authors declare no conflicts of interest.

Address correspondence to: Anita L. Schill, PhD, MPH, MA, National Institute for Occupational Safety and Health, 395 E St SW, Ste 9200, Washington, DC 20201 (ASchill@cdc.gov).

DOI: 10.1097/JOM.0000000000000037

FIGURE 1. Issues relevant to Total Worker Health™ graphic illustration. Updated August 2013. *Issues in these lists are for illustrative purposes, are not meant to be exhaustive, nor do they necessarily reflect equivalent importance. HIPAA, Health Insurance Portability and Accountability Act.

shortages for certain jobs and challenge the dominance of American innovation and creativity in the marketplace.[1,2] The emergence of new employment patterns and more-common use of previously established employment arrangements, such as precarious and part-time work, has implications for worker health and well-being.[3] Shifting population demographics, including increasing diversity and the prevalence of older workers, are changing the face of the American workforce. One of the most pressing examples of this change is the multigenerational workforce now commonplace in many employment settings. For the first time in history, there are four generations of employees working side by side.[4] Each generation brings unique challenges to the workplace.

Given these trends, employers are necessarily shifting their focus to preserving human resources through health and productivity management to remain competitive. At the same time, benefits systems are under increasing stress with rising health care costs. Adding to the complexities of health and well-being in the workplace, regulations arising from the Americans with Disabilities Act,[5] the Health Insurance Portability and Accountability Act,[6] the Genetic Information Nondiscrimination Act,[7] and the Patient Protection and Affordable Care Act[8] impact the responsibilities of and programs and services offered by employers.

The third group of issues relevant to TWH™ includes those related to workers and the promotion of their health and well-being. Promoting optimal well-being is a multifaceted endeavor that includes employee engagement and support for the development of healthier behaviors, such as improved nutrition, tobacco use cessation, increased physical activity, and improved work/life balance. There are numerous health and well-being assessment tools available in the marketplace to assist with achieving this goal. Older workers, in particular, are concerned with aging productively and preparing for a healthier retirement.

This group of TWH™ issues also addresses populations of workers that may have higher health risks. Younger workers are one such group. They are more likely to be concerned with education and skill-level gaps that sideline them from successful careers, especially given their painfully high levels of unemployment or underemployment. In addition, the modern workplace includes groups who face unique challenges, such as low-income workers, those transitioning from military to civilian careers, and differently-abled workers.

Programs that protect compensation and provide support during times of disability are equally important for promoting health and well-being.

EXAMPLES OF INTEGRATION

Programs that integrate occupational safety and health protection with health promotion and disease prevention range from simple to all-inclusive and everything in between. Examples that are relatively straightforward include the following:

- Regular joint meetings of safety teams and health promotion teams
- Combined safety and health promotion workgroups or steering committees
- Respiratory protection programs that simultaneously address tobacco use
- Ergonomic consultations and interventions that also cover joint health and arthritis management strategies
- Stress management efforts that first diminish workplace stressors and then build worker resiliency
- Integrated programs on topics addressing fall prevention, motor vehicle safety, first aid, hearing conservation, stretching and flexibility, and safe lifting for both work and community environments

Examples of more-inclusive programs include the following:

- Comprehensive screenings for work-related and non–work-related health risks
- Full integration of occupational health clinics, behavioral health services, traditional safety protection, health promotion programs, coaching, employee assistance programs, nutrition counseling, disability, workers' compensation, employee benefit programs, and community-based primary care services
- Occupational health combined with a workplace-delivered, patient-centered medical home model

Integration of occupational safety and health protection and health promotion and disease prevention creates improvements in the work environment and the conditions of work that benefit all workers, even for those not actively participating in voluntary programs. A culture of integration increases participation in both health protection and health promotion programs, especially among workers who are often the hardest to reach.[9] Ultimately, the potential of integration is decreased injury, illness, disability, and absenteeism rates based on reductions in individual health risks.[10] In addition, overall health-related costs decline, including workers' compensation, personal health care costs, and absenteeism- and presenteeism-related costs. From an employer's perspective, a culture of integration contributes to worker productivity. For workers and their families, TWH™ offers a promise of improved health and well-being.

THE NIOSH TWH™ PROGRAM

The mission of the NIOSH TWH™ Program is to examine a broad scope of workplace, employment, and workforce factors to offer to the nation policies, programs, and practices to better protect and promote worker health. The aims of the program are as follows:

1. Promote adoption of policies and practices proven to protect and improve worker health both on and off the job
2. Motivate transdisciplinary collaboration among investigators focused on preserving and improving the health of people who work
3. Overcome the traditional separation of the occupational health and health promotion professional communities, encouraging synergistic interventions
4. Encourage and support rigorous evaluation of comprehensive, integrative approaches to TWH™

NIOSH advocacy for TWH™ includes six major areas of focus: national leadership, research, partnership development, marketing and communications, Centers of Excellence to Promote a Healthier Workforce, and development of a TWH™ program for NIOSH employees.

Over the past 2 years, NIOSH leadership for TWH™ has revolved around the institute's convening power. In April 2012, NIOSH cosponsored with the American College of Occupational and Environmental Medicine an invitational summit on Advancing the Understanding of Health Protection and Promotion in the Context of an Aging Workforce. This summit explored issues related to the aging workforce, including barriers to integrating health protection and health promotion programs, and generated recommendations for best practices to maximize contributions by aging workers.[11] Later that same year, NIOSH cosponsored (along with the Department of Veterans Affairs, Centers for Disease Control and Prevention, Department of Health and Human Services Federal Occupational Health, US Office of Personnel Management, Department of the Army, President's Council on Fitness, Sports and Nutrition, and the Eagleson Institute) the Healthier Federal Workers Symposium to address TWH™ issues and opportunities within the federal workforce. In May of 2013, the Work, Stress, and Health Conference, jointly sponsored by NIOSH, the American Psychological Association, and the Society for Occupational Health Psychology, featured a subtheme of protecting and promoting TWH™. This international meeting created a forum for worldwide attention to occupational safety and health protection integrated with health promotion and disease prevention. Finally, seminal research articles that were originally commissioned by NIOSH for the 2004 Steps to a Healthier US Workforce Symposium were updated and published as a research compendium, *The NIOSH Total Worker Health™ Program: Seminal Research Papers 2012*.[12]

In an effort to build the research evidence for this approach, NIOSH includes TWH™ in its own program portfolio. In fiscal year 2013, two "small" (as defined by funding amounts) National Occupational Research Agenda research projects were funded. One of these projects will examine promising practices for healthy aging, and the other will focus on TWH™ for small businesses. A third project was funded under a different competition and is studying fatigue prevention for commercial pilots. Fiscal year 2014 funding will include support for one new "large" National Occupational Research Agenda research project that will explore the effect of a wellness grant on worker health and safety. To integrate the TWH™ approach into the NIOSH research culture, an institute-wide seminar series was initiated. This series creates an opportunity for extramural scientists to present their TWH™-related work and then engage in scientific discourse with NIOSH researchers.

To advance TWH™ nationally, NIOSH is actively engaged in partnership development. In 2011, NIOSH initiated an annual, invitational TWH™ National Expert Colloquium. Three colloquia have been convened to date, featuring national experts who spent a day sharing their individual perspectives on the intersection of occupational safety and health protection and health promotion and disease prevention. These national experts, including representatives from private industry, academia, labor, and government, help stimulate our thinking about NIOSH programmatic directions. The National Institute for Occupational Safety and Health also collaborates with the Centers for Disease Control and Prevention National Center for Chronic Disease Prevention and Health Promotion on projects of mutual interest. These collaborations include NIOSH contributions to the Centers for Disease Control and Prevention Worksite Health ScoreCard and steering committee membership for the National Healthy Worksite Program.[13,14]

As the NIOSH TWH™ Program has developed, we have used social media and other on-line communication tools to share and exchange program accomplishments, research, and promising practices relevant to the integration of health protection and health promotion and to expand on-line visibility of TWH™. One of the

most widely consumed outputs of our communication efforts has been an electronic newsletter, *TWH™ in Action!* Published quarterly, this e-newsletter now has more than 50,000 subscribers.[15] A popular feature is the regular article, *Promising Practices for TWH™*, which tells the story of a company or organization that is taking steps to actively engage in integrated health protection and health promotion in its workplace. The NIOSH TWH™ Program is also active on social media channels, such as Twitter (www.twitter.com/NIOSH_TWH) and LinkedIn (www.linkedin.com/groups/NIOSH-Total-Worker-Health-4473829/about). The newly redesigned Web site (http://www.cdc.gov/niosh/TWH/) remains the primary vehicle for keeping information easily available for those who share an interest in TWH™. The Web site is organized around major headings, including essential information about the TWH™ Program, information about the TWH™ research portfolio, how to stay connected, tools and resources, and selected TWH™ topics. Information on the TWH™ Program can also be found on Wikipedia (http://en.wikipedia.org/wiki/Total_Worker_Health).

As previously mentioned, NIOSH currently funds four Centers of Excellence to Promote a Healthier Workforce. The NIOSH Program and the Centers work closely together to coordinate activities and mutual interests through a coordinating committee composed of directors of each center and core team members of the NIOSH TWH™ Program. One of the centers, the Healthier Workforce Center for Excellence at the University of Iowa's College of Public Health, organized and hosted the first "Total Worker Health™ Symposium—Safe, Healthy and Cost-Effective Solutions" in November 2012.

The National Institute for Occupational Safety and Health has also risen to the challenge of "walking the TWH™ talk" by bringing TWH™-related programs and activities to our own employees. The HealthiestYou/HealthiestNIOSH program created a personalized wellness program option for employees, including a health risk appraisal and electronic coaching. Pilot programs are in process for sit–stand workstations and walking workstations. The NIOSH program also targets special events and campaigns aimed specifically at the needs of the employee population.

NEXT STEPS

Faced with ever-increasing challenges to meet stakeholder requests for expanding services and activities, the NIOSH TWH™ Program has focused on selected high-impact future directions. These include the following:

- Leadership to develop a national consensus statement of TWH™ best practices
- National leadership to develop a TWH™ national research agenda
- Intramural TWH™ research program development, targeting priority topics and populations
- Partnership development to include working alongside a supersize employer to explore TWH™ in practice
- Continuation of the annual, invitational TWH™ National Expert Colloquium
- Communication, outreach, and engagement programs for selected media campaigns, coordinated with the Centers of Excellence to Promote a Healthier Workforce, that address TWH™ knowledge gaps
- Ongoing coordination with the Centers of Excellence to Promote a Healthier Workforce in areas of mutual research interest

As we strive to meet current and future challenges related to demands for information and practical solutions to real-world needs, the TWH™ Program mission will remain firm in its commitment. We will continue to focus our attention on the broad scope of workplace, employment, and workforce issues and offer policies, programs, and practices to better protect and promote the health of working men and women.

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Integration of Health Protection and Health Promotion

Rationale, Indicators, and Metrics

Glorian Sorensen, PhD, MPH, Deborah McLellan, PhD, MHS, Jack T. Dennerlein, PhD, Nicolaas P. Pronk, PhD, FACSM, Jennifer D. Allen, ScD, MPH, Leslie I. Boden, PhD, Cassandra A. Okechukwu, ScD, MSN, Dean Hashimoto, MD, JD, Anne Stoddard, ScD, and Gregory R. Wagner, MD

Objective: To offer a definition of an "integrated" approach to worker health and operationalize this definition using indicators of the extent to which integrated efforts are implemented in an organization. **Methods:** Guided by the question—How will we know it when we see it?—we reviewed relevant literature to identify available definitions and metrics, and used a modified Delphi process to review and refine indicators and measures of integrated approaches. **Results:** A definition of integrated approaches to worker health is proposed and accompanied by indicators and measures that may be used by researchers, employers, and workers. **Conclusions:** A shared understanding of what is meant by integrated approaches to protect and promote worker health has the potential to improve dialogue among researchers and facilitate the research-to-practice process.

Increased attention is being placed on the worksite as an important venue for influencing worker health. Because the Occupational Safety and Health Act of 1970 mandated the development and enforcement of worksite standards and assigned employers the responsibility to maintain safe and healthy work environments, *health protection* efforts have been important in the prevention of work-related injuries and illnesses.[1,2] In addition, health behaviors are critical contributors to a range of chronic disease outcomes,[3–6] and workplace *health promotion* efforts may have a substantial influence on these health-related choices and behaviors. These initiatives include educational programs as well as workplace policies and practices that affect health directly or through their influence or support of individual health-supportive choices. The emphasis on primary prevention in the Affordable Care Act offers further opportunities for employers to encourage participation in workplace health promotion approaches.[7,8]

Traditionally, health protection programs and policies have functioned independently of workplace health promotion. These efforts are often located in organizationally distinct "silos," have separate budgets and personnel, oversee discrete policies and practices that affect worker health, and offer distinct educational and training programs, with little if any coordination or integration. These independent efforts related to worker health may include occupational health and safety, health promotion, disease management, and human resources and benefits, among others. This article examines the opportunities for the integration of health promotion and health protection, although integration across all health-relevant domains may also be valuable.

Growing evidence indicates that comprehensive policies and programs that simultaneously address health promotion and health protection may be more effective in preventing disease and promoting health and safety than either approach taken separately. Although additional evidence of the effectiveness of this approach is needed, there is an increasing acknowledgment of the potential advantages of integration. Integrating health promotion and health protection efforts may contribute to greater improvements in behavior change,[9,10] higher rates of employee participation in programs,[11] potential reductions in occupational injury and disability rates,[12,13] stronger health and safety programs,[14] and potentially reduced costs.[15] Integration further facilitates better use of limited resources and improves the overall health, productivity, and resilience of the workforce.[10,16] In addition, internal collaboration across multiple departments may lead to improved processes and outputs, and an enhanced work climate.

This integrated approach has been adopted as a research-to-practice priority by the National Institute for Occupational Safety and Health (NIOSH) in its Total Worker Health™ (TWH) program. The TWH program reflects a strategy for integrating occupational safety and health protection with health promotion, to prevent worker injury and illness and to advance health and well-being.[17] In addition, this integrated approach has been endorsed by the American College of Occupational and Environmental Medicine,[16] the American Heart Association for cardiovascular health promotion,[18] the International Association for Worksite Health Promotion,[19,20] the Institute of Medicine,[20] and others.[16,18,20–23]

Despite this broad conceptual support, there is no shared definition of integrated approaches or set of standard metrics useful in their evaluation. A common definition and consistent metrics would facilitate the adoption of integrated approaches to worksite health and assist wider dissemination of these strategies. Measures are available to assess safety climate,[24–26] the presence of workplace health promotion,[27] and a "culture of health."[28,29] These measures tend to focus on *either* health promotion or health protection rather than on their integration. Another relevant resource is NIOSH's Essential Elements of Effective Workplace Programs and Policies,[30] developed to serve as a guide to employers interested in comprehensive approaches to worker health. Nevertheless, they were not intended to be used as measures of integrated approaches. Thus, although there is growing dialogue in the literature about what might be included in integrated approaches to worker and worksite health, no standard definitions or metrics have been developed to assess these initiatives.

From the Dana-Farber Cancer Institute (Drs Sorensen, McLellan, and Allen), Boston, Mass; Harvard School of Public Health (Drs Sorensen, Pronk, Okechukwu, and Wagner), Boston, Mass; Northeastern University (Dr Dennerlein), Boston, Mass; HealthPartners, Inc (Dr Pronk), Minneapolis, Minn; Boston University School of Public Health (Dr Boden), Boston, Mass; Partners HealthCare, Inc (Dr Hashimoto), Boston, Mass; Boston College Law School (Dr Hashimoto), Newton Centre, Mass; New England Research Institutes (Dr Stoddard), Watertown, Mass; and National Institute for Occupational Safety and Health (Dr Wagner), Washington, DC.

This work was supported by a grant from the National Institute for Occupational Safety and Health (U19 OH008861) for the Harvard School of Public Health Center for Work, Health and Well-being and by a grant from the National Institutes of Health (K05 CA124415).

The authors declare no conflicts of interest.

Presented at the Total Worker Health Symposium, Iowa City, Iowa, November 2012.

Address correspondence to: Glorian Sorensen, PhD, MPH, Center for Community-Based Research, Dana-Farber Cancer Institute, 450 Brookline Avenue, Boston, MA 02215 (glorian_sorensen@dfci.harvard.edu).

DOI: 10.1097/JOM.0000000000000032

The purpose of this article is to propose a definition of an "integrated" approach to worker health. In addition, we aim to identify key indicators of the extent to which integrated efforts are being implemented within a given organization. We present measures that may be used by employers and researchers to assess the extent of implementation of an integrated approach.

METHODS

This study was developed by the Harvard School of Public Health Center for Work, Health and Wellbeing, a NIOSH-funded Center for Excellence as part of its TWH program. This Center includes three research projects aimed at testing an integrated approach to worksite health promotion and health protection. Center investigators have conducted research using the integrated approach and have contributed to its extant literature.[9,10,14,31–36] In our cross-project efforts, we identified a gap in the literature in defining and measuring integrated approaches to worker health recommended by the TWH program. With the aim of determining "how we will know it when we see it," we launched a multidisciplinary effort to develop indicators and measures of integrated approaches to health promotion and health protection. Members of the team have had significant experience in using integrated approaches in research and promoting their use in practice, and represent the fields of ergonomics, occupational health, industrial hygiene, occupational medicine, nursing, health promotion, social epidemiology, business management, law, economics, social policy, and sociology.

Our methods included an overview of the pertinent literature to determine candidate definitions and assess the extent to which relevant metrics might be available. (See Table 1 for examples.) We used an iterative modified Delphi process[37] by forming an expert review panel, including investigators and the External Advisory Board, as well as members of other TWH Centers of Excellence. With this method, the review team first identified common themes in the literature about integrated approaches to worker health. Through repeated discussions and revisions among Center members, these themes were used to generate a set of indicators and associated measures. In 10 meetings over 12 months, Center members discussed and arrived at a consensus regarding a final set of indicators and their measures. The resulting measures were reviewed by members of the Center's Worksite Advisory Board, who provided detailed recommendations for improvements. The measures were further tested through systematic cognitive testing with representatives of three employers. The measures have since been included in a survey of small-to-medium size worksites in one of the Center's studies.

DEFINING INTEGRATED APPROACHES TO WORKER HEALTH

We define an integrated approach to worker health as a *strategic and operational coordination of policies, programs, and practices designed to simultaneously prevent work-related injuries and illnesses and enhance overall workforce health and well-being*.[15–17,19,31,38] These policies and programs aim to protect worker health by reducing or eliminating the potential for exposure to job hazards (ie, health protection), while also promoting worker health by fostering individual health behaviors, such as tobacco control, healthful diets, and physical activity (ie, health promotion), in the context of a health-supportive organizational and physical environment that actively engages workers throughout the process. These integrated efforts may involve other organizationally disparate functions affecting worker health and well-being, such as disease management, behavioral health, employee assistance programs, and medical and benefits functions.

In practice, these approaches occur along a continuum. Some employers may be prompted by concerns about compliance with regulations and establish occupational health and safety programs and policies, in the absence of any health promotion initiatives. Other employers may institute *both* approaches to supporting worker health, but the functions of health promotion and health protection may exist in separate silos in different parts of the organization. With increasing integration, workplace policies and practices reflect employers' dual commitment to and goals for health promotion and health protection efforts. Beyond the simple summation of health protection and health promotion, the integrated approach reflects an organizational transformation and a culture of health and safety that supports worker health both within and outside the workplace.[9,10]

TABLE 1. Definitions Similarly Used for Integrated Approaches to Worker Health

Source	Definition
NIOSH, Total Worker Health[17]	"Total Worker Health™ is a strategy integrating occupational safety and health protection with health promotion to prevent worker injury and illness and to advance health and well-being."
American College of Occupational and Environmental Medicine[16]	"Workplace health protection and promotion is the strategic and systematic integration of distinct environmental, health, and safety policies and programs into a continuum of activities that enhance the overall health and well-being of the workforce and prevents work-related injuries and illnesses."
Institute of Medicine[20]	"Integrated occupational safety and health protection with health promotion activities is a coordinated system that addresses both workplace and worker health. It strongly supports the view that all illness and injury should be prevented when possible, controlled when necessary, and treated where appropriate, and an integrated approach serves to enhance the effectiveness of programs designed to promote and protect worker health."
International Association for Worksite Health Promotion[19]	"The strategic integration of worker health protection and promotion to prevent worker injury and illness, advance worker health and well-being, and optimize organizational performance."
World Health Organization[21]	"A healthy workplace is one in which workers and managers collaborate to use a continual improvement process to protect and promote the health, safety and well-being of all workers and the sustainability of the workplace by considering the following, based on identified needs: • Health and safety concerns in the physical work environment; • health, safety and well-being concerns in the psychosocial work environment, including organization of work and workplace culture; • personal health resources in the workplace; and • ways of participating in the community to improve the health of workers, their families and other members of the community."

Guidance on the process of implementing integrated interventions is increasingly becoming available.[38,39]

INDICATORS OF INTEGRATION

We have outlined a set of indicators of integration, including organizational leadership and commitment to worker health; collaboration between health protection and worksite health promotion; supportive organizational policies and practices (including accountability and training, management and employee engagement, benefits and incentives to support workplace health promotion and protection, and integrated evaluation and surveillance); and comprehensive program content. Each of these individual indicators may be measured along a continuum, such that successful implementation of integrated approaches to worker health may be enhanced with greater implementation of each indicator.

Organizational Leadership and Commitment

Top management is responsible for articulating the vision for worker and worksite health, and ensuring that adequate resources are available for implementing integrated approaches to worker health. Creating and sustaining a healthy workplace begins with a clearly articulated and communicated vision from senior leadership that ties health to the organization's mission.[20] Leadership can also ensure implementation of policies and programs by establishing accountability for action and ensuring that adequate resources are available.[40] Processes and policies relevant to safe design and purchasing decisions reflect top management commitment. Top management is also responsible for communicating throughout the organization the worksite's commitment to this integrated approach and to worker health goals.

Collaboration Between Health Protection and Worksite Health Promotion

Rather than functioning independently, there is coordinated and collaborative decision making and shared learning around developing, implementing, and evaluating programs, practices, and policies to protect and promote worker health. To the extent possible, policies and programs are planned and implemented to coordinate and leverage dual effects; for example, a policy aimed at reducing potential exposures to hazardous fumes may be linked to overall efforts to promote respiratory health, including through tobacco control policies and programs, such as banning smoking at worksites. Similarly, efforts aimed at reducing ergonomic exposures can emphasize the potential benefits for physical activity, while also minimizing the risk of injury.

Coordination of health protection and health promotion occurs across multiple levels of influence, including policies and practices at the organizational and environmental levels as well as programs for individual workers. This coordination underscores the application of differing operating principles used in occupational health and safety and worksite health promotion, which must be recognized and aligned for successful integration. Principles of prevention through anticipation, recognition, elimination, and control of hazards, along with ongoing environmental and health surveillance, provide an operating premise for occupational health and safety.[41,42] These principles, along with the legal responsibilities under the Occupational Safety and Health Administration Act, reflect the primary decision-making role played by management in protecting workers from occupational hazards.

The physical and organizational work environment may also play a central role in promoting healthy behaviors. For example, tobacco control policies, availability of healthy foods in work cafeterias, and benefit options that provide incentives for healthy behaviors are central to effective health promotion.[43–45] At the individual level, educational and training programs can support health behavior changes for workers, and may also provide workers opportunities to build skills to minimize exposures to work hazards, for example, effective use of lifting devices for patient care workers to minimize ergonomic exposures.

Supportive Organizational Policies and Practices

Supportive organizational policies and practices provide operational supports for worker health.

Accountability and Training

Staff members are held accountable for implementing integrated policies and programs when these responsibilities are included in their job descriptions. Performance metrics, applied to annual reviews, include responsibility for interdepartmental coordination and collaboration in support of health promotion and health protection. Workers and managers can be trained to recognize and correct safety and health threats. To assist in program implementation, some worksites may turn to external vendors, who provide the experience and expertise to coordinate workplace health promotion and protection efforts.[7]

Management and Employee Engagement

The importance of engaging managers and employees across the organization is well recognized as fundamental to program success.[20] To the extent possible, integrated interventions take advantage of existing mechanisms to engage employees and managers across health promotion and health protection, and to involve them in decision making and planning. Successful integration of health promotion and protection relies on active engagement of workers throughout the process. Engaged and empowered workers are encouraged to identify and report threats to safety and health and to expect they will be addressed. In this context, the mission of an existing health and safety committee might be expanded to also address health promotion, or a new committee with shared responsibilities in both domains may be created. Workers may be involved in problem identification and solving. Employees may also be engaged through a program "champion" that coordinates efforts to promote and protect worker health.[38]

Benefits and Incentives to Support Workplace Health Promotion and Protection

Benefits and incentives are instituted that protect and promote workplace and worker health and well-being. Health care coverage is a central linkage point for health protection and promotion efforts.[46,47] Workplace benefits that address health and well-being might include flextime, paid sick leave, screening and prevention coverage, and health coaching or wellness opportunities. For example, employees may receive a cash bonus for completion of a health risk appraisal, attendance at health and safety trainings, or quitting smoking. Incentives for managers may acknowledge success in health and safety within their departments and in leading workplace health promotion and protection efforts. A critical review of benefits and incentives that currently exist in the workplace is important to determine the extent to which they support or inhibit workplace and worker health and well-being, and legal and ethical issues need to be addressed.[48,49] For example, programs that provide incentives to reduce reporting of injuries may have the unintended consequence of minimizing reporting without altering actual injury rates, and also shift the burden of responsibility for injury reduction to individual workers without attending to needed multilevel supports in the work environment.[50]

Integrated Evaluation and Surveillance

Ongoing evaluation and monitoring of integrated programs, policies, and practices can provide necessary feedback for program monitoring, quality control, and ongoing quality improvement. A

fully integrated system conducts continual monitoring and reporting that will consist of multiple audits, evaluations, and feedback mechanisms to all relevant workplace stakeholders. Reporting of both occupational health and behavioral exposures and outcomes is critical for both ongoing engagement and support. An integrated system for health data can be used to ensure that data are organized in a way that contributes jointly to health promotion and protection efforts.[20,47]

Comprehensive Program Content

The effectiveness of health protection and promotion messages for workers may be enhanced when these messages are coordinated and acknowledge the additive and sometimes synergistic effects of exposures to worksite hazards and individual health behaviors. Thus, for example, an integrated respiratory health program for workers may address the importance of tobacco use cessation in the context of efforts to control or eliminate potential adverse exposures on the job. Similarly, programs aimed at reducing musculoskeletal disorders may incorporate messages that underscore the potential intersections of inadequate sleep, low levels of physical activity, and work-related musculoskeletal injuries, and in turn, the role of pain in reducing the likelihood that an individual will be physically active.[51]

The effectiveness of health messages may also be enhanced when they are linked to workers' job experiences and work environment.[52] For example, long work hours and rotating or night shifts may impact sleep patterns, with consequences for diet choices.[53] Acknowledging and attempting to mitigate the influence of rotating or night shifts may increase the salience of information about the roles of sleep in dietary patterns and physical activity for workers on these shifts. Similarly, worker health outcomes may be affected by the work organization; for example, in a study of health care workers, we found that low supervisor support and harassment at work were associated with increased risk of low back pain and sleep deficiency.[32]

RECOMMENDATIONS FOR MEASUREMENT

We have operationalized these seven indicators with corresponding measures, as presented in Table 2. These measures may serve multiple purposes. For example, researchers may use them to assess the extent to which a company is implementing an integrated approach, to benchmark where a company might stand relative to other companies in the implementation of an integrated intervention, or to identify factors associated with variations in integration across companies. These factors may be rated on a three-point scale (eg, absent, partially adopted, and fully achieved).

Companies may use these measures as a "self-assessment" to estimate the extent to which they have integrated policies, programs, and practices related to worker and worksite health. As a planning tool, the measures can indicate areas of potential strength and improvement along the continuum toward full integration, and serve as a stimulus for priority setting and decision making. In the context of a discussion with outside experts, this tool may be used to provide consultation around ways to increase integrated approaches to worker health. In this case, worksite representatives selected to represent diverse departments may complete the assessment individually, and then discuss their perceptions and work toward consensus. A consensus rating is important as people in different positions may have different perceptions of the degree to which any of the items are applied within their organization.

DISCUSSION

This article responds to the need for a shared definition of and common metrics to assess integration of health promotion and health protection. We have described seven indicators of integrated approaches that may locate an organization along a continuum, and have proposed a set of measures to assess the extent to which a worksite is implementing an integrated approach to worker and worksite health. These measures may be used to provide a benchmark for comparisons with other organizations, provide organizations feedback to facilitate the process of moving toward greater program effectiveness, and inform research aimed to identifying factors contributing to adoption and implementation of the integrated approach.

The indicators of integrated approaches to health promotion and health protection may encompass what has also been termed an integrated management system, that is, one that integrates policies, programs, and practices into an overarching framework that coordinates programs and policies instead of breaking them down into competing "silos."[20,38] An integrated management system may use integrated processes at each step of a plan-do-check-act cycle,[54] and the indicators of integration could be used to evaluate and monitor each step. Following this framework, a comprehensive commitment to worker health and safety is articulated as a core value of the organization, which includes demonstrated management commitment, establishes and implements organizational interaction between health protection and health promotion, and uses data and evaluation for ongoing monitoring and future decision making.[38]

While we have focused here primarily on the integration of health protection and worksite health promotion, there are other functions in the worksite that affect worker health that may also be incorporated into overall integrated efforts. For example, further coordination with disease management programs, employee assistance programs, human resources and benefits, and efforts to promote work–family linkages can strengthen efforts to promote and protect worker health. Similarly, clinical medical services provided by employers may include on-site occupational health clinics to provide better access for prevention, surveillance, and treatment of work-related injuries and illnesses, as well as equally accessible clinical support services for health promotion and wellness.[55] Ideally, support for worker health and safety would also be integrated into the job descriptions of supervisors and managers who are also responsible for the production process, including workplace design, purchasing, production scheduling, and work assignments. These managers have considerable influence on the ways in which work is organized and over which investments are made.

The Affordable Care Act suggests further opportunities for programs supporting worker health. Employers will be given more latitude to offer incentives for participation in workplace health promotion programs. The use of the electronic medical record may provide opportunities for improved communication and improved evaluation of workplace influences on worker health.[56]

Although we have proposed a set of indicators for integration, it is important to note that the measures proposed here are being further tested as part of the process of ongoing measure development. We continue to explore the most appropriate methods for summarizing the measures presented here, and acknowledge that weighting the measures across the defined indicators will require further attention. Given the clear need for metrics that can be used across industry sectors and worksite size, it is important that future methods development include a representation of worksites across a range of settings by size, industry, geography, and other factors. It is also important to note that these indicators rely on reports of individual employees within the work organization; further work is needed to better understand the concordance among interrater individual ratings and among individual ratings and objective indicators. In addition, exploration of the characteristics of organizations (eg, size and industry) associated with adoption and maintenance of integrated approaches will be helpful in moving the field forward.

CONCLUSIONS

Workplace environments, policies, and practices may threaten or support worker health. Integrated approaches to worker and worksite health offer opportunities for the workplace to function as both an accelerator of chronic disease prevention and, in an increasingly

TABLE 2. Measures by Indicators of Integrated Approaches

Indicators	Measures
Organizational leadership and commitment	• Top management expresses its commitment to a culture of health and an environment that supports employee health
	• Both worker and worksite health are included as part of the organization's mission
	• Senior leadership allocates adequate human and fiscal resources to implement programs to promote and protect worker health
Coordination between health protection and health promotion	• Decision making about policies, programs, and practices related to worker health is coordinated across departments, including those responsible for occupational safety and health and those responsible for worksite wellness
	• Processes are in place to coordinate and leverage interdepartmental budgets allocated toward both worksite wellness and occupational safety and health
	• Efforts to promote and protect worker health include both policies about the work organization and environment and education and programs for individual workers
Supportive organizational policies and practices	
Processes for accountability and training	• Program managers responsible for worksite wellness and occupational safety and health are trained to coordinate and implement programs, practices, and policies to target both worksite wellness and occupational safety and health
	• Operations managers are trained to ensure employee health through coordination with and support for occupational safety and health and worksite wellness
	• Job descriptions for staff responsible for worksite wellness and occupational safety and health include roles and responsibilities that require interdepartmental collaboration and coordination of worksite wellness and occupational safety and health programs, policies, and practices
	• Performance metrics for those responsible for worksite wellness and occupational safety and health include success with interdepartmental collaboration and coordination of worksite wellness and occupational safety and health programs, policies, and practices
	• Professional development strategies include training and setting goals at performance reviews related to interdepartmental collaboration and coordination of worksite wellness and occupational safety and health programs, policies, and practices
	• Worksite wellness and occupational safety and health vendors have the experience and expertise to coordinate with and/or deliver approaches that support the coordination and collaboration of workplace health promotion and protection efforts
Coordinated management and employee engagement strategies	• Both managers and employees are engaged in decision making about priorities for coordinated worksite wellness and occupational safety and health programs, policies, and practices
	• Joint worker–management committees addressing worker and worksite health reflect both worksite wellness and occupational safety and health
	• Workers are actively engaged in planning and implementing worksite wellness and occupational safety and health programs and policies
Benefits and incentives to support workplace health promotion and protection	• Incentives are offered to employees to complete activities to stay healthy (eg, attend a training on health/safety), reduce high-risk behaviors (eg, quit smoking), and/or practice healthy lifestyles (eg, gym membership discounts)
	• Incentives are offered to managers who protect and promote health (eg, accomplish health and safety in their departments and encourage reporting of hazards, illnesses, injuries, and near misses; lead and encourage their employees in health promotion and protection efforts)
	• Workplace benefits address health, safety, and well-being (eg, health care coverage, flextime, paid sick leave, screening and prevention coverage, and wellness opportunities)
Integrated evaluation and surveillance	• The effects of worksite wellness and occupational safety and health programs are monitored jointly
	• Data related to employee health outcomes are integrated within a coordinated system
	• High-level indicator reports (eg, "dashboards") on integrated programs are presented to upper level management on a regular basis, while protecting employee confidentiality
Comprehensive program content	• The content of educational programs such as classes, on-line courses or webinars, or toolbox talks addresses potential additive or synergistic risks posed by exposures on the job and risk-related behaviors
	• The content of educational programs such as classes, on-line courses or webinars, or toolbox talks acknowledges the impact of job experiences and the work environment on successful health behavior change

complex working environment, a key determinant of individual health behavior.[16,31,57,58] We have identified a set of core indicators of the implementation of integrated approaches to worksite health promotion and health protection. A shared understanding of what is meant by the integrated strategies recommended by the TWH program and others has the potential to improve dialogue among researchers and facilitate integration of health promotion and health protection efforts among US workplaces. Broad application of the measures recommended here will provide a means for comparisons across studies, a platform for identifying worksite characteristics associated with the extent of program implementation, and a process for providing feedback to employers and workers interested in building comprehensive approaches to worker health.

ACKNOWLEDGMENTS

The authors thank Benjamin Amick and Jeffrey Katz for their input on the article. In addition, we thank members of our

External Advisory Board for their guidance and review of the concepts presented here, including Elizabeth Barbeau, Letitia Davis, Frank Dobbin, Robert Herrick, Paul Landsbergis, Glenn Pransky, Margaret Quinn, Mark Schuster, David Weil, and Laura Welch; as well as members of our Worksite Advisory Board for careful review of the measures, including Sreekanth Chaguturu, Thomas Hawkins, Robert McLellan, James Melius, Hendrik van Brenk, Mary Vogel, and Kurt Westerman. We also thank the staff and postdoctoral fellows contributing to the work of the Center, including Linnea Benson-Whelan, Alberto Caban-Martinez, Kincaid Lowe, Evan McEwing, Candace Nelson, Silje Reme, Sara Tamers, Lorraine Wallace, and Katherine Williams.

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Participatory Ergonomics as a Model for Integrated Programs to Prevent Chronic Disease

Laura Punnett, ScD, Nicholas Warren, ScD, Robert Henning, PhD, Suzanne Nobrega, MS, Martin Cherniack, MD, and The CPH-NEW Research Team

Objective: To describe the value of participatory methods for achieving successful workplace health promotion (WHP) programming, and specifically the relevance of participatory ergonomics (PE) for the Total Worker Health (TWH) initiative. **Methods:** We review the concept of macroergonomics, and how PE is embedded within that framework, and its utility to modern WHP approaches such as "social health promotion." We illustrate these constructs in practice within TWH. **Results and Conclusions:** Participatory ergonomics is relevant to WHP because (1) psychosocial stress contributes to individual health behaviors as well as chronic diseases; (2) job stress cannot be addressed without employee involvement in hazard identification and solutions; (3) the interaction of multiple levels within an organization requires attention to needs and constraints at all levels, just as the social-ecological model addresses higher-level determinants of and constraints on individual behaviors.

ERGONOMICS: THE FULL SCOPE OF THE DISCIPLINE

Ergonomics is sometimes framed, especially by those outside the field, in its narrowest interpretation, that of optimizing the physical dimensions of workstations, tools and equipment, lifting tasks, and static loads. Nevertheless, the discipline is not limited to those job-level considerations of physical task features, sometimes called "microergonomics" or "hardware ergonomics." One standard definition of ergonomics, "fitting the work to the worker," encompasses not only physical work demands but also mental demands, the social environment, psychological impact, and organizational features of the workplace.

In a work system, the various components—the workers as well as the hardware and the software—interact within an organization that needs to meet production and customer demands to remain economically viable. Thus, in its broadest conceptualization, attention to organizational and psychosocial issues is a fundamental and integral aspect of occupational ergonomics, not an "add-on" activity.

Ergonomists design work to support human limitations as well as to promote human capabilities, with attention to both the micro-level as well as the macro- or system-level features that define the job and impact the worker. The initial problem to be solved may be framed in terms of worker health and safety or system efficiency, for example, the usability of a software system, but these are not mutually exclusive. Reducing errors might be motivated by concerns about injury to the operator or to others, or about system quality and productivity, but worker safety and comfort are always part of a good human factors design solution.

Increasing attention to the overlap among these goals, within the larger context of the organization, has led to development of the concept of "macroergonomics,"[1] referring to harmonization of the vertical interactions among the levels of the workplace (Fig. 1):

- Job physical factors, information processing, psychosocial factors
- Work organization (division of labor among jobs and workers, and between people and machines)
- Organizational structure, policies, climate, and culture

Macroergonomics requires the practitioner to evaluate and optimize user acceptability of technical or social workplace solutions within the larger context. Prevention of "job stress" is also a goal. Psychosocial stressors at work are defined slightly differently among investigators, but the fundamental concepts[2–8] include the following:

- Low decision latitude or "job control," meaning limited opportunity to decide how one carries out one's own work or to participate in how the work is organized or scheduled. It may also coincide with low utilization of one's skills or opportunity to learn new skills.
- High job demands, which refers to the overlapping domains of physical work pace and information processing. Key elements include a rapid work pace, few pauses, conflicting demands, and insufficient time to accomplish tasks well and without error. High job demands are more problematic when coupled with low job control ("job strain") and/or low rewards.
- Low social support from coworkers and/or supervisor, referring both to affective relationships (getting along well with each other) and instrumental support, such as coworkers helping each other on the job and quality of supervision. Social support may buffer the adverse effects of job strain.
- Low rewards, relative to the effort required. These include both material rewards, such as salary and benefits, and intrinsic rewards of contributing to the overall mission and satisfaction with one's own accomplishments.
- Perceived fairness in how different people are treated and how institutional rules and regulations are applied or enforced. Experiences of discrimination, incivility or harassment, and perceptions of how these are handled, are also relevant.
- "Emotional labor," meaning the need to mask one's true feelings or experiences to present a required appearance or to tend to other people's needs.
- Job insecurity and/or instability related to the company's economic position.

These psychosocial domains are not always clearly distinct from physical domains. One example is that rapid and repetitive work, which can be measured biomechanically in terms of cycles per hour of repeated hand motion patterns, may also entail a high pace of mental workload and/or produce psychological experience

From the Center for the Promotion of Health in the New England Workplace (Dr Punnett, Dr Warren, Dr Henning, Ms Nobrega, and Dr Cherniack), Lowell, Mass; University of Massachusetts Lowell (Dr Punnett, Ms Nobrega), Lowell, Mass; University of Connecticut Health Center (Dr Warren, Dr Cherniack), Farmington, Conn; and University of Connecticut (Dr Henning), Storrs, Conn.

This work was supported by Grant Number U19-OH008857 from the National Institute for Occupational Safety and Health (NIOSH), US Centers for Disease Control and Prevention. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH.

None of the authors has any conflict of interest to declare in relation to this manuscript.

Address correspondence to: Laura Punnett, ScD, Center for the Promotion of Health in the New England Workplace, Department of Work Environment, University of Massachusetts Lowell, One University Avenue, Lowell, MA 01854 (Laura_Punnett@uml.edu).

DOI: 10.1097/JOM.0000000000000040

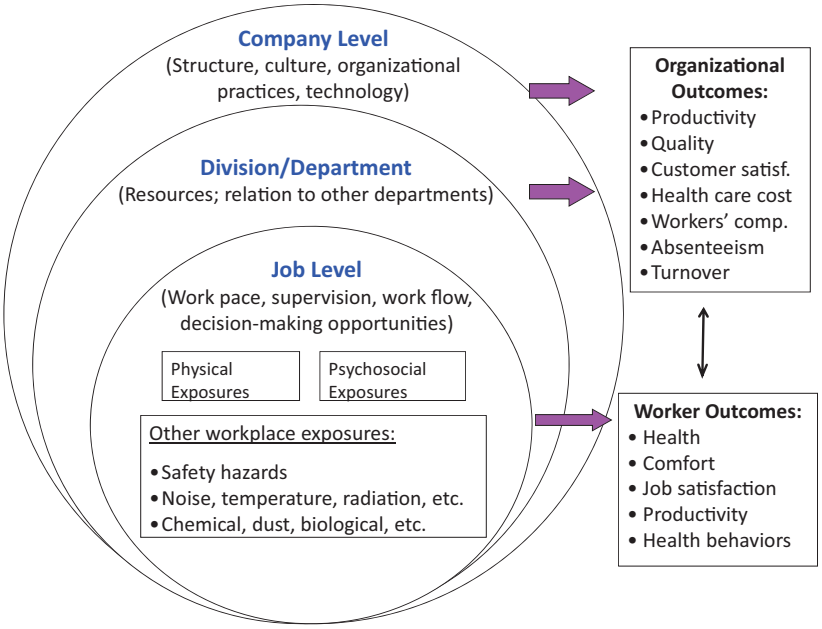


FIGURE 1. The workplace as a multilevel system.

of time pressure. Similarly, low job control is often accompanied by highly stereotyped physical work patterns.

Such correlations among physical, mental, and psychosocial job features do not occur at random.[9] Many aspects of a job are determined by higher level decisions about how the work process is organized.[10] These upper-level determinants are often key to understanding why physical and psychosocial stressors occur and especially to achieving healthy job redesign.

In the domain of occupational ergonomics and safety, as in other areas of occupational health, good design emphasizes engineering controls over administrative controls, which usually focus primarily on worker behavior. Engineering controls, in turn, are prioritized by the type of control achieved. Thus, an ergonomist may seek to improve the human factors of a job so that workers stressed by time pressure or distracted by multiple and conflicting demands are less likely to be injured—in other words, to achieve a *secondary prevention* goal.

A more effective approach is *primary prevention*, to prevent the stress itself, not merely to mitigate its effects. Excessive job demands, low job control, and other psychosocial job stressors are remediable.[11] An effective ergonomics program addresses the overarching work organization as it affects workers directly or indirectly, in addition to specific job-level physical and psychosocial risk factors (Fig. 1). "User-friendliness" is a core concept in human factors design, applied not only to software interfaces but also to the workplace as a whole. The range of comprehensive ergonomics program goals includes the following:

- Reduce occupational health and safety hazards
- Increase employee autonomy and decision-making opportunities
- Encourage participation and creativity in problem solving
- Structure healthier schedules
- Enhance interpersonal relationships at work
- Promote consistent and constructive feedback, fair recognition, and rewards for good work

THE VALUE OF A PARTICIPATORY APPROACH FOR TOTAL WORKER HEALTH

Another concept that has developed rapidly in the field of ergonomics recently is that of participatory ergonomics (PE), an intervention approach in which workers are involved in workplace, job, and work organization redesign efforts. Participatory ergonomics follows in an integral way from the goals of macroergonomics.[12] To harmonize the needs of each level of the organization, input is needed from employees at all of those levels, and there must be genuine attention to that input. It is an iterative process that seeks active engagement of all stakeholders—and there is no group of stakeholders that has more at stake than the workers themselves.

It is argued here that a participatory process such as PE is highly relevant to success of the NIOSH Total Worker Health (TWH) program. Participatory ergonomics has its roots in an understanding that effective work redesign requires taking into account workers' first-hand knowledge of their jobs, including the sources of variance in job demands and constraints.[12] Most of the goals listed earlier would not be achievable without worker involvement in problem identification, worker knowledge of what skills they bring to their jobs, and worker judgments about potential solutions. Employees can also factor in workplace social dynamics, their scheduling needs, and whether they feel fairly rewarded and recognized for their contributions.

The idea behind the concept of "Research-to-Practice" (R2P) is to translate scientific findings into usable guidance for another specific context. This poses a meta-level human factors problem: How does one translate proof of concept, best practices, etc, into a program that will work for a particular site? It becomes necessary for the users (workers) and the organization to play a role in this translation. Otherwise, the technical fix will not be properly implemented or sustained, no matter how much professional expertise goes into designing it.

Although PE can be a time-intensive process, its advantages include greater buy-in from all levels of an organization: avoidance of obstacles that are unforeseen by upper management, easier acceptance of input solicited from outside sources (eg, consultants), and better integration of programs with the workplace culture and needs of employees in different subgroups. Thus, it has a greater probability of leading to sustainable job changes.

Psychosocial stressors, such as low job control, high demands, and poor social support, are well-known to influence markedly our risk of disease and injury. It has recently been shown that these same factors, along with work organization features such as shift work and overtime, also influence individual "health behaviors" such as smoking, diet, and exercise patterns.[13–18] These health behaviors are

already well-known as important risk factors for chronic diseases such as cardiovascular conditions, diabetes, mental health problems, musculoskeletal disorders, and others.

Many practitioners who are responsible for safety and health in the workplace are still not aware of the associations between psychosocial working conditions and health behaviors. Yet, ergonomics, if practiced in a comprehensive way, provides an opportunity to address the root causes of both work-related illness and injury *and* some of the root causes of poor health behavior. Even though health promotion per se is not a main goal of ergonomists, the TWH approach has broadened the occupational health outcome pallet to include improved health behaviors as well as more traditional improvements in system efficiency and worker health and safety. Attention to job stress, psychosocial characteristics of the job, and work organization represent the nexus between occupational safety and health (OSH) and workplace health promotion (WHP). Ergonomists who fully understand the concept of "fitting the work to the worker" have thus been addressing some of the root causes of health behaviors for years, often perhaps without realizing it.

CPH-NEW: PARTICIPATORY ERGONOMICS APPLIED TO INTEGRATED WORKPLACE PROGRAMMING

The Center for the Promotion of Health in the New England Workplace (CPH-NEW), one of the TWH Centers of Excellence, has developed a model for integration of OSH with WHP that is firmly based in a participatory approach. Just as an ergonomics program will likely not succeed long-term without genuine worker engagement, a WHP program also needs the same inputs. In fact, we have argued that the need for worker leadership in WHP priority setting and intervention design efforts is even greater.[19]

The WHP concept is fundamentally about supporting individuals in making healthier lifestyle choices. A WHP program that does not recognize workers as decision makers in this process will not be optimally effective. Furthermore, to the extent that a WHP program is imposed in a top-down manner without fully adapting to the conditions of people's daily lives, it may increase the experience of low decision latitude, rather than rectify it. Even if it seems efficacious in the short-term, such an approach could actually interfere with the conditions needed to achieve sustainable behavior change, in complete contradiction to the desired outcomes.

Framing health promotion in terms of healthy decision making implies that a program's process is as important as its content. In other words, the process itself needs to be part of the solution. Workplace health promotion should be carried out in a way that increases workers' decision-making opportunities (a predictor of healthier behaviors and reduced chronic health outcomes) or it will undermine the program's goals. This does not mean disempowering managers, but rather engaging all levels within the workplace in a genuine dialogue.

Almost 20 years ago, the World Health Organization (WHO) introduced the term "social health promotion,"[20] calling attention to the importance of environmental conditions that foster (or impede) healthy behaviors. More recently, WHO has defined a healthy workplace as "one in which workers and managers collaborate to use a continual improvement process to protect and promote the health, safety and well-being of all workers and the sustainability of the workplace."[21] World Health Organization has specifically cited the need for "positive human relations at work that foster decision-making and self-efficacy." It called upon managers to then address "health and safety concerns in the physical work environment" and "health, safety and well-being concerns in the psychosocial work environment including organization of work and work place culture" *as part of* the activities required to create a "healthy workplace."

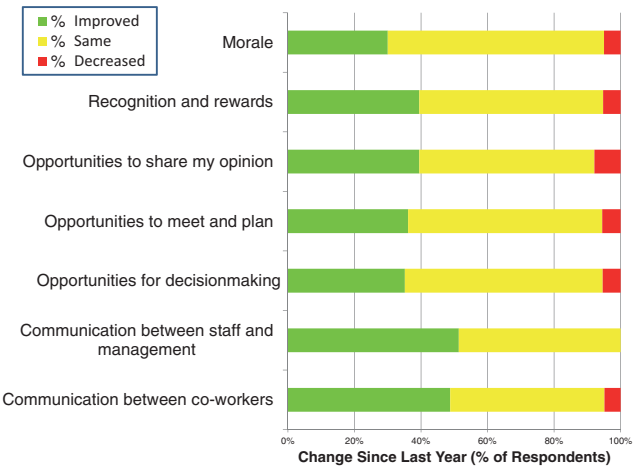
The levels of the workplace, as conceptualized in the macroergonomics construct, map closely onto the socioeconomic model of public health, which is commonly used in the design of health promotion programs in communities as well as workplaces.[22,23] This model states that changes at the individual level will not be possible or sustainable without attention to higher-level environmental constraints and determinants. This is analogous to the macroergonomics paradigm and the PE approach of involving stakeholders from all levels of the organization.

The CPH-NEW advocates a sustainable programmatic approach that engages employees on a regular basis in identifying workplace problems, setting priorities, and developing solutions, thereby facilitating a sense of employee ownership over both the program itself and any resulting interventions. This programmatic approach is also designed to improve the health of the organization through improved organizational communication and provision of opportunities for integrating ergonomics with health promotion initiatives.

Furthermore, because psychosocial stress is a key contributor to both chronic disease and precursor health behaviors, it is crucial to seek an ergonomics model that is well-suited to address job stress. One essential structural aspect of job stress reduction is improved worker decision latitude. Participatory ergonomics addresses this basic work design characteristic through a process in which employees learn ergonomic fundamentals (including physical, psychosocial, and organizational risk factors). Beyond being trained, however, workers also engage in priority setting, brainstorming of solutions, and examining the interactions among workplace and work organization design issues.

The CPH-NEW "IDEAS" tool[24] formalizes a PE approach to intervention planning. The IDEAS tool provides a viable means for applying the integrated TWH concept in practice. A PE framework is crucial to adapting or addressing the many job- and organization-level factors that can either help support or interfere with a proposed intervention. The IDEAS tool directs specific attention to broad identification of both workplace facilitators as well as barriers to each intervention alternative proposed.

At one CPH-NEW study site, for example, landscaping and maintenance workers were invited to consider how to improve their health, directly or indirectly, without need to distinguish "work-related" risk factors from "personal" risk factors. The team prioritized stress as a major health problem, with multiple communication issues identified as root causes. For example, one effect of



* Percentages exclude "Don't know" responses from the denominator.

FIGURE 2. Real estate maintenance workers: Perceived changes in company climate in the past year, from survey of all maintenance personnel at the study site (45 respondents of 60 personnel).

TABLE 1. Results of Qualitative Evaluation of "IDEAS" Process by Design Team Members (Workers) and Managers at a Real Estate Maintenance and Landscaping Firm

Design Team Members	Management Representatives
A useful forum/tool for making improvements	More aware of workers' concerns
Solution-driven: Made change happen	Resident education materials are a good solution
Interaction-driven: Improved communication between technicians and management	Personal development of DT members: Problem-solving, communication skills, pride, accomplishment
Felt engaged and invested in the program	Wish to see the program continue

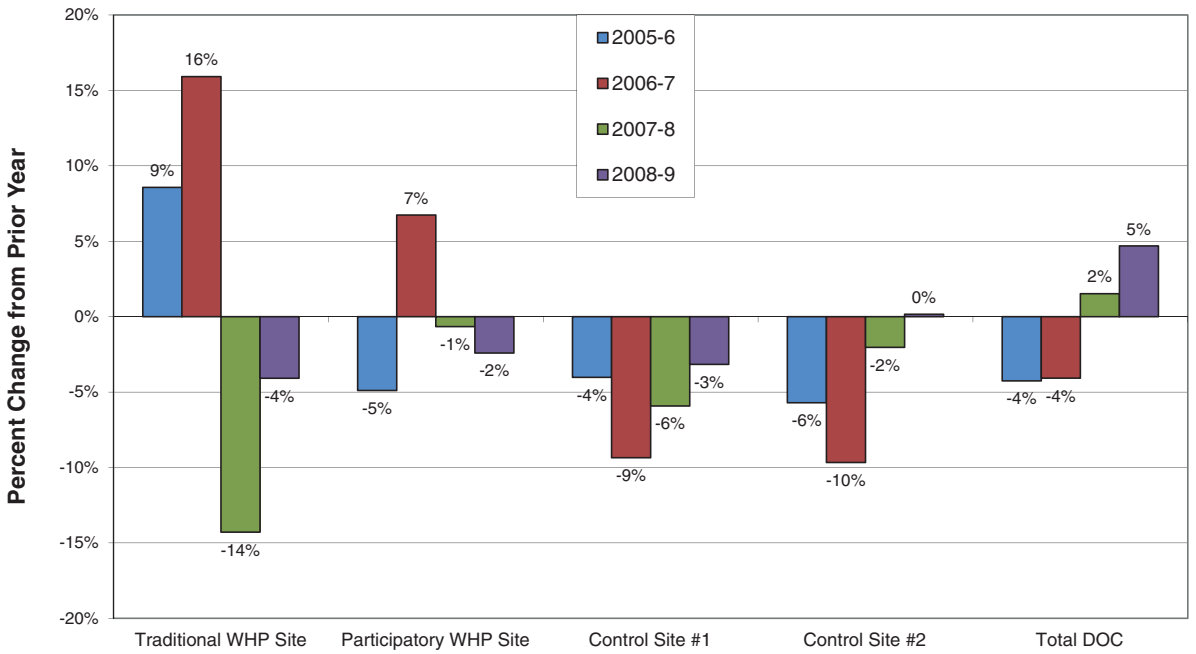


FIGURE 3. Percent change in sickness absenteeism rate over 4 years in Connecticut Department of Correction facilities: Traditional (expert-driven) WHP program, PE/WHP program, two "control" (nonintervention) sites, and statewide experience ("Overall:" 19 facilities). Interventions began in 2007.

disorganized and incomplete communication among maintenance workers, property renters/clients, and front office dispatchers was that maintenance workers were often sent out unnecessarily for minor issues that took valuable time away from handling pressing service needs elsewhere in a timely manner. This resulted in time pressure, lack of satisfaction, frustration, and cynicism. Workers discussed multiple sources of the communication problems, presented their analysis to supervisors and managers, and proposed a range of possible solutions. This process involved several structured discussions with management and workers to select and implement solutions.

The job scheduling system was consequently redesigned, in combination with other measures to improve communication and work climate such as replacement of poor phone and pager service, and educational materials to help office personnel and rental clients understand basic rental unit operating instructions. Subsequent to implementing employee-designed interventions, a survey of all maintenance personnel at the study site was conducted to assess perceived impact. Respondents saw improvements in a wide variety of areas, especially in communication between staff and management (Fig. 2). Although we cannot attribute the perceived improvements exclusively to the participatory program, there is certainly evidence of a connection.

- Communication with managers and coworkers was a root cause of stress reported by maintenance staff at the start of the program, and it became a specific goal of the intervention effort.
- Communication ranked the highest in perceived improvements.
- The program itself promotes organized forms of communication about safety and health between frontline employees and upper management. A structure was established for periodic meetings between management and workers in which safety concerns would be addressed. These discussions resulted in new learning for workers and managers and facilitated a deeper understanding of each other's perspectives.

The perceived usefulness and effectiveness of the program were also assessed from interviews with the employees involved in the design efforts and management representatives who interacted with the team. The employee design team members saw the participatory program as useful because it provided them with an important forum for raising concerns, as well as a tool for improving the workplace (Table 1). Managers became more aware of workers' concerns, recognized personal development of the design team members, and viewed the proposed interventions as good solutions. Of note, the success of the program was highly dependent upon the program

facilitator's ability to remain impartial throughout intervention planning. The organization expressed subsequent interest in hiring a facilitator so that the program would continue after the research study ended.

Preliminary evidence of health benefits from the participatory model comes from another CPH-NEW study underway within the Connecticut State Department of Correction (DOC). Correction officers are at high risk for chronic disease due to obesity, hypertension, depression, and other risk factors.[25,26] One DOC facility received a PE/WHP program for corrections officers, to be compared with a traditional expert-driven program in another. Again, the participatory program was designed and implemented with the explicit goal of enhancing decision latitude and with a broad invitation to raise any health concerns. Topics ranged from heat stress from poorly designed uniforms to poor communication and other obstacles to job performance.

The sickness absenteeism rates shown in Figure 3 represent the two intervention sites and two control sites selected at study inception as the four most similar prisons in the system, based on facility characteristics and supervisor responses to a survey about organizational readiness. Data are also shown for all 19 DOC facilities. Lost time at the participatory site was lower than that at the traditional site after the introduction of interventions (2007) and was also reduced in comparison with the overall total. Inferences must be cautionary because the two study sites had worse rates than the DOC statewide before interventions, for unknown reasons. Nonetheless, the greatest decrease in absenteeism in the participatory site, both in comparison to the traditional program and to the rest of the state system, occurred during the later 2 years, when the participatory program could be said to be hitting its stride. Perhaps most telling is that, after the introduction of interventions in 2007, the participatory site experienced the largest annual decreases in absenteeism, in contrast to the traditional intervention site, the control sites, and DOC as a whole.

An interesting parallel is provided by the weight loss program offered at the participatory site.[27] The program was developed by the employee design team, addressing a variety of issues in the work environment affecting motivation, physical activity, and knowledge of and access to healthy food. Participants in the full program had an average weight loss of 1.8 body mass index ($\pm$0.4) at 20 weeks, or more than 5% of their starting values, compared with a slight weight increase in a comparable group of nonparticipants.

In summary, the CPH-NEW's programmatic approach to integrating OSH and WHP, utilizing PE as a model, offers the following strengths:

- Participatory problem solving and employee engagement address both health promotion (WHP) and protection (OSH).
- The influence of work organization on personal behaviors is emphasized, particularly the contribution of low decision latitude to job stress, one of the root causes of unhealthy behaviors.
- There is attention to process: how interventions are planned and carried out, not only what health and safety needs these interventions address.
- The program structure affords a pathway for regular review by upper management decision makers of interventions proposed by employee design teams, contributing to program sustainability and the institutionalization of a process for continuous improvement of employee health protection and promotion.

We have demonstrated the relevance of PE to WHP on two parallel bases. One is that psychosocial stress contributes to the individual health behaviors that are typical targets of WHP programs. Ergonomics entails remediation of psychosocial as well as physical hazards in the workplace. A process that lacks employee involvement in hazard identification and solution design may be disempowering and thus add rather than reduce job stress. Furthermore, a WHP program that fails to empower workers as problem solvers will not be effective or sustainable over the long-term. Conversely, success in a broadly designed ergonomics program may contribute to a WHP effort, even if inadvertently.

The other basis is that both OSH and WHP problems arise within a multilevel construct in which multiple organizational levels, including workers, supervisors, and managers, are the locus of entrenched health risk factors, often despite hazard recognition. Therefore, effective remediation requires a participatory process, with genuine opportunities for participation in decision making by employees at these multiple levels. A successful worker health program must identify and improve determinants of hazards as well as constraints on individual behaviors that exist at each level. This cannot be achieved without direct input from affected workers as well as input and support from supervisory and managerial levels. The PE approach promotes the multiple input, cross-level communication, and the trust necessary to create sustainable organizational and individual health.

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Total Worker Health and Work–Life Stress

Leslie B. Hammer, PhD and Steven Sauter, PhD

Objective: Review relationships between work–life stress and health behaviors to advance understanding of pathways between occupational and individual risk factors and health and safety outcomes. **Methods:** A background on the Total Worker Health concept is provided, and a review of research on the relationship between work–life stress and health behaviors is presented. **Results:** Research evidence indicates that work–life stress serves as a negative occupational exposure relating to poor health behaviors, including smoking, poor food choices, low levels of exercise, and even decreased sleep time. **Conclusion:** The association between work–life stress and adverse health behaviors suggests that interventions at both the occupational (health protection) and individual (health promotion) level may be helpful in mitigating effects of work–life stress, consistent with the Total Worker Health approach. Further study is needed to investigate gains from an integrated prevention strategy.

Workplace integration of health protection and health promotion activities is becoming a new standard for safeguarding the health and safety of the workforce. Recent guidance statements by the Institute of Medicine[1] and the American College of Occupational and Environmental Medicine[2] advocate strongly for the integration of prevention activities addressing the health and safety of workers. In addition, in 2011, the National Institute for Occupational Safety and Health (NIOSH) intensified its commitment to the integration of workplace health protection and health promotion by expanding its portfolio of research on this topic under the auspices of the NIOSH Total Worker Health™ (TWH) program. Examples of these expanded programmatic efforts include deeper support for intramural research on integration of prevention practices and funding of a fourth extramural Center of Excellence to Promote a Healthier Workforce.[3]

Integration of workplace health promotion and health protection activities is not a new concept. The theoretical and practical justification for this approach was laid down two decades ago in several seminal reports.[4–6] Nevertheless, enthusiasm over this approach has heightened in recent years. Driving forces include (1) growth of preventable chronic health conditions in the workforce, (2) deeper understanding of risks posed by these conditions to the health, safety, and performance of workers and, in turn, to the health of the organization and the economy, (3) a growing body of research linking many of these conditions to workplace exposures as well as lifestyle factors, and (4) accumulating evidence of the superiority of integrated prevention strategies in mitigating these risks.[7–10]

Numerous arguments have been advanced in support of prevention strategies that combine health protection with health promotion. Integrated programs have operational advantages—enabling comprehensive targeting of risk factors and more efficient use of resources by elimination of redundancies across fragmented programs.[4,11–13] Furthermore, risky health behaviors and exposure to hazardous work environments cluster in the workforce, arguing for joint attention to both sets of risk factors.[13] Finally, as detailed by Schulte et al[14] and acknowledged in virtually all reports advocating for systems approaches to prevention, individual and occupational risk factors may act in concert to influence the health and safety of workers.

Within the Schulte et al[14] framework, several pathways between individual and occupational risk factors and illness and injury outcomes can be discerned. Individual risk factors and occupational exposures may each contribute directly and independently to the same health or safety outcomes (additive model). Interactions of individual and occupational risk factors are also depicted in this framework and are representative of the TWH approach. A relevant example cited by Schulte et al[14] is the increased risk of osteoarthritis with prolonged kneeling among obese workers.

Interactions between individual factors and occupational exposures are of special significance in the argument for integration of prevention activities because they suggest that integrated interventions would yield multiplicative or exponential effects. In other words, these interactions support the prevention "synergy" hypothesis that originated with NIOSH (1984) and recurs throughout the literature that advocates for integrated prevention strategies,[2,4,13,15,16] although synergistic effects of integration have not been systematically examined in intervention research to date.

Not mentioned in the Schulte et al[14] framework is an indirect pathway between occupational exposures and safety and health outcomes via influence of occupational exposures on health behaviors. Effects of occupational exposures on health behaviors, especially tobacco and alcohol use, is well-established in the job stress and coping literature.[17] Most recently, a European consortium of investigators reported significant associations between unfavorable workplace psychosocial conditions and physical inactivity, increased smoking intensity, the extremes of body mass index, and the incidence of both weight gain and loss.[18–20] Findings were based on both cross-sectional and prospective analyses of cohort studies inclusive of more than 160,000 workers. Similarly, a 1999 review by Frone[21] found support for a relationship between work-related stressors and elevated alcohol consumption and problem drinking.

Along this line, NIOSH analysis of data from the National Organizations Survey III suggests a pathway between the workplace psychosocial environment and participation in workplace health promotion programs.[22] Quality of work life (eg, autonomy, flexibility, and skill development) in organizations was positively associated with availability of worksite health promotion (stress management) programs, suggesting greater opportunity for participation in health promotion activities in positive work environments. Similarly, Sorensen and Barbeau[13] and Punnett et al[12] suggest that worker receptivity to health messages and motivation to participate in health promotion programs can be enhanced in the presence of workplace environmental interventions to reduce safety and health risks. *In this article, we expand on the role of health behaviors in explaining the effects of occupational psychosocial exposures on health outcomes*.

WORK–LIFE CONFLICT AND NEGATIVE HEALTH BEHAVIORS

Allen and Armstrong[23] suggested that stressful working conditions due to work–family conflict (WFC) lead to negative health

From the Department of Psychology (Dr Hammer), Portland State University, Portland, Ore; and Department of Psychology (Dr Sauter), Northern Kentucky University, Highland Heights, KY.

This study was funded in part by the National Institute for Occupational Safety and Health (grant # U19 OH010154) on which Leslie Hammer is a grantee.
The authors declare no conflicts of interest.

Address correspondence to: Leslie B. Hammer, PhD, Department of Psychology, Portland State University, Portland, OR 97201 (hammerl@pdx.edu).

DOI: 10.1097/JOM.0000000000000043

behaviors, which ultimately result in poor health outcomes. They further argued that these negative health behaviors may represent coping responses to stressful working conditions or are a response to a loss of resources such as time, which occurs with increased work–life stress, making it more difficult to find time to exercise or prepare healthy meals. Although their findings[23] revealed significant relationships between work–life stress, negative health behaviors, and ultimately negative health outcomes, we note that a systematic review of the literature in this area is lacking.

Table 1 identifies 27 studies representing the results of our review of the broader literature on work–life conflict and health behaviors. Notably, we find that work–life conflict is generally examined as an occupational exposure in correlational studies, which are much more prevalent than work–life conflict studies of actual programs or interventions.

To be included in our review, the study must have examined some form of work–life conflict as an antecedent and some type of health behavior outcome. *Work–life conflict* in the literature is most often defined as WFC or negative spillover and frequently consists of two dimensions (ie, work-to-family or family-to-work). Health behavior outcomes typically found were modifiable behaviors, such as food consumption/choices, smoking, alcohol use/abuse, and sleep duration. This last behavior was difficult to define because we wanted to stay focused on modifiable health behaviors and many studies of sleep examined quality, which is not a modifiable behavior per se. This points to the need for future work on sleep hygiene factors as a way to define modifiable sleep behaviors from a health promotion perspective, and we argue that this is important for future research, given the strong relationship between sleep and many long-term health outcomes.

An electronic search using the databases EBSCOhost, psycInfo, JSTOR, ProQuest, PubMed, and Google Scholar was conducted using combinations of the key words and phrases, both dimensions of WFC, work–family spillover, alcohol, problem drinking, diet, exercise, physical activity, drug abuse, sleep, smoking, tobacco, including several synonymous iterations of these constructs. Furthermore, the references of earlier work–family article reviews were scanned for articles missed by the electronic search.[24,25] After articles were collected, a systematic review was completed to determine the level at which each article empirically assessed the target relationship between WFC/spillover and health behaviors.

The most convincing pathway through which WFC impacts negative health behaviors is through the draining of psychological and physical resources.[26,27] Stress and strain deplete available emotional and behavioral resources that could be devoted to improving health and well-being. As such, WFC has been identified as a reason for decreased physical exercise and poor choices or lack of time to prepare healthy foods.[23,28,29] In the case of poor food choices, negative spillover between work and family was related to negative food choice strategies in a qualitative study of low-income workers.[29] Study participants described characteristics of their jobs, such as long hours and inflexible schedules, as depleting their nonwork and family time and energy resources to make healthy food choices and prepare healthy foods. These findings are consistent with those of Allen and colleagues on WFC and family dinner behaviors, including frequency.[30,31] Allen and Armstrong[23] found that WFC was related to less physical activity, eating more high-fat foods, and eating fewer healthy foods.

A second pathway is coping, and the relationship between job stress and negative coping behaviors such as alcohol and tobacco use and abuse has been established.[17] Therefore, it may very well be the case that different theoretical mechanisms explain the WFC–negative health behavior relationship depending on the health behavior examined.

Of special interest, Van Steenbergen and Ellemers[32] suggested that positive spillover can lead to increased emotional resources and energy that, in turn, lead to increased physical exercise and healthy food choices. Van Steenbergen and Ellemers[32] extended the research on WFC and health behaviors to include the study of work–family facilitation (beneficial effects of combining work and family). Theoretically, it is argued that while the stress and strain that result from WFC can tax a system and wear down physiological systems leading to decreased health, positive emotions and positive relationships between work and family can actually replenish such systems and lead to improved physiological health and well-being. Although this study did not specifically examine health behaviors, it does suggest the possibility that similar mechanisms may hold for the beneficial effects of combining work and life such that improved health behaviors may be seen when WFC and stress are reduced and the benefits of combining work and nonwork are enhanced.

WFC INTERVENTIONS AND HEALTH BEHAVIORS

Work–family conflict intervention studies are still extremely rare[33,34] and, as indicated in Table 1, most studies still give far more attention to describing WFC as an exposure in relation to health behaviors as opposed to examination of interventions to prevent WFC and associated negative health behaviors in work organizations.[35]

The Work, Family, and Health Network has been the largest national effort to date to support organization-level work–life intervention studies aimed at health protection through work–life stress reduction. Specifically, the intervention focuses on increasing supervisor support for family and increasing employee control over work time, and outcomes include health behaviors, and numerous health outcomes for workers. Although results of the larger randomized field experiment evaluating the health benefits of a workplace intervention aimed at reducing WFC and stress are not yet published, the initial pilot studies are the first to provide evidence of work–life intervention effects on health[36] and health behaviors.[37,38]

One of these pilot studies by Hammer and colleagues[36] developed, implemented, and evaluated a work–life intervention using a randomized design and was based on family supportive supervisory training and behavioral self-monitoring. The findings of this study demonstrated improved supervisor support for work and family and beneficial effects on worker job satisfaction, turnover intentions, and self-reported physical health symptoms. Although this intervention did not evaluate the effects on health behaviors specifically, findings are promising and suggestive of potential mediating mechanisms leading to decreased stress and improved health behaviors, ultimately impacting longer-term health outcomes.

A second pilot study associated with the Work, Family, and Health Network used a quasi-experimental nonequivalent control group design with a time lag of 6 months to evaluate the effects of an intervention aimed at increased control over work time and work place.[37,38] This intervention was aimed at decreasing WFC through increased schedule control on the basis of face-to-face participatory training sessions with groups of employees in a corporate headquarters work environment where workers were already afforded a fair amount of flexibility and control over work. Employees reported improved health behaviors (ie, reduced smoking and alcohol consumption, increased physical activity, more time for sleep, and improved diet) after the intervention that increased positive work–life spillover and decreased negative WFC compared with control groups.[37]

In sum, we suggest that further research is needed to examine WFC reduction interventions and programs that (1) target changes to the work environment to reduce the workplace hazard of WFC and improve workplace social support for family and personal life, control over work time, and formal policies and programs designed to support workers' work and nonwork lives with respect to their effects on worker health behaviors; and (2) are implemented in conjunction with health promotion interventions to assess the interactive and synergistic effects on health behaviors and long-term health outcomes above and beyond the effects of either program

TABLE 1. Work–Life Stress and Health Behaviors

Citation	Exposure Versus Intervention	Work–Family Stress Variables	Health Behavior Outcome Variables
Allen and Armstrong[23]	Exposure	WFC	Healthy and unhealthy food consumption/choices
Allen et al[30]	Exposure	WFC	Family dinner frequency
Barnes et al[41]	Exposure	Time spent on work and family	Sleep duration
Berkman et al[42]	Exposure	Manager work–family balance score	Cardiovascular risk score that included smoking behaviors
			Sleep duration
Cho and Allen[31]	Exposure	WFC	Family dinner frequency
Crain et al[43]	Exposure	WFC	Sleep duration
Devine et al[29]	Exposure; qualitative	Negative work–family spillover	Healthy and unhealthy food consumption/choices
Devine et al[44]	Exposure; qualitative	Negative work–family spillover	Healthy and unhealthy food consumption/choices
Devine et al[45]	Exposure	Negative work–family spillover	Healthy and unhealthy food consumption/choices
Frone[46]	Exposure	WFC	Substance dependence
			Substance abuse
Frone et al[47]	Exposure	WFC	Cigarette use
			Frequency of heavy drinking
Frone et al[48]	Exposure	WFC	Alcohol abuse/use
Frone et al[49]	Exposure	WFC	Alcohol abuse/use
Frone et al[50]	Exposure	WFC	Alcohol abuse/use
Grzywacz and Marks[51]	Exposure	Positive and negative work–family spillover	Alcohol abuse/use
Grzywacz and Marks[52]	Exposure	Positive and negative work–family spillover	Exercise habits
Lallukka et al[53]	Exposure	WFC	Health behaviors
			Tobacco use
			Alcohol consumption
			Physical inactivity
			Diet
Lallukka et al[54]	Exposure	WFC	Tobacco use
			Alcohol consumption
			Physical activity
			Healthy and unhealthy food consumption/choices
Moen et al[37]	Intervention; quasi-experimental intervention with nonrandom assignment	Positive and negative work–family spillover	Smoking Alcohol consumption Physical activity Time for sleep Healthy and unhealthy food consumption/choices
Moen et al[38]	Intervention; quasi-experimental intervention with nonrandom assignment	Positive and negative work–family spillover	Sleep duration Exercise Health care management
Roos et al[55]	Exposure	WFC	Alcohol abuse/use
Roos et al[56]	Exposure	WFC	Healthy and unhealthy food consumption/choices
			Physical activity
Sekine et al[57]	Exposure	WFC	Sleep quality/duration
Van Hooff et al[58]	Exposure; daily diary	Work–home interference	Sleep quality
Wang et al[59]	Exposure	WFC	Daily alcohol consumption
Williams et al[60]	Exposure	Positive work–family spillover	Sleep quality/duration
Wolff et al[61]	Exposure	WFC	Alcohol abuse/use

WFC, work–family conflict.

alone. Such WFC reduction interventions and programs should be designed to support healthy psychosocial work environments by preventing stressors in the organization of work that can lead to WFC. These interventions should aim to facilitate emotional and behavioral resources leading to a reduction in negative health behaviors, and ultimately chronic disease. Examples include giving employees control over work schedules; training managers, supervisors, and coworkers to provide support for family and personal life to employees; or planned redesign of the work organization to improve work processes so that employees feel that they have role clarity to focus on tasks that are most critical for performance. Although increasing control over work may be particularly challenging in certain highly structured work environments, practices such as increasing control through implementation of self-scheduling practices and increasing control over work processes are strategies that can prove effective in reducing WFC.

CONCLUSIONS AND FUTURE RESEARCH NEEDS

Research evidence, as shown in Table 1, indicates that the psychosocial stressor of WFC serves as a negative occupational exposure relating to poor health behaviors, including smoking, heavy drinking, poor food choices, low levels of exercise, and even decreased sleep time. We argue that the mechanisms that tie WFC to negative health behaviors include resource depletion and resource allocation, as well as coping mechanisms. We expect to see the most pronounced effects on improvements in health outcomes and disease that are the result of occupational exposures through the combination of WFC reduction programs and interventions in combination with health promotion interventions that target individual behavior change, rather than either type of program or intervention alone. This would result in a two-pronged approach to behavior change that is characteristic of TWH programs and interventions. The demonstrated associations between WFC and health behaviors not only add to our understanding of the influence of WFC on health, but also greatly expand the evidence base that health behavior comprises a major pathway by which workplace psychosocial stressors influence the health and well-being of workers and their families. This leads, in turn, to the implication that workplace programs to control health behaviors through health promotion interventions alone are likely to not be as effective as those that use a comprehensive prevention strategy that is also aimed at health protection at the organizational level, such as those that reduce work-related psychosocial stressors.

Although we would expect that health protection interventions focused on decreasing unsafe working environments would have the strongest effect on safety outcomes, we find it surprising that given the volume of research on WFC and health behaviors, almost no attention has been given to a possible link between WFC and safety behaviors. Although two studies have shown correlational evidence of the relationship between WFC and safety outcomes,[39,40] little is known about the associated mechanisms that may be operating in the relationship between WFC and safety behaviors. There is a suggestion that work–life interventions that target work–life stress reduction can lead to increased resources, similar to the mechanisms described with health behaviors, and thus, improved safety behaviors. We, therefore, reason that interventions designed to reduce WFC could have a corresponding positive effect on safety behaviors and, likewise, could have enhancing effects when combined with interventions that promote health behaviors. The integration of health protection interventions aimed at WFC hazard reduction and health promotion may result in greater levels of safety and health than either one type of intervention by itself.

Health, safety, and work are intimately related, and it is time that scholars and practitioners alike go beyond the focus of either health protection or health promotion and move toward what scholars have been advocating for over two decades[4–6]—specifically, that scholars and practitioners take a broader systems view of the organization of work and its clear impact on workers' abilities to engage in healthy behaviors. This TWH approach to WFC that integrates individual health promotion interventions and organizational health protection interventions is expected to lead to reduced negative health and safety behaviors and improved health and safety outcomes for workers, and families alike.

ACKNOWLEDGMENT

The authors thank Joseph Sherwood for comments on an earlier version of this article and for providing editorial assistance with the manuscript.

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Integrated Worker Health Protection and Promotion Programs

Overview and Perspectives on Health and Economic Outcomes

Nicolaas P. Pronk, PhD

Objective: To describe integrated worker health protection and promotion (IWHPP) program characteristics, to discuss the rationale for the integration of occupational safety and health and worksite health promotion programs, and to summarize what is known about the impact of these programs on health and economic outcomes. **Methods:** A descriptive assessment of the current state of the IWHPP field and a review of studies on the effectiveness of IWHPP programs on health and economic outcomes were undertaken. **Results:** Sufficient evidence of effectiveness was found for IWHPP programs when health outcomes were considered. Impact on productivity-related outcomes is considered promising, but inconclusive, whereas insufficient evidence was found for health care expenditures. **Conclusions:** Existing evidence supports an integrated approach in terms of health outcomes but will benefit significantly from research designed to support the business case for employers of various company sizes and industry types.

In 2004, as part of its "WorkLife" program, the National Institute for Occupational Safety and Health (NIOSH) sponsored the *Steps to a Healthier US Workforce* symposium. The symposium connected professionals from the occupational safety and health (OSH) and worksite health promotion (WHP) communities with the intention to facilitate progress toward a research, practice, and policy agenda related to integrated worker health protection and health promotion (IWHPP). Growing interest in coordinated efforts toward protection and promotion of health and well-being at the worksite has led to the recent introduction of the NIOSH Total Worker Health™ Program.[1]

Efforts to integrate OSH and WHP (IWHPP) programs are designed to avoid worker illness, injury, and disability and to promote health, function, and well-being. Functions traditionally considered to be under the auspices of OSH include activities such as compliance with Occupational Safety and Health Administration regulations, safety trainings, ergonomics, blood-borne pathogens, and radiation safety, among others. The focus of WHP has typically been on improving the health of workers through individual behavior change and group-based activities, although more recent efforts have focused on changes in organizational policies that reduce exposures to risks in the physical or psychosocial environment.[2,3] IWHPP initiatives create multidisciplinary approaches that operate at multiple levels at the workplace, including the individual-, group-, organizational-, and environmental level. In the context of legal, social, political, and economic factors, IWHPP programs present opportunities for collaboration, integration, and synergy among multiple stakeholders.[2]

It may be assumed that integrated solutions are more effective than separate efforts to protect and promote health among workers.[4] Evidence to support this assertion is needed and, hence, the purpose of this article is to briefly describe IWHPP program characteristics and place them in context, to discuss the rationale for the integration of OSH and WHP programs, to summarize what is known about the impact of these programs on health and economic outcomes, and to offer perspective on the state of current knowledge of this emerging field.

From the HealthPartners Institute for Education and Research, Bloomington, Minn, and Harvard School of Public Health, Boston, Mass.

This work was supported in part by a grant from the National Institute for Occupational Safety and Health (U19 OH008861) for the Harvard School of Public Health Center for Work, Health and Well-being and the HealthPartners Institute for Education and Research.

The authors declare no conflicts of interest.

Address correspondence to: Nicolaas P. Pronk, PhD, Health Promotion Department, HealthPartners 8170 33rd Avenue South, Bloomington, MN 55425 (nico.p.pronk@healthpartners.com).

DOI: 10.1097/JOM.0000000000000031

DESCRIBING AND DEFINING INTEGRATED WORKER HEALTH PROTECTION AND PROMOTION

Several conceptual frameworks and descriptive presentations of IWHPP efforts exist in the literature. An early description of an integrated health and safety model compared and contrasted the health promotion and occupational safety and health fields and proposed a model featuring three interactive systems—job demands and worker characteristics, work environment, and extraorganizational influences. This model explicitly recognized the need to address environmental factors in protecting and promoting worker health.[5] As a result of the 2010 *Towards Better Work and Well-being* conference, sponsored by the Finnish Institute of Occupational Health, well-being at work was conceptualized as the interaction among a variety of factors and their relationships to productivity of workers, companies, and the nation as a whole. The critical factors identified in well-being included socioeconomic status, workplace factors, environmental factors, occupational hazards, health, and a host of demographic factors.[6] The proceedings of a National Institutes of Health and Centers for Disease Control and Prevention chronic disease prevention workshop describe IWHPP as including the intervention targets of work environment (physical, organizational, and psychological), individual health-related behaviors, and the work–family–community interface in the context of legal, social, political, and economic factors that give rise to opportunities for collaboration, synergy, and integration.[2] The American College of Occupational and Environmental Medicine describes components of workplace health protection and promotion programs to include efforts that are strategic, integrated, systematic, and that bring together environmental and safety policies and programs that prevent work-related injuries and illnesses along with activities that enhance the overall health and well-being of the workforce.[7] The fusion of worker health protection and promotion was also described by the International Association for Worksite Health Promotion as a coordinated and comprehensive approach that includes programs and policies that address the physical and organizational work environment and promotes personal health among individual workers and their families. This description recognizes multilevel interventions and the roles that leadership, management, and individual employees play in the context of a corporate culture and the broader community.[8,9] The World Health Organization introduced a global plan of action for worker health in 2007.[10] The framework considers the worksite to be a primary setting for the protection and promotion of health among workers, their families, and the community. It presents an integrated approach to planning, delivery, and evaluation of programs organized around principles of business ethics, a strong business case, and a strong legal case. Finally, the NIOSH defines Total Worker Health as "a strategy integrating occupational safety and health protection with health promotion to prevent worker injury and illness

and to advance health and well-being."[1] This program explicitly recognizes that health and well-being of workers is a shared objective by workers, their families, and employers and is impacted by the work environment and nonwork activities.

In an effort to summarize the various descriptions of IWHPP programs, Fig. 1 depicts key words, elements, factors, and characteristics as referred to by these sources into a single illustration that may support the creation of a clear and concise definition of IWHPP programs. The figure is not intended to distill the multiple factors presented down to a small set of basic elements. Rather, the intent is to recognize that many factors need to be considered, many factors interact or are affected by others, and thoughtful consideration of how these factors interrelate and are dependent on each other will likely provide insight in how to conceptualize and define IWHPP approaches. The emerging field of integrated worker health protection and promotion will benefit greatly from a clear and concise, yet open, broad and robust definition; one that will be sufficiently flexible to stimulate innovations and growth.

WHY INTEGRATE?

A comprehensive approach to worker health on the basis of multidisciplinary, multilevel, and integrated methods has been advocated in the literature since the late 1980s.[5,11–18] A rationale to support the promotion of integrated programs may cite several reasons.

First, the simultaneous reduction of accidents or injuries and improvement of the health status of the workforce is perhaps the most obvious reason. The idea that an integrated approach can achieve both objectives more efficiently is appealing and makes common sense. Leveraging already available resources (such as safety-related resources and processes to further health promoting objectives) may also be considered good resource stewardship.[1,7,18]

Second, workers' risk of disease is increased by exposure to both occupational hazards and risk-related behaviors. For example, tobacco smoke contains toxic agents (eg, benzene) that may also be present in certain workplace environments. Workers who smoke may be doubly exposed to these agents because of their exposure to workplace hazards. These exposures may act synergistically when effects go beyond the addition of the two exposures alone, such as in the case of tobacco smoke and asbestos.[19,20]

Third, workers at highest risk for exposure to hazardous working conditions are also most likely to engage in higher risk behaviors or have recognized health risk factors such as obesity or hypertension. Working-class occupations tend to have more job risk exposures and are more likely to become injured or ill because of workplace hazards than professional employees.[21–29]

Fourth, integrating OSH and WHP may increase participation, engagement, and success rates (effectiveness) for high-risk workers. The fact that people often place the highest priority on those risks that are outside their personal control, are undetectable, and seemingly unfair[30–32] (features associated with job hazards) may lead workers to perceive that reduction of occupational hazards is more important than personal health behavior changes.[33] Skepticism about an organizational commitment to protect worker health may reduce employee participation in WHP programs.[13,34,35] Conversely, employer efforts to create a corporate culture of trust and respect may enhance

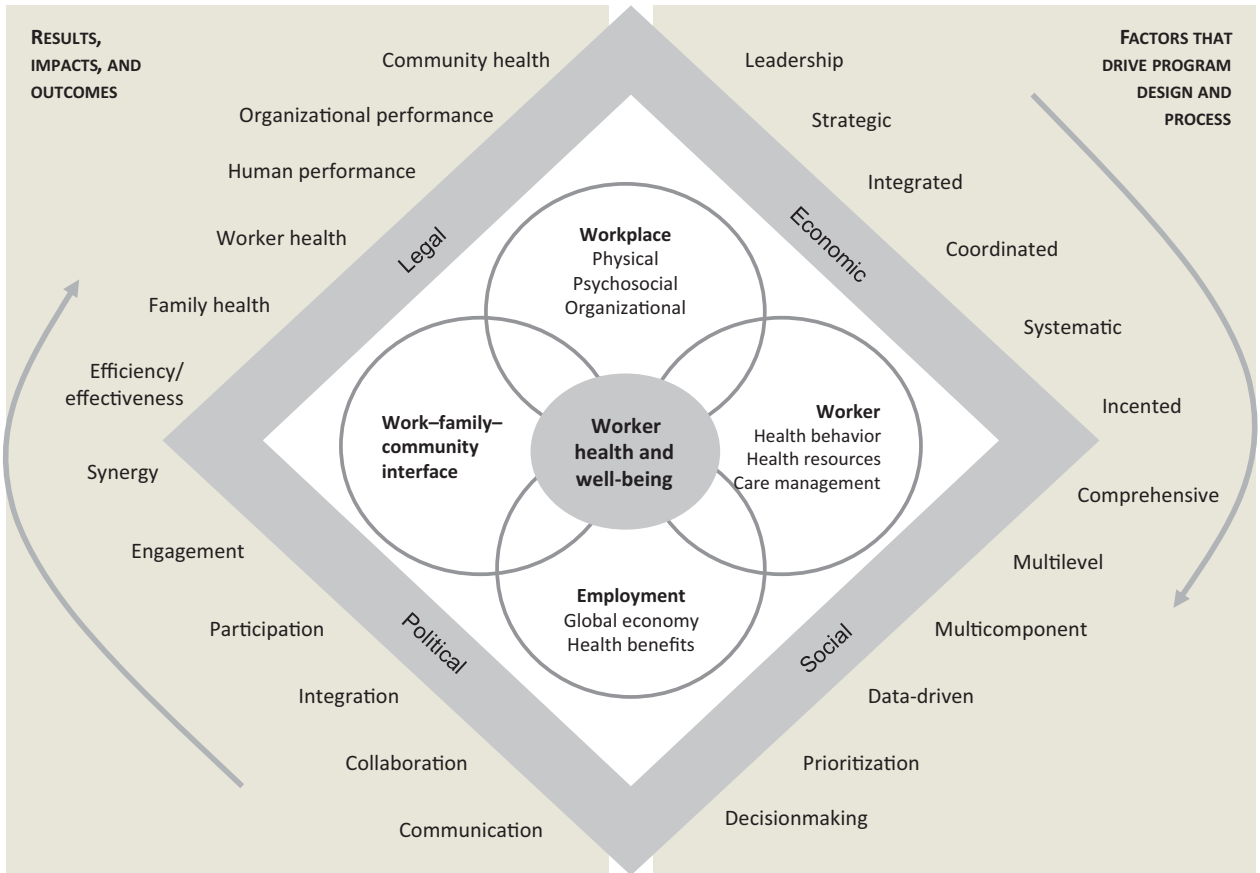

FIGURE 1. Compilation of key words, characteristics, and factors of integrated worker health protection and promotion programs.

workers' receptivity and openness to messages and programs designed to change behaviors and improve health.[36,37]

Lastly, integrating OSH and WHP may benefit the larger organization through cost reductions or cost savings. Positive economic outcomes cannot be generated without intervention effectiveness. A systematic review by the Task Force on Community Preventive Services noted strong evidence of effectiveness for assessments of health risks with feedback and follow-up interventions.[38] Despite some studies reporting mixed results[39] or expressing cautious optimism for achieving a positive return on investment,[40] evidence of positive economic impact of OSH interventions[41,42] and WHP programs[43–45] separately is supported by a growing literature. Nevertheless, evidence of cost savings as a result of IWHPP programs is only slowly emerging.[4,46]

EVIDENCE OF EFFECTIVENESS FOR INTEGRATED WORKER HEALTH PROTECTION AND PROMOTION PROGRAMS

IWHPP programs are those that integrate OSH and WHP components, not those that look at either one or the other. To summarize current knowledge, a literature search (PubMed database; http://www.ncbi.nlm.nih.gov/pubmed) was conducted to identify reports on IWHPP programs by using key words and search strings that were based on the results depicted in Fig. 1. Results were complemented by references identified from previously conducted reviews and committee reports. The health outcomes were conceptualized as changes in health behaviors and health risk factors as well as the impact of preventive efforts on injury and illness reduction. Economic outcomes were conceptualized as changes in productivity losses (ie, reductions in absenteeism- and presenteeism-related factors) as well as changes in health care expenditures. Identified IWHPP program reports were grouped according to the following categories: studies reporting on experimental trial results of interventions among workers, existing reviews or committee reports on IWHPP, and case study examples of intervention results specific to the experience of a single employer.

Experimental Studies

Eleven experimental studies were identified in the literature that included intervention and control or comparison groups and that provide direct evidence on the impact of integrated worker health programs on health-related outcomes and economic indicators. These studies are presented in Table 1 and include randomized controlled trials and quasiexperimental studies in a variety of workplaces and job types ranging from call centers to construction laborers. Studies included interventions related to tobacco, nutrition, physical activity, and weight loss from a health promotion perspective and office ergonomics, work organization, and employee trainings from a health protection perspective.

Across the 11 studies listed, all reported improvements in health-related outcomes. From an experimental design perspective, 7 of the 11 studies were randomized controlled trials[46,48–52,54] and they all showed results in a similar, positive direction. Furthermore, the health outcomes tended to be supported by well-accepted, yet varied, measurement methodologies.

Economic outcomes in terms of productivity-related impact were reported by 5 of the 11 studies.[46,47,54–56] The randomized controlled trials[46,54] and one quasiexperimental study[47] monitored productivity indicators directly using company records and monitoring systems. The remaining two quasiexperimental reports represented pilot investigations with a relatively small numbers of study subjects.[55,56] One study[56] reported productivity improvements, whereas the other[55] did not.

Only one study reported on health care expenditures and found no significant effect.[46] This study, a randomized controlled trial, measured health care expenditures through monitoring logs on the basis of the self-report.[46]

One additional observation of interest was reported by Sorensen and colleagues[49] in the WellWorks-2 trial. Results of this study indicated improvement in health promotion program participation. Additional process evaluations have corroborated these findings.[50,57,58]

Several studies reviewed relate to interventions in the area of ergonomics where sit-stand devices are introduced into the work environment, thereby changing work organization and components of the physical and psychosocial environments.[54–56] These studies recognize the contextual impact on psychosocial variables in the workplace and relationships to behavioral variables, specifically physical activity or sedentary behavior.[59,60] As such, they integrate ergonomics with behavior change programs into an IWHPP-type application and look for effects on health and productivity-related outcomes. The three studies included in this review represent an innovative and emerging area of research.

On the basis of a review of experimental studies of IWHPP programs, it may be concluded that additional sufficiently powered randomized trials are needed. A consistent observation was the impact on health-related outcomes, but gaps remain related to economic outcomes.

Reviews or Committee Reports

In addition to a review of experimental studies, review articles and committee reports were identified that specifically addressed IWHPP programs. Identified reports are presented in Table 2 and include seven literature reviews and four committee reports that discuss health or economic outcomes. Included are systematic reviews[64,65,67] and more general reviews of the literature,[61–63,66] an in-depth report from the Institute of Medicine,[18] and seminal research articles for the NIOSH Total Worker Health.[4,17,68]

In general, these reports communicate agreement that IWHPP programs generate positive health outcomes. The IOM Committee to Assess Worksite Preventive Health Program Needs for NASA Employees has presented its recommendations for program evolution at NASA and concluded that sufficient evidence of effectiveness supports the promotion of integrated worker health programs.[18] Nevertheless, their recommendations were based on health outcomes only and did not include economic considerations.

Several reports presented positive economic outcomes in terms of productivity indicators.[17,62,65–68] Few reports included economic outcomes in terms of health care expenditures, and those that did based their findings mostly on separate OSH or WHP study results.[66–68] When the literature was considered in the context of a proposed conceptual model, the evidence base was considered limited for both health and economic outcomes.[61]

In summary, review articles and committee reports identified indicate mostly positive health-related outcomes. Some evidence suggests positive economic outcomes, mostly limited to productivity loss reduction, although this evidence seems limited to separate OSH or WHP program evaluations. Hence, the economic outcomes may be summarized as promising, but inconclusive evidence of effectiveness. A need exists for additional research specifically focused on the economic impact of IWHPP programs.

Single Employer Case Examples

To support a business case for IWHPP programs, the business community often looks at examples in practice that present a proof of concept. These examples are often referred to as "case examples" or "case studies" and may be helpful to illustrate what is possible and what processes need to be considered for successful adoption in the workplace setting. Several employer-specific case examples are presented in Table 3.[18,69–77] It should be noted that this presentation of case examples does not constitute an exhaustive list, but provides

TABLE 1. Experimental Studies on Integration of Worker Health Protection and Promotion Programs

Study and Reference	Design	Health Outcomes	Economic Outcomes		Comment
			Productivity Loss Reduction	Health Care Expenditures	
The Brabantia Project[47]	Quasiexperimental pre-/poststudy with comparison sites	+	+	NA	Study to improve the health and wellness by means of lifestyle changes and changes in working conditions among Dutch workers (three Brabantia sites) and measured through changes in behavior, health risks, stress reactions, quality of work performed, and absenteeism
WellWorks-1[48]	RCT at the worksite level	+	NA	NA	Study on the effects of a 2-year integrated health promotion and health protection intervention on changes in dietary habits and smoking
WellWorks-2[49]	RCT at the worksite level	+	NA	NA	Study on the effects of an integrated health promotion and health protection intervention on participation in health promotion programs as well as programs to reduce exposures to occupational hazards. This study also showed improvements in occupational safety outcomes
Healthy Directions/Small Business[50]	RCT at the worksite level	+	NA	NA	Multilevel study conducted in 24 small manufacturing worksites to study the health impact of an intervention on multiple health behaviors
Tools for Health[51]	RCT at the worksite level	+	NA	NA	Study among high-risk construction laborers to test a behavioral intervention to improve health behaviors (smoking and fruits and vegetables intake)
Dutch low back pain study[46]	RCT at the individual level	+	+	NS	Graded exercise intervention compared to usual care for sick-listed workers with nonspecific low back pain on return-to-work, cost of health care utilization, and cost of productivity loss
MassBuilt Study[52]	RCT and methods development study	+	NA	NA	Smoking cessation intervention with a curriculum that integrated occupational concerns and delivered in collaboration with unions to construction apprentices at 10 worksites
Safety & Health Involvement for Truckers pilot study[53]	Single-group pre-/posttest design	+	NA	NA	A weight loss and safe driving competition for truckers spending a lot of time alone on the job. Competition, computer-based trainings, behavioral self-monitoring, and motivational interviewing techniques were deployed successfully
Office ergonomics and sit-stand workstations[54]	RCT at the individual level	+	+	NA	Investigation of the effects of an office ergonomics training combined with sit-stand workstations on musculoskeletal and visual discomfort, behaviors and performance
Australian sit-stand workstations project[55]	Quasiexperimental design with comparison groups	+	NS	NA	Study on the impact of a sit-stand workstation on sitting time, blood lipids, blood glucose levels, and productivity indicators
Take-a-Stand Project[56]	Two-group pre-/postcomparison interrupted time series study	+	+	NA	Study on the effects of a sit-stand workstation on sitting time, mood states, back, neck, and shoulder pain, productivity, and other office behaviors

NA, not available; NS, nonsignificant change; RCT, randomized controlled trial; +, significant improvement.

TABLE 2. Reviews or Committee Reports on Integration of Worker Health Protection and Promotion Programs

Review Type or Report and Reference	Health Outcomes	Economic Outcomes		Comment
		Productivity Loss Reduction	Health Care Expenditures	
Literature review and framing of an integrated concept[61]	LE	LE	LE	A review article that describes the importance of the need to attend to both personal health practices and organization of work when implementing workplace interventions to promote and protect worker health
Literature review on the impact of workplace-related organizational changes using the health circles model[62]	+	+	NA	A review article that assesses the impact of organizational changes induced as part of the health circles model in Germany on health and well-being and sickness absence outcomes
IOM Committee Report on the NASA program[18]	+	NA	NA	The committee report that articulated the rationale for an integrated approach to worker health and also proposed a structure for the implementation of such an approach
Literature review and analysis[63]	NR*	NR*	NA	Occupational health interventions (defined as programs that eliminate or control hazards, change behavior and skills, or prevent illness or treat disease and related disabilities) and shows that despite the presence of high-quality studies in this area, more research and improved methodologies are needed
Systematic review and best evidence synthesis[64]	Mixed	NA	NA	Purpose of the review was to identify studies evaluating the effect of workplace interventions on visual or upper body musculoskeletal symptoms among computer users
Systematic review and meta-analysis[65]	+	+	NA	Work health promotion conceptualized as an integrated worker health type of program and outcomes considered included well-being, workability, and sickness absence
Literature review[66]	+	+†	+†	The report describes the integration of health protection and health promotion programs, reviews existing literature, and describes various models to integration
Systematic review[67]	+	+	+	Assessment of available evidence to consider whether health and productivity arguments as a result of occupational health and safety interventions make a good business case. Most studies included in this review were OSH studies only and do not meet the criteria for integrated worksite health protection and promotion programs
NIOSH Total Worker Health Report—1[17]	+	+	NA	The report describes the rationale and scientific evidence for IWHPP as a means to enhance the effectiveness of efforts to promote and protect worker health
NIOSH Total Worker Health Report—2[68]	+	+†	+†	The report describes evidence supporting the value proposition for integration OSH and WHP programs
NIOSH Total Worker Health Report—3[4]	+	NA‡	NA‡	The article provides an economic analysis of potential gains—an integrated approach to worker health may yield

*Outcomes in this domain were assessed or studied but no results reported.

†Evidence based on separate health and productivity management-type studies that mostly report on health promotion, disease prevention, or other interventions separately.

‡Results suggest that workplace conditions and health habits both influence health and the interaction appears to be synergistic (indicate positive spillover suggesting economic efficiency).

IWHPP, integrated worker health protection and promotion; LE, limited evidence; NA, not available; NR, not reported; NS, nonsignificant change; OSH, occupational safety and health; WHP, worksite health promotion; +, significant positive outcomes reported.

benchmarks and best practice examples in support of the characteristics identified in Fig. 1. The case examples presented are generally well recognized in the industry as large, progressive organizations that tend to have a history of moving toward integrated solutions that optimize impact and efficiency.

In summary, the case examples report positive health-related and economic outcomes of IWHPP programs. All tend to have strategic measurement approaches in place that allow for ongoing, long-term reporting on key outcomes and integrate their efforts into management systems. Generally speaking, these best practice examples report outcomes that justify more focused research in the underlying factors and causal pathways for the impact of IWHPP approaches to improve health, reduce costs, and optimize performance at work.

PERSPECTIVES ON CURRENT KNOWLEDGE

On the basis of a review of experimental studies, review articles, committee reports, and best practice examples, it is concluded that sufficient evidence exists in the literature to support the contention that IWHPP programs generate improvements in the worker health status. Although emerging evidence indicates that IWHPP programs may generate positive productivity outcomes, the evidence base for health care cost reduction is considered insufficient.

The best practice examples presented in Table 3 recognize a relatively rich "practice-based evidence" foundation. Nevertheless, because an obvious publication bias regarding positive case examples exists, there is a need to interpret these examples with caution. A strong business case may justify the investment into IWHPP

TABLE 3. Case Examples of Single Employer Experiences of Integration of Worker Health Protection and Promotion Programs

Employer and Reference	Comment
3M[69]	Integration of services including, but not limited to, health coaching, on-site seminars, supervisor trainings, behavioral health, employee assistance programs, and occupational health and safety into a comprehensive worker health protection and promotion initiative. Social support and policy initiatives are implemented across the organization to effectively promote health and wellness and protect worker health
Chevron[70]	Initiatives focused on the management of risks to avoid accidents, injuries, and illnesses through highlighting the relationship between health risks and on-the-job injuries. Multilevel and multicomponent programming designed to stimulate culture change including the measurement of business unit-specific progress toward and achievement of health and safety goals
Dell[71,72]	Key safety initiatives are integrated with behavior-based health promotion programs to optimize the impact on worker health. Ergonomic programs, safety training, lifestyle change programs, stretching programs, among others, are directed and implemented through environmental health and safety teams that work in close collaboration with managers and leaders throughout the organization
Dow Chemical[73]	Health and human performance initiatives integrate health promotion, industrial hygiene, employee assistance programs, occupational safety and health, diversity, health benefits, and organizational development initiatives for the purpose of optimizing health promotion and protection efforts. A strong emphasis on measurement has made this an exemplar program with documented evidence of effectiveness
IBM[18]	Global standards for employee well-being and safety are integrated into a management system that ensures the compliance, planning, measurement, and improvement of industrial hygiene, ergonomics, safety, medical, wellness, and preventive benefit programs across IBM business units. The program is well documented and recognized for its excellence
Johnson & Johnson[74]	Long-standing program with strong evidence of effectiveness (both and health and financial outcomes) that integrates safety and health improvement initiatives for its workers. Ongoing evaluation of the program continues to evolve the program as needed and present positive findings
UAW-General Motors[75]	Health and safety—at work and at home—are recognized as a number one priority. The program is integrated across heath, wellness, ergonomics, and safety with strong support and leadership commitment from the company and the union. The program has been well documented in terms of outcomes
USAA[76]	Areas of focus include workplace interventions for worker safety, creation of a culture of wellness, and support for individual-level interventions to optimize health. The program has been evaluated and continues to report significant benefits in health and financial outcomes
Weyerhaeuser Company[77]	Sport science-based program to prevent injury and improve health and performance among tree planters. Highly detailed program designed to increase preplanting season fitness levels and nutrition practices and in-depth documentation of performance (productivity) and injury prevention outcomes

initiatives by employers.[78] Legal, financial, and moral reasons represent the major drivers in decision making to invest and implement programs.[79] On the OSH side, legal considerations tend to be the driving force behind the decision to implement because the achievement of minimal OSH standards is a regulatory requirement for companies. On the WHP side, studies show associations with low occupational injury rates and occupational illness (eg, asthma and cardiovascular disease)[46,47,49,77,80–83] and positive financial impact,[45,84] although controversy on financial impact remains.[40,85,86] Because investment decisions for WHP are rarely prioritized on the basis of legal or regulatory rationale, financial and moral reasons (eg, Soler et al[38] and Pronk[87]) tend to apply here.

Additional research on IWHPP initiatives has been proposed and recommended by others.[2,17] On the basis of the results of this report, emphasis should be placed on high-quality studies designed to show the relationships between integrated programs and economic outcomes. Furthermore, attention needs to be paid to company size and industry type. Large employers tend to be well represented in the research conducted to date. Although some examples exist,[88,89] small employers are represented less although most workers find employment in smaller companies.[89] In addition, clear differences exist between the needs of companies and workers across various industries, such as manufacturing, construction, or health care. These differences range from the type of health problems most frequently encountered (eg, low back pain vs metabolic profiles) to the risk factors driving health issues, the prevalence of sickness absence, the work organization, and the benefits design for workers and their families, just to name a few.[2]

The integration of efforts to protect and promote worker health is undoubtedly important. Nevertheless, tools to measure integration remain elusive, which creates challenges for implementation and management. A clear need exists to define, measure, evaluate, and validate integration methods. As stated earlier, integration is more than merely adding worker health protection and promotion efforts together; it reflects shared commitment, goals, and objectives for worker health. Integration reflects strategic and operational activities that extend into deliberate and intentional interactions, partnerships, and interdependencies of efforts to protect and promote worker health. Sorensen and colleagues[90] present a discussion on defining and measuring an integrated approach to worker health and outline a set of seven indicators of integration considered along a continuum. Important next steps include the testing and refinement of the proposed measures, the consideration and recommendation of operational implications and guidance, and the dissemination of results to support organizational adoption.

To deliver on the promise of IWHPP programs, it will behoove all stakeholders involved to collaborate more vigorously toward the creation, adoption, implementation, and maintenance of such programs.[91] The stakeholders include human resources, OSH, and WHP professionals, but the roles of others such as employee assistance providers, health plan administrators, on-site care delivery providers, and community-based partners should be recognized as well. Whereas incentives such as health care cost containment, improved health and well-being, and reduced financial liability exist for IWHPP programs,[91,92] the lack of a compelling business case that justifies resource investment remains a significant challenge.[93]

Future research should address these concerns and base specific hypotheses on information gathered directly from the stakeholders using both qualitative and quantitative methods.

CONCLUSIONS

The integration of worker health protection and promotion efforts is an area of emerging importance. Existing evidence supports an integrated approach in terms of health outcomes but will benefit significantly from research designed to strengthen the business case for employers of various company sizes and industry types.

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Integrated Health Programs, Health Outcomes, and Return on Investment

Measuring Workplace Health Promotion and Integrated Program Effectiveness

Martin Cherniack, MD, MPH

Objective: To explore return on investment (ROI) in workplace health promotion studies. **Methods:** Studies with high ROI attribution for workplace health promotion were reanalyzed using standardized measures. Key variables included intervention duration, sector and population size, annualized cost, and health outcomes. **Results:** ROI was often overestimated. Programs with the highest reported ROI were concentrated in large corporations, where cognitive programs incurred low per person costs. Ten of the 12 studies involved individualized health promotion only, and did not engage work organizational modification or integration with occupational health. Some effective health interventions were discounted because they were not easily monetized. **Conclusions:** ROI, an investment metric, amplifies short-term labor-related effects and discounts longer-term chronic disease prevention.

The Patient Protection and Affordable Care Act of 2010 presumes that incentive-oriented worksite health promotion (WHP) provides a critical pathway to reduced group health costs. The so-called *business case*, the short- or intermediate-term return on investment (ROI), is plausibly supported by published literature. In a heavily cited review of ROI estimates from WHP programs, Chapman quantified 42 epidemiological studies representing 537,319 employees, observed for an average of 3.6 years.[1] The case seems overwhelming for the effectiveness of modestly costed lifestyle interventions. In 20 of the 42 studies, absenteeism was reportedly decreased, with an average incidence or cost reduction of 30% (22.3% to 38.4%). Group health costs were reportedly reduced on average by 21.8% (12.7% to 31%). Two subsequent updates reinforced the earlier results.[2,3] Nevertheless, employers and insurers seem to have taken a cautious approach to this evidence base.[4]

Plausible explanations for diffidence include slow adoption because of limited knowledge dissemination; the distraction of potential innovators in a time of economic contraction; the long-term perspective needed for chronic disease mediation; and the unavailability of concise health performance metrics, which chronologically parallel more customary measures of output.[5] Goetzel and Ozminkowski[6] make the case that the major obstacles to implementation of WHP reflect the limited dissemination of information and incomplete implementation. Although information-based barriers to dissemination and adoption are increasingly understood,[7] a contrarian viewpoint would note that North American workplaces are not especially resistant to reorganization or process change. Investments in workforce retraining and in new software adoption are documented in the business literature, despite limited evidence for ROI.[8,9]

From the Ergonomics Technology Center, University of Connecticut Health Center, Farmington, Conn. Dr Cherniack is currently receiving a grant (5U19OH008857, Center for the Promotion of Health in the New England Workplace) from NIOSH, Total Worker Health Program.

The author declares no conflicts of interest.

Address correspondence to: Martin Cherniack, MD, MPH, Ergonomics Technology Center, University of Connecticut Health Center, 263 Farmington Ave, MC-2017, Farmington, CT 06030 (cherniack@.uchc.edu).

DOI: 10.1097/JOM.0000000000000044

In addition, there is conflicting evidence. In a nationally cited article in *Health Affairs*, Gowrisankaran et al[10] evaluated a program for hospital workers that included many components of a model program: a health risk assessment (HRA), participation in wellness activities, health fairs, disease targeting, extensions to families, and health insurance subsidization of $1647. Over 2 years, 82% participated; admissions for targeted conditions fell by 41%; and hospital admissions decreased by 12%. Nevertheless, there was no reduction in benefits costs, thus obviating the utility of the program investment. The authors did not explain the anomaly of reduced utilization and increased costs. Cherniack and Lahiri[5] explained why effective prevention might not lower benefits costs, because of costly replacement technology and cost shifts by capital-intensive medical organizations.

Diffidence does not prove ineffectiveness. Adult life is significantly centered on the workplace in terms of the allocation of time and life demands, environmental health factors, and group health financing. The evidence base for preventive interventions is substantial. The associations between reduced metabolic syndrome components and cardiovascular disease risk and between blood pressure control and stroke are fluent in their preventive message. The success of the National Diabetes Prevention Program in reducing the progression of prediabetes to diabetes by as much as 70% through lifestyle alteration and health coaching has been replicated.[11,12] Although more arcane, the Whitehall studies on the association of work organizational relationships with cardiovascular disease have informed the corporate policy.[13–15] Finally, the dramatic reduction in work-related cancer risks through national regulation of workplace carcinogens[16,17] and secondarily through smoke-free workplace policies[18] represents a public health success in industrial countries, albeit a success that was hard fought in the United States. Furthermore, traditional occupational health and safety and ergonomic programs directed to the organizational level are recognized for their positive effect on health outcomes.[19] These accomplishments within the field of occupational safety and health deepen the mystery around less-than-vigorous adoption of WHP in the integrated National Institute for Occupational Safety and Health (NIOSH) Total Worker Health format.

When health outcomes are separated from investment, there are variables but positive results for WHP. A review of 316 studies that evaluated WHP programs found positive results for weight control, borderline positive results for nutrition, exercise and cholesterol management, and weak results for health risk appraisals.[20] Other literature reviews have reported overall positive impacts of worksite programs,[21,22] but equivocal success in changing lifestyle characteristics such as dietary habits or physical activity.[22,23] Although only the study by Dishman et al[22] was a formal meta-analysis and was restricted to a single outcome (fitness), these reviews were well constructed and selective. They included all eight studies selected for this article, published before 2001.

In the contemporary workplace, where cost and value are explained as symmetrically associated through the intelligent factoring of markets, health effects are either an externality or a measured investment in the generation of value. This differs from the native world of the eighteenth-century classical economics, where the

wealth of the nation was envisioned as a direct translation into the health of individuals. Thus, the stipulation for "making the business case" presumes that individual health may bear on work, but is not in itself central to work. This article is offered as a clarification of the problems inherent in making the business case for WHP and also suggests an alternative direction. It addresses ROI through a structured reanalysis of the methods and outcome estimations of major national studies that substantiate the positive ROI argument.

METHODS

Criteria for Review of Prior Studies

ROI calculations are assessed through the detailed reanalysis of the 12 studies reviewed by Chapman that had the highest reported ROI. Chapman provided a score on the quality of the studies, which was not included, the emphasis being on the reported ROI, not the quality of the Chapman analysis. The ROI in the 12 selected studies varied from 3.4 to 15.6. Two studies that were included in the Chapman analysis were excluded from this analysis, although they fell within the reported ROI range. Specifically, a study by Leigh et al[24] (ROI = 4.73) was excluded because it only involved retirees, and a study by Chapman et al[2] (ROI = 6.52) was excluded because it has not been published. Table 1 lists the common variables that were used in this reanalysis.

For reanalysis, the following general precepts were followed:

1. Specific group health costs (direct costs, estimated costs, econometric projections) were included.
2. Where long-term health care cost and utilization information was available on a comparable nonintervention population, savings trends were corrected.
3. Populations not targeted by identified interventions were removed from both cost and outcome determinations, thus restricting ROI calculations to the target population.
4. Calculations of ROI that were purely estimates, not directly derived from data, were excluded.

The ROI is defined as a standardized monetization of diverse outcomes that include the valuation of absenteeism, group health costs, and/or productivity. The health outcome is not distinguished by comparative costs with another health intervention, as in cost–benefit analysis, or as a nonmonetized change in status, as in cost-effectiveness analysis. Rather it is treated as an investment that would include indicators such as net present value, internal rate of return, and payback period. The ROI calculation in this analysis is not milieu specific and does not readjust for inherent differences in outcome characteristics.

TABLE 1. Variables Used in ROI Calculations

Variable Name	Variable Description
Population	Characterization of the workforce by site and industry
Design	Key characteristics of the study design: on-site or off-site, cognitive or practice driven, national HRA or locally designed instrument
Goal	A priori single or multiple expected outcomes
Participants	Number of workers participating
Duration	Length of the intervention
Absenteeism	Whether measured or included as an outcome
Productivity measure	How productivity was used as an outcome measure
Medical cost reduction	Whether and how group health costs were assessed
Costs annualized per person	Annualized WHP per person costs in the target population
Productivity savings	Estimated monetization of productivity savings
Avoided costs	Health and productivity costs reduced during the intervention
Savings annualized per person	Calculable net costs on a person basis
ROI (Chapman)	Reported ROI in the Chapman reviews
ROI (recalculated)	Recalculated ROI based on criteria explained in this text; ROI was the annualized per person savings/annualized per person cost

HRA, health risk assessment; ROI, return on investment; WHP, workplace health promotion.

RESULTS

Studies With Most Positive ROI

Table 2 lists the studies used in this analysis. The most impressive results involved City of Birmingham workers (study 1) where health costs were compared with a state average from 1985 to 1990.[25] A direct staff model of services was coupled to screening and health counseling. The authors did not themselves offer an ROI estimation, which was acknowledged by Chapman.[1] Although Chapman did not describe the basis for the reported ROI ratio of 19.4:1, it seems to be the ratio of the City of Birmingham's employee health care interval cost differential between program inception in 1985 and 1990, the most favorable year for cost reduction, the latter being, compared to the annualized direct cost operating budget of $400,000. If the 5-year comparative average costs are annualized and compared against program expense for all program years, the ROI is 1.5:1. Given that health promotion interventions may require an induction period for acceptance or effect, weighting toward the final year of observation may be legitimate. More importantly, there were major changes in health care service organization, which were fully acknowledged by Harvey et al.[25] Health Maintenance Organization (HMO) representation went from 0% to more than 90% from 1985 to –1990; duration of hospital stays declined by 72%; and the number of admissions declined by 63%. The authors of the Birmingham study are guarded in their assessment of the contribution of health promotion to reduced group health costs, attributing the majority of the change to revisions in the health care delivery system. It is not unreasonable to assume that over a relatively short 5-year interval, a dramatic systemic reform will affect costs more substantially than WHP. In addition, although the program is categorized as WHP, there were no actual workplace interventions and no analyses of participant versus nonparticipant differences in utilization.

The next most impressive ROI (15.6%) in study 2 was reported by Aldana et al.[26] It cites reduced absenteeism costs totaling $3.04 million among school personnel over a 2-year interval. In all, 2401 members of a school district participated in an insurer-provided and electronically accessed wellness program. They were compared with 2309 current and retired nonparticipants. Participants averaged 14.7 absentee days a year, whereas nonparticipants averaged 15.4 days. The ROI is based on an apparent estimation of replacement costs compared to modest program expenses of approximately $100,000 per year. The program also included data on group health claims costs, but the results were not included in the cost–benefit analysis. Even with estimated reduced participant cost of less than $50 per person, the estimate of monetary benefit seems overgenerous. Daily personnel replacement costs were estimated at $103 to 306 ($231 for lost wages + $75 for replacement). Although it is arguable that sick time should be categorized as a net cost, in this reanalysis of ROI, the cost was accepted but the retiree population was removed from the cost per person calculation, because their inclusion produces a

TABLE 2. Studies and Key Variables Included in the Analysis

Study	Authors	Population	Design	Goal	Participants	Duration	Absenteeism	Productivity Measure
1	Harvey et al[25]	Municipal workers	Staff model interventions	Multiple	4,000	5 yrs	ND	ND
2	Aldana et al[26]	School employees	Electronic media	Multiple	1,407	5 yrs	↓0.7 d/yr	ND
3	Henritze et al[27]	National brewery	Life check/wellness center	Multiple	692	8 wks	ND	ND
4	Shephard et al[28]*	Insurance corporate offices	On-site fitness	Medical claims data	534	1 yr	ND	ND
5	Shephard[29]	Insurance corporate offices	On-site fitness/ screening/cognitive	Multiple	400	6 yrs	ND	Estimated
6	Stave et al[30]	Pharmaceutics	Stages of change contract	Multiple	1,275	3 yrs	↓1.0 d/yr (30%)	ND
7	Fries and McShane[31]	General employed	HealthTrack cognitive	Medical visits	50,576	1 yr	ND	ND
8	Ozminkowski et al[32]	Bank employees Citibank	HealthTrack cognitive	Multiple	11,194	~3 yrs	ND	ND
9	Golaszewski et al[33]	National insurance company	HRA/site activities/wellness centers	Estimated costs based on life-years	~30,000	15 yrs	ND	Quantified
10	Mills et al[34]	Consumer products	HRA, portal, and classes	Multiple	618	1 yr	↓4.3 d/yr	Anamnestic
11	Hall-Barrow et al[35]	Hospital workers	Staff model/educational	Worker's compensation; absenteeism	3,000	1 yr	↓50/person/yr	ND
12	Dalton and Harris[36]	Telecommunications company	Direct integrated, multilevel	Health care cost reduction	158†	4 yrs	↓48%	ND

Study	Medical Cost Reduction‡	Cost/Annualized per Person	Productivity Savings	Avoided Costs, $	Savings Annualized per Person, $	ROI Chapman	ROI Recalculated
1	3	600,000/45	ND	902,000	207	19.4	1.5
2	3 NS	<100,000/42	ND	1,500,000	214	15.6	5.0
3	2	64,841/94	ND	ND	ND	10.1	ND
4	1	ND	ND	106,918	52	4.9	6.9
5	3	587,600/1,414	ND	136,000	340	ND	ND
6	3	~127,500/100	ND	1,670,000	313	6.1	2.6
7	3	1,500,000/30	ND	4,398,000	87	6.1	2.9
8	1	590,000/53	ND	~2,200,000	143	4.6	3.7
9	1	4,000,000/309§	55%	10,000,000	200	3.4	2.5–3.3
10	2	85,300/138	91%	919,500	1,490	6.2	1.9
11	4	104,000/34	ND	152,000	50	8.0	1.4–8.0
12	2	ND	ND	ND	ND	7.1	ND

*Adjusted to 1990 dollars.
†Pilot only.
‡Medical costs: 1, econometric projection on the basis of intervention; 2, not calculated; 3, group health utilization; 4, reduced worker's compensation/absenteeism costs.
§Includes gym costs to the employee.
HRA, health risk assessment; ND, not determined; NS, determined but not significant; ROI, return on investment.

dilution effect in analyzing absenteeism. By removing retirees, the annual additional absenteeism costs associated with nonparticipation would amount to $214 a year per employee or $495,000 a year. The residual 5:1 ROI is still impressive, and may represent a legitimate achievement, although a final determination on cost utility would necessarily require a longer-term systemic evaluation of attendance and absenteeism in the participating population. Assessing cost savings on the basis of absenteeism in a selected population is somewhat problematic for occupations where professional absenteeism is built into the cost structure. For teachers, a retained substitute/replacement group is often maintained as a permanent reserve educational workforce, and reimbursed at a replacement rate that is below standard pay.

The study by Henritze et al[27] (study 3) involved an evaluation of health effects from an 8-week relatively intensive program. There were slight positive directional changes in weight and physical activity, and 6% reduction in the Framingham risk score for initial cardiac event. Nevertheless, there was no attempt to monetize these changes, which was the appropriate decision, given the type of data that was collected. For that reason, no ROI reanalysis is offered.

The studies on Canadian life insurance home office employees by Shephard et al[28] and Shephard[29] (studies 4 to 5) address the effectiveness of a fitness center and a cognitive WHP program. A complication of the two studies is that the first-year data (1978) involves preinflationary start-up costs, so both reports have been standardized to 1990 dollars in Table 2. The authors estimated that ROI was 6.85 at initiation when participation was high and there were no exercise facility rental costs. Nevertheless, the component of avoided costs rested on a differential between 1977 and 1978 health care costs in a Canadian and American office. Curiously, nonparticipants in the Canadian home office had a larger decrease in health care costs during the WHP project than active participants, although the absolute cost difference was continuously lower for the participant group. By 1984, the participation rate had dropped to 13% and physical performance improvement had plateaued, although the authors did not account for age-related performance reduction. The authors observed a minimal company-wide effect on absenteeism (−0.13%), in part because the small group of active participants seemed to have had a low level of absenteeism at baseline that was maintained. They estimated that at 6-year reduced absenteeism and estimated improvements in productivity half of the first year estimates, with similarly less impressive returns from health care cost reduction. When actual use costs for the on-site facility were calculated in 1990 dollars, they estimated that costs ($1414 per participant) exceeded benefits. Contrary to Chapman's conclusion, the author interpreted their results as not justifying long-term investment in WHP. Nevertheless, the project costs are distorted because the opportunity cost was based on conversion from a subsidized to a market rental rate in a costly metropolitan center. Moreover, participation rates were consistently low over time but also consistently maintained among a small adept group. In the reanalysis, the authors' original short-term ROI estimate is accepted, and the Shephard et al's[28] interpretation of long-term ROI as less than 1:1 was not reinterpreted. There is a more positive case that can be made. A first floor exercise facility in a city center that engages even a small sector of the workforce can be a successful investment if the scope of a cost–benefit analysis is narrowed, because office space costs and company interest and subsidization can wax and wane over intervals that are considerably longer than the induction period for chronic diseases. Contrarily, a small number of highly motivated individuals who are generally healthier than coworkers may not require on-site incentivization.

The study by Stave et al[30] (study 6) involved 3-year cognitive stages of change program/contract, which tracked 1275 participants over 10 years. The ROI of 6:1 is an approximation on the basis of estimated yearly cost savings of $713 per participant. A breakdown of actual program costs is not reported; the authors' $100 per person estimate is accepted. The data allow for a more quantitative and appropriate estimation of cost reduction because costs for health care, disability, and worker's compensation are available for a comparison group that did not participate in WHP. The nonparticipant population seems a more appropriate comparison group than the within-cohort assessment used in the ROI calculation. When the nonparticipating group is used, total annual per person savings seem to be less approximately $213, an approximate 9% reduction in health care costs. Worker's compensation costs were also higher in the nonparticipating group. The ROI ratio, although still impressive, is reduced to 2.6:1, less than half of the published estimate.

The study by Fries and McShane[31] (study 7) is not based exclusively on a working population but instead on a high-risk general patient population group. When the analysis was restricted to the employed subcohort, the ROI was smaller (2.9:1) as reported in Table 2. Moreover, the estimated program cost ($30 per person per year) is low because the intervention was primarily computer based.

Study 8 by Ozminkowski et al[32] involved more than 20,000 Citibank employees. Using simple annualization, the reanalyzed ROI was 20% lower than was reported by Chapman, a difference that is sufficiently small that it does not distract from the original conclusion. More serious limitations stem from outcome estimates that were econometric projections, on the basis of presumed changes in health care utilization patterns. These changes were not externally measured but were presumed from reported results on an HRA (HealthTrack). There was no validation procedure to determine whether the presumed monthly differential in health care costs ($42→$77) for participants versus nonparticipants was actual or an anamnestic artifact associated with re-evaluation after the administration of a cognitive program.

Golaszewski et al[33] (study 9) took a more sophisticated approach to estimating health care cost reductions over a 15-year interval in a corporate wellness program that included an HRA and an on-site health facility (annual out-of-pocket employee cost of $179). More than half of the benefit of the program is attributed to productivity gains. Nevertheless, productivity gains were not observed, but estimated from the available literature. Furthermore, the ROI was assessed to be 25% higher in nonparticipants on the basis of productivity gains, although this may be misleading because the participant category was sufficiently broad to encompass the greater part of the workforce. The inverse relationship between participation and cost savings calls the methodology into question. Even more important, the project had only 4 years of observation with savings from 1990 to 2000 being projections. The projected ROI in 2000 was higher than the observed cost–benefit ratio in 1990; hence, the estimate in this analysis of 2.5 to 3.3 reflects the differential of observed and extrapolated costs. Some problems with basing ROI calculations on productivity are addressed in the Discussion section.

Study 11 by Hall-Barrow et al[35] presents a different interpretive problem. There was a broad employee health initiative that included pre-employment and annual evaluations and screening, a worker's compensation cost reduction program, and WHP classes and materials on nutrition, smoking cessation, accident avoidance, and stress reduction. The reported 8:1 ROI is based on a presumptive first-year savings of $817,000, 81% attributed to a reduced worker's compensation claims and 19% to reduced lost work time. Although the combination of workplace health and safety with health promotion represents integration, the primary savings came from changes in worker's compensation policy and reporting frequency, not from WHP. Reduced worker's compensation costs were due to a 17% drop in payment for claims. Restricting outcomes to lost work time alone reduces the ROI to 1.4:1, which is perhaps too parsimonious. Because cost reductions may reflect either decreased risk or higher barriers to reporting, it is unclear whether costs were avoided or transferred. Chapman[2] recognized problems with this study and gave it a low meta-evaluation priority score, but residual questions remain

on whether administrative change rather than health change can be meaningfully included in a study of ROI.

DISCUSSION

Programs with the highest reported returned value for the WHP investment share a common feature—the very low per person annualized cost. They are sited in large corporations or organizations—where company-wide or global policy tends to decant around conventional commercial programs—that administer and interpret conventional HRAs and software-enhanced interventions. Notably, the four representative low per person cost studies presented in Table 3 are characterized by telephonic, electronic, and cognitive interventions. In almost no cases were there attempts to integrate WHP with the consideration of physical demand, scheduling, or work organizational changes. Workforce participatory programmatic review, let alone participation in design of interventions, was generally absent. Accordingly, the positive net-cost determinations whether from Chapman's report or from this revision involve marginal input costs. Only the study by Mills et al[34] involved annualized per person costs that exceeded $100, and had the lowest ROI. An additional feature is that intervention success was often based on improved productivity, assessed by self-report and occurring in a service sector where productivity measurement has been elusive.

Another important feature of these studies is a singular concentration on personal behavior and the almost complete absence of workplace interventions that NIOSH terms, Total Worker Health™ (http://www.cdc.gov/niosh/twh/).[37,38] The program described by Dalton and Harris[36] (study 12) stands out because of multiple levels of intervention: changes in the work environment, tripling participation in a Health Maintenance Organization (HMO), developing health and safety programs, providing on-site primary care services, and providing on-site nurse-directed counseling. There was little change in fitness as surveyed in the pilot group by questionnaire, although there were small positive changes in blood pressure and VO_2 max. Smoking and work stress were reduced, as was severe hypertension. There were a number of positive trends around hospital admissions and changes in treatment patterns. No cost–benefit analyses or even estimates of program costs were projected. Chapman[2,3] reported a cost–benefit ratio of 7:1, an observation that is misleading and not representative of the rigor of the study. There was a short paragraph describing the provision of on-site primary care medical services. The authors estimated $1.2 million in indirect benefits, thus providing a cost–benefit ratio of 16:1, but the nature of these benefits and the coefficients are not provided. On-site medical care had clear lost time saving benefits for the employer, but is not the basis for an overall ROI estimation; selecting a nonrepresentative ROI number does not do justice to a carefully conceived report that recognized many long-term changes in health care that may have influenced results. Perhaps the most important conclusion is that an integrated and comprehensive intervention program does not lend itself to a simple ROI calculation.

Chapman concludes, "Worksite health promotion represents one of the key strategies for maintaining the productivity of American workers at a time when their average age is increasing faster than most of our global competitors." The rationale for reconsideration of the Chapman studies is based on the assumption that the reduction of interventions to a single ROI may overlook contingencies and findings that generate different conclusions. In these 12 high ROI studies, the errors almost uniformly result in overstatement of ROI. Although there may have been some optimized presentation of results by Chapman, the more basic problems are structural. They are related to systemic problems with meta-analyses and to the application of ROI to health outcomes, which are often better evaluated in terms of comparative effectiveness rather than through monetization or monetization surrogates. Stated differently, the accounting of avoided costs and the reduction of projected health changes

TABLE 3. Estimating Cost-Effectiveness of Cognitive Interventions

Authors	Population	Design	Participants	Time, yr	Productivity Measure	Medical Cost Reduction*	Cost per Person/ Annualized, $	Productivity Savings	Savings per Person/ Annualized, $	Recalculated ROI
Aldana et al[26]	School employees	Electronic media	1,407	5	ND	3 NS	42	ND	214	5
Fries and McShane[31]	General employed	HealthTrack cognitive	50,576	1	ND	3	30	ND	87	2.9
Ozminkowski et al[32]	Bank employees	HealthTrack cognitive	11,194	~3	ND	1	53	ND	143	3.7
Mills et al[34]	Consumer products	HRA, portal, and classes	618	1	Self-report	2	138	91%	1,490	1.9

*Medical cost reduction: 1, econometric projection from reduced risk factors; 2, not calculated; 3, group health utilization, estimated.
HRA, health risk assessment; ND, not determined; NS, determined but not significant; ROI, return on investment.

because of preventive interventions into simple monetary units is a complex procedure and also sufficiently specific to workplace sectors and populations. The ROI is not a unit-less vector. The methods involved in attributing costs, monetizing health outcomes, assessing relative effectiveness, and accounting for long-term trends in group health costs may require a nuanced application of cost-effectiveness. An additional and fundamental problem affecting semiquantitative aggregated reviews is homogenization of key outcomes and cost variables that cross noncomparable interventions and populations. A meta-analysis that associates outcomes as diverse as long-term group health costs, workplace productivity, and estimated cardiovascular disease risk will flounder over concrete variables, such as absenteeism, because replacement costs cut variably across different occupational sectors. Thus, the formulaic satisfaction of a priori categories, such as absenteeism or even worker's compensation utilization, when stripped of the context, will tend to aggregate noncongruent cost variables when studies assess different populations with context-specific interventions. This amplifies the problem of linking outcomes to dissimilar explanatory variables, when the outcomes themselves are unstable. The selection of a global ROI estimate may isolate the most positive appearing statistical associations from a diversified intervention.

These hazards are reflected in the 2012 weight loss study reported by Lahiri and Faghri[39] (Table 4). A participatory weight loss intervention involved incentivized and nonincentivized nursing home workers. The 6.3:1 ROI reported by the investigators requires interpretation. A cost–benefit analysis might presume a 3:1 efficacy for incentivized weight loss. Nevertheless, the ROI representation would be more discouraging, as the cost of incentivization would not seem justified in terms of the monetized outcomes. The two outcome measures used for the ROI calculation—absenteeism and productivity—pose different dilemmas. This nursing home workforce had low rates of baseline absenteeism. The productivity measures were anamnestic, provided by line workers and requisite supervisors. A more objective outcome measure, such as reduced infection rates and costs in patients, has been adopted only sporadically in the nursing home sector of health care. Accordingly, if productivity was removed from the equation because of uncertainty, the ROI would be bleak and not justify programs that actually seemed to have quite positive health outcomes. The example only restates the well known problems associated with estimating productivity in health care work.

Cost-effectiveness ratios may be relevant for evaluating interventions in terms of health benefits, but ROI or monetary-based valuations (if computed accurately) are important for decision makers in the private sector, responsible for implementing WHP intervention and allocating resources to WHP. Nevertheless, such ROI calculation would require prospective studies that would measure costs and benefits of WHP accurately from each of the relevant stakeholder's perspective and help bring about an alignment of incentives to overcome barriers to implementation of WHP interventions. The following examples serve to question whether a *business case* for preventive health interventions can be made realistically through observations and generalizable measures that must conform to a short-term investment cycle. The term "business case" is highlighted because the term's ubiquity essentially strips it of putative meaning. In Table 5, two of the 12 studies that were reanalyzed[33,34] are grouped with two recent illustrative studies—from Lahiri and Faghri,[39] and a Kaiser Foundation study on hotel workers in Hawaii by Meenan et al.[40] The latter study is included because of its detailed economic analysis and a priori experimental design. Like Lahiri and Faghri,[39] it included costs of absenteeism, presenteeism (productivity loss), and group health costs. The four studies are illustrative because they attempt to provide cost justification in terms of worker productivity, which is a frequent denominator in making the *business case.*

The authors acknowledged the difficulty of productivity estimates on the basis of measurable output. The simplest approach was to align a combination of self-assessment of performance and external observation as coefficients of usual pay and performance. Lahiri and Faghri[39] monetized productivity by attempting to quantify task-specific changes with self-report and supervisory confirmation, using the current wage rate to estimate a marginal productivity gain. Mills et al[34] addressed the problem of administrative and service

TABLE 4. Net-Cost Model for Weight Loss in the Nursing Home Sector

	Average Subject Cost, $	Average weight loss, lb	ROI (Productivity + Absenteeism)	ROI (Absenteeism Only)
Incentivized group ($n = 51$)	129	7.3	6.5	0.2
Nonincentivized group ($n = 48$)	97	2.1	6.6	0.6

ROI, return on investment.

TABLE 5. Contributions to ROI in Studies Using Productivity Estimators

Study Identification	Productivity Measure	Calculation	Result	Net Effect	Effect on ROI
Meenan et al[40]	Self-report	Presenteeism + absenteeism	Presenteeism ↓ Y2 Y1 ±↑	No net effect	No effect
Lahiri and Faghri[39]	Self-report	Productivity + absenteeism	Productivity 80% of avoided cost	↑↑	80% of effect based on productivity
Mills et al[34]	Observed absenteeism Self-report productivity	Productivity + absenteeism	↓0.36 d lost ↑10.4% productivity	↑↑	72% of effect based on productivity
Golaszewski et al[33]	Productivity based on literature	Sensitivity at 4% productivity gain (STD), 0% and 25%	ROI 4.0 at 4% ROI 1.4 at 0% ROI 14 at 25%	↑↑	65% of ROI based on productivity

ROI, return on investment; STD, short-term disability.

work by assigning the value to performance change. In both settings, the high value attached to productivity improvement cannot possibly be linked to conventional measures of productivity involving revenue gains or staff decimation. At best, the measures reflected positively on well-being of nursing home and insurance company workers, important but tangential to what is usually meant by a business case. The paradox of the productivity argument is that salaried and/or service workforces, the usual populations cited in this literature, are notoriously difficult to assess. For corporations operating in a multisite, even international milieu, the allocation of resources and the measured outcomes are more general than those faced by the public sector or by smaller employers, where stability of employment and long-term engagement with the workforce are prevalent concerns. Unless the measurement goal is firmly defined, a generic productivity measure cannot provide quantitative resolution. Furthermore, large nonindustrial employers often have the capacity to negotiate group health directly through self-insurance and scale. They can also rapidly introduce or retract programmatic change without putting operating budgets into jeopardy, or inducing nonabsorbable effects from changes in workforce morale.

The problem that comes from applying universal WHP measures across sectors is highlighted in the study of Meenan et al.[40] Cost reduction from weight loss was based on projected decreases in cardiovascular disease risk stratification and reduced future health care costs. There were high program costs without noticeable gain. A dollar spent on WHP produced 2 cents in projected health improvement, little change in weight, and increased absenteeism. There could hardly be a more negative case. There is, however, an underlying context. This was a low-wage workforce ($15.86/hr) that had an estimated 2-year turnover rate of 55.4%, and differs by virtue of income and flexibility from most of the corporate office staffs, which are summarized in this analysis. Although the content of aptness of a WHP program can always be criticized for its applicability, the "3W" program used on the hotel worker population was specifically designed by Kaiser Permanente for this workforce and included on-site and classes as well as a cognitive program.[41]

Although the term "return on investment" might seem appropriate directed to a financial officer, sonority does not resolve the issue that health benefits, and even organizational benefits, are not congruent with performance measures such as output, absenteeism, or reduced labor unit costs. Furthermore, improving workforce health in many cases requires organizational engagement in work-life quality, and almost always requires the longer-term perspective of risk factor reduction and chronic disease management. Evolving changes in health care delivery and financing are more likely to produce savings or losses in the short and intermediate terms than effective prevention, and the incumbent employer may see no direct benefit. The study by Gowrisankaran et al,[10] published as a refutation of ROI from WHP, demonstrates almost the opposite. Reduced morbidity and hospitalization for targeted primary diseases was as remarkable as the inability to lower associated health care costs because a rational market should convert lowered demand to cost reduction. That, of course, presumes that health care markets behave rationally.

If not ROI, then what? First, investment-return ratios related to operations should be routinely separated from analyses that involve health care costs and health effects. Second, health outcomes should be assessed in more traditional public health formats, involving cost-effectiveness or cost-utility approaches. Finally, if we accept that health care costs are indirectly associated with health, and that quality of work, quality of life, and reduced impairment have an intrinsic value, then the solution is a different type of assessment instrument, whose units permit a professionally directed translation into costs. The quality-adjusted life year and the disability-adjusted life year are steps in this direction, but the task before the Total Worker Health™ research community is for a more translatable metric.

CONCLUSIONS

A set of conclusions that are implicit in this analysis of ROI are as follows:

1. Workplace health promotion will likely be ineffective in a difficult and unstable work environment where there is little worker autonomy.
2. There is little rational basis for comparing dissimilar workforces through a contingent index of effectiveness such as ROI.
3. The concept of ROI in a workplace health intervention is incongruous with the more usual approach in health research of comparative effectiveness, where interventions are compared between nonmonetized outcomes, or comparable outcomes are assessed by comparative program costs.
4. There are insufficient econometric tools to enable the evaluation of preventive expenditures in the workplace on long-term, multilevel health outcomes.
5. Effectiveness in health interventions and ROI calculations are often incongruent. Reduction of chronic disease burden does not necessarily reduce health care costs, and long-term benefits may be recognized after work tenure has ended.

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Employer Health and Productivity Roadmap™ Strategy

Michael D. Parkinson, MD, MPH

The National Institute for Occupational Safety and Health Total Worker Health™ Program defines essential elements of an integrated health protection and health promotion model to improve the health, safety, and performance of employers and employees. The lack of a clear strategy to address the core drivers of poor health, excessive medical costs, and lost productivity has deterred a comprehensive, integrated, and proactive approach to meet these challenges. The Employer Health and Productivity Roadmap™, comprising six interrelated and integrated core elements, creates a framework of shared accountability for both employers and their health and productivity partners to implement and monitor actionable measures that improve health, maximize productivity, and reduce excessive costs. The strategy is most effective when linked to a financially incentivized health management program or consumer-directed health plan insurance benefit design.

Employers, organizations, and the US economy generally are under increasing global pressure to improve performance, optimize efficiency, and deliver value. The National Institute for Occupational Safety and Health Total Worker Health™ program acknowledges the unprecedented issues that employers face and the role that an integrated approach to "occupational safety and health protection with health promotion" can play in creating healthier, high-performing workforces.

Over the past 30 years, the body of evidence supporting the need for an integrated approach to employee health has grown. Beginning with the work of Edington,[1] numerous researchers and business leaders have explored the relationship between health behaviors and health care risks and total worker productivity costs.[1–6] Similarly, studies of major corporations' culture, total compensation, and benefits-related policies and practices have shown that alignment of financial and other incentives from the "C-suite" to the employee level in the workplace is key to optimal organizational and financial performance.[7] Total health management to produce maximal vitality, productivity, and even corporate survival is increasingly recognized as a business imperative—not a "nice to do."[8] A definitive literature review of 28 studies concluded that well-designed worksite wellness programs can be cost-effective, generating $3.27 in medical cost savings and $2.73 in absenteeism reductions on average for every dollar spent on employer-based health promotion activities.[9] A more recent analysis of workplace wellness programs mandated by the Patient Protection and Affordable Care Act demonstrated the widespread employer use of health assessments, biometric screenings, coaching programs, and disease management interventions and concluded that resulting behavior change (particularly longer term) and return-on-investment results were mixed.[10] The distinction between "direct" health care cost savings and so-called "indirect" productivity-related costs (absenteeism, disability, workers' compensation, presenteeism, etc) is increasingly being blurred, because employers realize that unhealthy and distracted employees working in suboptimal or unsafe worksites are a risk to themselves and to the economic competitiveness of their company.

The earliest effort to define a unifying approach to integrated employee health that "bridged" the traditional "siloed" approach to health protection and health promotion was embodied in the Institute of Medicine report "Integrating Employee Health: A Model Program for NASA."[11] This framework was translated into more generalizable approach for all employers and organizations by the National Institute for Occupational Safety and Health[12] and the American College of Occupational and Environmental Medicine.[13] Critical to the Institute of Medicine report was the definition of a "healthy workforce" in practical and measurable terms (Table 1). These characteristics can assist employers to define goals, implement strategies, and execute policies, programs, and tactics to improve the health and performance of their employees.

As good as these models are, however, they lack a comprehensive strategy to incorporate and address (1) the epidemiology or true "determinants" of what causes poor or good health, disease, and disability; (2) the financing of health care through emerging insurance and benefit designs; and (3) innovations in the delivery of medical care. In short, how can employers "put it all together" to proactively address the core drivers of poor health, excessive medical costs, and lost productivity, leveraging best practices in aligned incentives, integrated employee-centric worksite programs, and emerging innovations in how care is paid for and delivered?

Employers, employees, and family members are not aware of the major impact that health behaviors have in improving health and preventing and even reversing chronic disease. Employers also do not realize how they can impact employee and family behaviors through the broadly defined "work environment" by using multiple levers they either control or influence. Canadian researchers Evans et al[14] created a "Determinants of Health and Disease Model," which demonstrated the multifactorial—and predominantly "nonmedical"—root causes of health, disease, and premature death. "Well-being," "prosperity," as well as social, physical, and genetic environments are interrelated and impact health and function, disease, and the need for health care. Employers can have a major impact on most of these determinants. More recently, the Robert Wood Johnson Foundation[15] echoed the findings of this predominantly nonmedical model by succinctly summarizing the determinants of health as "where and how we live, learn, work, and play."

Seventy percent of premature mortality has been attributed to behavioral and environmental causes, with only 10% being impacted by medical care.[16] Furthermore, it is estimated that 75% of health care costs are related to chronic diseases that are largely preventable through healthy eating, moderate physical activity, no tobacco use, and moderate (if any) alcohol consumption.[17] If US employees and their families adopted the successful preventive health behaviors, documented in health studies in other geographic regions and in American subpopulations (eg, 7th Day Adventists, Harvard physician and nurse studies), heart disease could be reduced by up to 83%, diabetes by 91%, and cancer by 60%.[17–19]

Compounding the burden of preventable disease that employers and employees bear is the realization that, conservatively, 30% of health care spending is wasteful, ineffective, or inefficient (Table 2).[20] Employers who purchase health insurance coverage for 60% of Americans struggle to address unnecessary services (overuse and misuse of visits, tests, and procedures), inefficient care practices, excessive prices, excessive administrative costs, missed prevention

From UPMC Health Plan and WorkPartners, Pittsburgh, PA.
The author declares no conflicts of interest.
Address correspondence to: Michael D. Parkinson, MD, MPH, UPMC WorkPartners, US Steel Tower, 7th Floor, 600 Grant St, Pittsburgh, PA 15219 (parkinsonmd@upmc.edu).

DOI: 10.1097/JOM.0000000000000049

TABLE 1. Characteristics of a Healthy Workforce*

Healthy
Demonstrating optimal health status as defined by positive health behaviors; minimal modifiable risk factors; and minimal illnesses, diseases, and injuries
Productive
Functioning to produce the maximum contribution to achievement of personal goals and the organizational mission
Ready
Possessing an ability to respond to changing demands, given the increasing pace and unpredictable nature of work
Resilient
Adjusting to setbacks, increased demands, or unusual challenges by bouncing back to optimal "well-being" and performance without incurring severe functional decrement

*Adapted from Institute of Medicine.[11]

TABLE 2. Excess Cost, Waste, and Inefficiency in US Health Care Spending[20]

Unnecessary services	Excessive prices
Overuse, misuse, defensive medicine, higher cost but no value	Prescription drugs, medical devices, physician and hospital services
Inefficient delivery	Missed prevention
Fragmentation, lack of coordination	Primary, secondary, tertiary
Excess administrative costs	Fraud

[20]Adapted from IOM 2011: The Healthcare Imperative: Lowering Costs and Improving Outcomes. http://www.iom.edu/Reports/2011/The-Healthcare-Imperative-Lowering-Costs-and-Improving-Outcomes.aspx.

opportunities, or fraud. Most of these known causes of excessive health care and productivity costs (stress and mental health, short- and long-term disability, workers' compensation, occupation-related illness and injuries, and presenteeism) can be addressed by an employer using a comprehensive and integrated strategy supported by targeted tactics, programs, and practices. By improving the health status of employees (and their families) and by directly targeting specific ineffective and inefficient medical practices and delivery methods, both the employer and employee can improve health and produce savings.

Within the past decade, in response to the challenges of rising costs, lack of prevention focus, underutilized preventive care, and lack of engagement in chronic care management, employers have increasingly deployed consumer-directed health plans (CDHPs).[21,22] Consumer-directed health plans typically include coverage for preventive care at 100% with no copayment or cost to the member; an account (either health reimbursement arrangement or health savings account) that pays for medical care and prescriptions; a higher deductible than traditional health plans; and above the deductible, coinsurance for medical services up to an annual out-of-pocket maximum amount. Account balances can be "rolled over" into the next year(s) to offset future health care expenses. Numerous studies have now documented the improvement in consumer and patient engagement, lowering of utilization, reduction in cost, and equal or improved quality compared with traditional insurance plan designs.[23]

Innovations in delivery of medical care have dramatically increased in recent years in response to rising costs, higher deductibles, and lack of convenience and timely access to traditional sources of care. Electronic records with enhanced patient–provider connectivity provide exchange of information and "electronic" or virtual visits.[24,25] Urgent or retail store–based clinics and employer on-site care[26] have created more convenient, accessible, and lower-cost options for preventive, urgent, and chronic care. On-site and "near-site" care options for employees (and in some cases their families) are growing and create an opportunity to better coordinate wellness, primary care, and disease management through linked electronic medical records.

THE NEED FOR AN INTEGRATED STRATEGY: AN EMPLOYER HEALTH AND PRODUCTIVITY ROADMAP™

The primary determinants of health and disease are related to our homes, schools, worksites, and communities. Similarly, health care needs are predominantly attributable to personal health behaviors in unhealthy environments. Employers, therefore, have a major role to play in both improving health and reducing total health-related costs. Integration of all health-, productivity- and safety-related efforts can create value to both the employer and employee. Specifically, creating simple, reinforcing messages in corporate vision, compensation and promotion and benefit alignment sends the message that employee and family health is core to the success of the organization. Healthier employees are safer employees. Properly designed workplaces and safety policies are reinforced by healthy, alert employees. Data from multiple vendors in silos (viz "health and wellness," medical claims, disability, absenteeism, etc) are rarely integrated to show new and actionable associations for intervention. Most often, the same employees and their family members have multiple but common challenges. For example, stress/depression and musculoskeletal injuries, often the most common causes for lost work time and disability cost, are related to obesity, physical inactivity, and tobacco use. Yet, in many cases, the root cause of the acute clinical issue is not addressed or even acknowledged because of disparate vendors or data sources. On-site services may be limited to traditional preemployment screening or occupational medicine, yet the employee has poor or delayed access to needed primary care services. Excessive but uncoordinated services, redundant cost, and nonprioritized interventions create employee confusion and wasteful expense for both the employer and employee. An *integrated*, employee-centric strategy is needed to create a maximally healthy and productive workforce in efficient and cost-effective manner by using best evidence and practices.

The University of Pittsburgh Medical Center (UPMC) Health Plan and WorkPartners have developed an integrated strategy, called the Employer Health and Productivity Roadmap™, to address the core drivers of poor health, excessive medical costs, and lost productivity (Fig. 1). Because UPMC is an integrated financing and delivery health care system, we have been able to define and coordinate interrelated insurance, benefits, and medical care delivery approaches to address the needs of an entire group of employees and their families. The use of the term "Roadmap" is deliberate, implying a journey and destination—toward a healthy and productive workforce. This roadmap strategy should not be exclusive to UPMC or even to only integrated delivery and financing health care systems. The approach can be used by all employers, working with their respective health plan and other benefits and medical care partners, to achieve maximal efficiency, effectiveness, and employee-centeredness for their workforce and dependents.

The Health and Productivity Roadmap™ defines the major elements or "milestones" understood by employers and their benefit-, medical- and occupation-related vendor partners to measure progress toward addressing unhealthy behaviors, excessive medical costs, and lost productivity. Each of the roadmap elements is tied to key metrics that will establish a shared action plan with milestones to leverage and implement best practices in policies, programs, and innovative

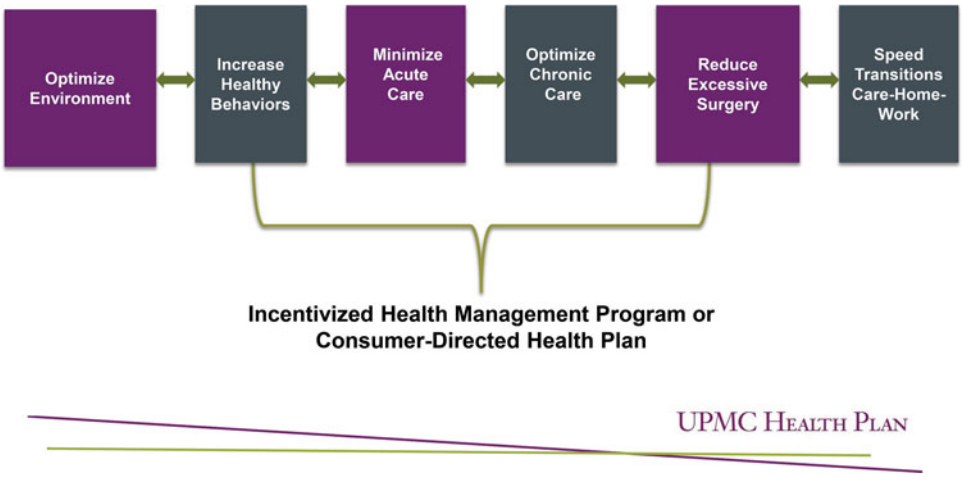

FIGURE 1. Employer Health and Productivity Roadmap™—understand, improve, and partner with your doctor. Copyright 2013 UPMC Health Plan. All rights reserved.

care delivery models. Each roadmap element represents an accountable and measured partnership with the employer, which is tracked quarterly to ensure progress to improved health, greater engagement, lower medical costs, and improved productivity.

From the perspective of the employees and their family, the goals and action steps are simple, incentivized, and tailored to their health and care needs, viz "understand your health, improve your health and care, and partner with your doctor." Each element and its associated metrics (Fig. 2) are reported quarterly to the employer to generate an action plan throughout the year, not just at benefits enrollment time as is most often the current practice.

ELEMENT 1: OPTIMIZE ENVIRONMENT

Building a culture of health, performance, and productivity has been shown to be a critical determinant of the health and competitiveness of any business. Studies further have demonstrated an association between health behaviors, physical health risks, work-related factors, social and emotional factors, and financial stress and employer absenteeism, presenteeism, and self-reported job performance.[6] A comprehensive assessment of environmental drivers of health and productivity is an essential first step to determine organizational strengths and needs. Environment is broadly defined to include not only the traditional safety-related physical characteristics and practices of the workplace but also attitudes, behaviors, policies, and even compensation schedules and promotion opportunities. Major domains include the following: leadership and culture; employee roles, responsibilities, and rewards alignment; absence management; wellness programs and resources, including health assessments and biometric screenings, cafeteria/vending machine options, physical activity, stress and resiliency, tobacco cessation, and weight management; engagement and communication channels; ergonomics, including a workplace environment assessment; and safety and wellness infrastructure. The assessment "gap analysis" identifies key areas for potential improvement and provides the basis for an action plan to move the organization toward best practices.

Typically, employers benchmark their products, services, and overall financial performance (eg, projected improvement in "earnings per share" if publicly traded) against peer competitor companies or "margin" in not-for-profit organizations. An employer-specific "Health and Performance Total Economic Opportunity" model is under development to estimate the aggregate financial impact of optimizing the roadmap elements. In other words, "What would be the total 'top line' and 'bottom line' financial performance if we instituted best practices shown to produce the highest performance from a healthy and productive workforce?" Similarly, where possible, select other roadmap element metrics (eg, alternative, less-expensive care delivery options) are calculated in potential cost savings to the employer.

Assisting employers to create the infrastructure to sustain health, wellness, and productivity is a key responsibility of the health plan and other vendor partner. Providing consultation, educational support, and skills acquisition through a "wellness committee" provides the infrastructure within the company to initiate and sustain improvement efforts. The wellness committee curriculum includes the culture of health, behavior change, population health management, and successful program evaluation. The employer's wellness committee becomes a group of representational, organizational team leaders both "vertically" and "horizontally" within the company to increase buy-in and successful implementation.

ELEMENT 2: INCREASE HEALTHY BEHAVIORS

The optimal health care and productivity-related cost reduction strategy is to improve the overall health of the population. Employees with healthy behaviors—healthy eating, physical activity, nonsmoking, moderate (or no) alcohol use—have been associated with the lowest possible total costs.[1,27] Measuring and rewarding healthy "champion" employees and stating clearly and frequently that assisting employees and their families to achieve health goals are key leadership messages. Typically based on self-reported periodic health assessments, employees and adult family members are classified into "low risk" (0 to 2 risks), "moderate risk" (3 to 4 risks), and "high risk" (5 or more risks) groups.[1] The risks and health behaviors typically include obesity, stress, existing medical condition, tobacco usage, seat belt usage, high cholesterol, elevated blood pressure, physical inactivity, poor self-perception of health, high-density lipoprotein, poor life satisfaction, excessive alcohol usage, and illness days. Keeping the low-risk group low and moving medium- and high-risk individuals to lower risk is essential to reducing total medical and productivity-related costs. Biometric measurements (height/weight, body mass index, blood pressure, and cholesterol levels) should be obtained and tracked over time to further motivate behavior change and self-care. Lifestyle coaching using multiple methods (on-line, telephonic, groups, or on-site) is monitored for both enrollment ("How many who should improve are enrolled?") and graduation ("How many of those enrolled have

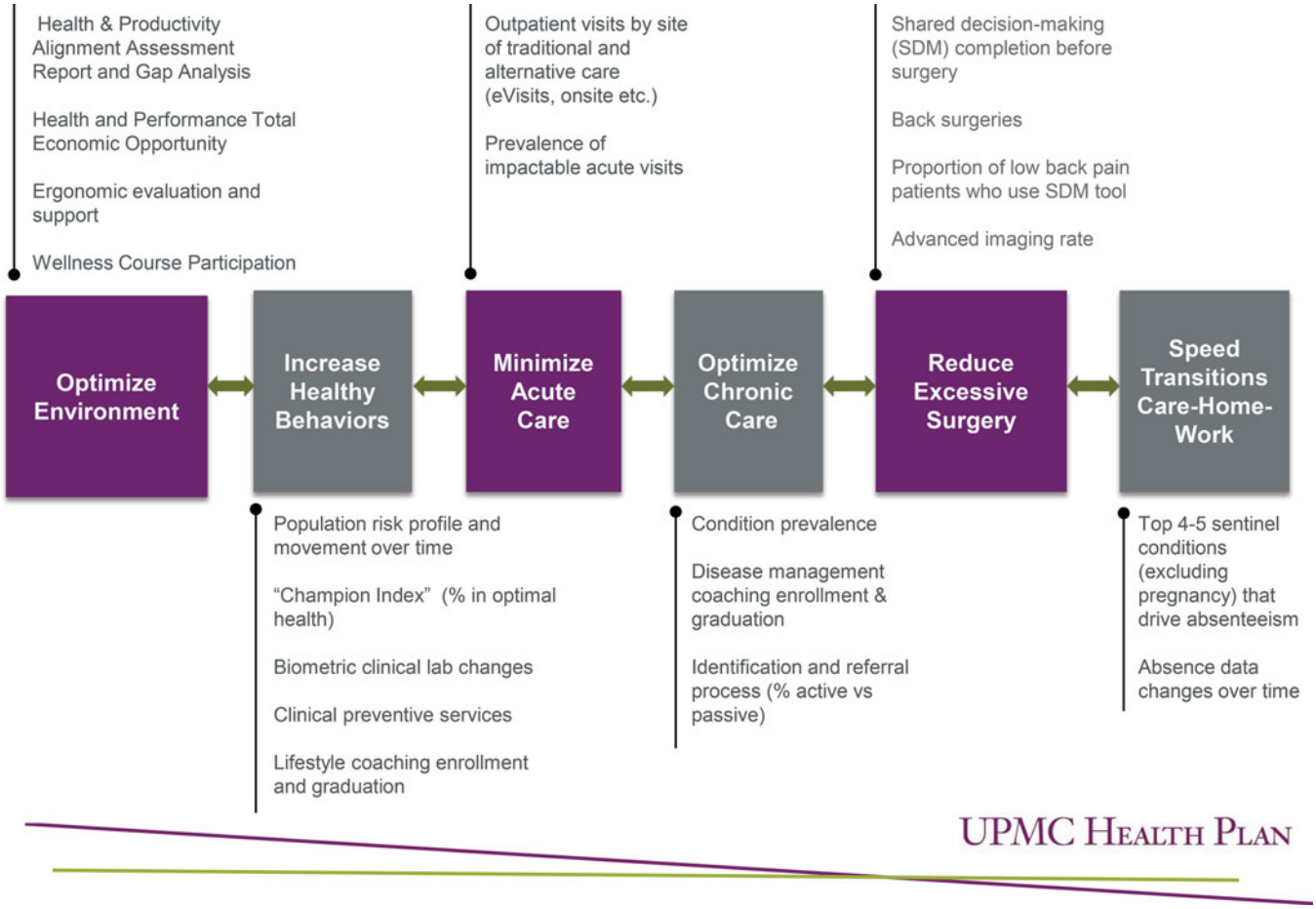

FIGURE 2. Employer Health and Productivity Roadmap™. Elements and metrics. Copyright 2013 UPMC Health Plan. All rights reserved.

acquired the knowledge, skills, and motivation to improve?"). Age- and gender-appropriate, evidence-based preventive services are incentivized with no cost to the employee in benefit designs. Additional financial incentives are offered for completion of periodic health examinations, screening tests, and immunizations.

ELEMENT 3: MINIMIZE AVOIDABLE OR INEFFICIENT ACUTE CARE

Avoidable illness, or inefficient and inconvenient access to health care, causes significant disruptions in an employee's life and that of his or her family—and result in unnecessary and avoidable medical and productivity costs for the employer. By improving health behaviors, employers reduce the prevalence of acute care and chronic conditions that drive medical care utilization.

When medical services are required, these are too often delivered at traditional sites of care and in ways that require excessive cost and absence time from the workplace. It is not uncommon for a 10- to 15-minute routine primary care visit to involve 4 to 8 hours of lost work time, given commuting and delays in being seen even when scheduled. The emergence of bilateral communication between patients and providers via electronic medical/health records, employer on-site or near-site clinics, and new virtual technologies to provide care creates more efficient, convenient, and less costly options compared with a traditional face-to-face provider visit.[24–26] Expanding existing traditional occupational medicine services can also provide more accessible and cost-effective care options. On-site health coaches (as opposed to telephonically-based) have been shown to be more effective in creating impactful employee relationships and to increase engagement in healthy behavior and care management programs.[28]

Confidentiality of employee health and medical information is always a concern. As collection of information and delivery of services expand at the worksite, the employer must take particular care to communicate clearly and frequently how personal information is securely protected to prevent individual identification of health conditions.

ELEMENT 4: OPTIMIZE CHRONIC CARE

Reducing the incidence and prevalence of the most common and costly chronic diseases is a major longer-term goal for employers. Self-reporting, claims, and pharmacy data are used to report the overall prevalence and annual incidence of hypertension, diabetes, asthma, depression/anxiety, and other conditions. *Patient activation*, defined and measured as actively being involved in one's health care decisions for chronic disease, has been associated with lower health care costs and better outcomes.[29] Competency-based "graduation criteria" can be defined for major chronic conditions, which include the following: education and engagement skills to improve health behaviors to prevent, treat, and even reverse the disease condition; self-monitoring for the disease; adherence to prescribed medications; and learning how to take a more active role in partnership with their provider in shared decision-making. As in all engagement programs,

both enrollment into and graduation from the health-coaching program are financially incentivized.

ELEMENT 5: REDUCE EXCESSIVE SURGERY

The increasing prevalence of chronic disease, rapid emergence and adoption of new technologies, and a largely fee-for-service payment system that "overvalues" diagnostic and therapeutic interventions as opposed to evaluation and management services have all led to an excess of "preference-sensitive" surgeries and more generally, capital-intensive procedure-driven medicine. Major categories include spinal and cardiac procedures, hip and knee replacements, and advanced imaging in absence of clinical "red flags."[30] Studies have consistently demonstrated a 25% to 30% reduction of preference-sensitive surgeries when a patient understands the full range of care options, the benefits and harms of each, expresses their value and preferences, and in turn, has those values and choices considered in dialogue with their physicians.[31–33] Given the prevalence of low back pain among all employers and its medical and productivity-related costs, the condition is a logical first target for a comprehensive approach using shared decision-making. An integrated patient, provider, plan, and employer program attempts to optimize patient shared decision-making for low back pain and maximize behavior change (nutrition, physical activity, weight loss, and smoking) and conservative therapies (medication and physical therapy).[34] Specific policies in certain programs (eg, workers' compensation state regulations) may be limiting and prescriptive, restricting employer leeway in proactively addressing misuse and overuse. Nevertheless, patient-centric shared decision-making should be the foundation for all health care decisions, particularly for high-cost discretionary procedures and diagnostic tests, regardless of type of benefit-related program.

ELEMENT 6: SPEED TRANSITIONS FROM CARE TO HOME AND WORK

Mental health, social concerns, and musculoskeletal conditions typically comprise the leading causes of absenteeism, disability, and workers' compensation. Monitoring the leading mental, physical, environmental, and medical conditions that drive time away from work is a necessary first step to reducing absenteeism and total productivity-related costs. Eliminating unnecessary, uncoordinated, and costly "gaps" in employee and family care or miscommunication among multiple providers can produce savings and contribute directly to the employer's "bottom line."[35] Isolated or "siloed" programs create underuse or confusion among employees, leading to excessive employer cost as well as lost income and emotional stress. Integrating primary, secondary, and tertiary prevention strategies in an "employee-centric" fashion can create better care coordination, leveraging worksite and community care models that produce earlier return to work, full functioning, and savings.

"POWERING" THE ROADMAP: INCENTIVIZED HEALTH MANAGEMENT PROGRAM, CDHP, OR BOTH

The roadmap is optimally "powered" (ie, produces the most rapid behavior change, care engagement, and cost savings) by incentivized comprehensive health management programs, consumer-directed health benefit designs, or both.[36] Improving elements 2 to 5—healthy behaviors, reducing acute care, optimizing long-term care, and reducing unnecessary surgery—are in large part the domain of group health insurance coverage purchased by employer. An articulated, targeted approach to each element has not been the focus of health plans. Medical and pharmacy costs alone, the traditional reporting metrics used by health insurers, do not capture the data necessary to monitor and improve these critical roadmap elements. Over the past decade, however, both incentivized comprehensive health management programs and "next generation" CDHPs have grown to promote the collection of relevant data and increase the engagement of employees.

Increasingly, employers, led by the experience of large employers, realize that the alignment of healthy behaviors and care engagement with transparency of cost and financial incentives can accelerate health improvement, more appropriate utilization, and economic savings. The growing awareness of the effectiveness of appropriately designed and communicated incentives and the emerging field of behavioral economics provide an evidence-based approach to improve behavior change and engagement.[36–39] Nationally, 73% of large employers (generally more than 1000 employees) offer CDHPs, and nearly 20% are "full replacement" CDHP account-based plans (health reimbursement arrangements or health savings accounts), meaning that they no longer offer traditional health maintenance organization or preferred provider organization options.[18] These employers offer on average $300 per individual employee and up to $700 per family for health and care engagement incentives.[40] Recent studies using premium cost reductions as opposed to cash incentives[41] (similar to UPMC's employee benefit plan) have shown that the structuring of the incentive is very important to both employee engagement and the potential for health care costs savings. In addition, creating transparency of cost (and increasingly quality) to the employee and employer and providing lower cost and more convenient care options drive more effective and efficient care delivery, consumer engagement, and significant savings.

SUMMARY

Employers and leaders of all organizations are increasingly challenged by growing competitive and economic forces. A core asset of any organization is the health and productivity of its workforce or its "human capital." Employers can have a major influence on the health and care behaviors of employees, their family members, and the community through both their direct impact and their role as visible leaders. The Employer Health and Productivity Roadmap™ provides an integrated and incentivized strategy for employers to address the core drivers of poor health, excessive medical costs, and lost productivity.

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Employer Health and Productivity Roadmap™ Strategy

Michael D. Parkinson, MD, MPH

The National Institute for Occupational Safety and Health Total Worker Health™ Program defines essential elements of an integrated health protection and health promotion model to improve the health, safety, and performance of employers and employees. The lack of a clear strategy to address the core drivers of poor health, excessive medical costs, and lost productivity has deterred a comprehensive, integrated, and proactive approach to meet these challenges. The Employer Health and Productivity Roadmap™, comprising six interrelated and integrated core elements, creates a framework of shared accountability for both employers and their health and productivity partners to implement and monitor actionable measures that improve health, maximize productivity, and reduce excessive costs. The strategy is most effective when linked to a financially incentivized health management program or consumer-directed health plan insurance benefit design.

Employers, organizations, and the US economy generally are under increasing global pressure to improve performance, optimize efficiency, and deliver value. The National Institute for Occupational Safety and Health Total Worker Health™ program acknowledges the unprecedented issues that employers face and the role that an integrated approach to "occupational safety and health protection with health promotion" can play in creating healthier, high-performing workforces.

Over the past 30 years, the body of evidence supporting the need for an integrated approach to employee health has grown. Beginning with the work of Edington,[1] numerous researchers and business leaders have explored the relationship between health behaviors and health care risks and total worker productivity costs.[1–6] Similarly, studies of major corporations' culture, total compensation, and benefits-related policies and practices have shown that alignment of financial and other incentives from the "C-suite" to the employee level in the workplace is key to optimal organizational and financial performance.[7] Total health management to produce maximal vitality, productivity, and even corporate survival is increasingly recognized as a business imperative—not a "nice to do."[8] A definitive literature review of 28 studies concluded that well-designed worksite wellness programs can be cost-effective, generating $3.27 in medical cost savings and $2.73 in absenteeism reductions on average for every dollar spent on employer-based health promotion activities.[9] A more recent analysis of workplace wellness programs mandated by the Patient Protection and Affordable Care Act demonstrated the widespread employer use of health assessments, biometric screenings, coaching programs, and disease management interventions and concluded that resulting behavior change (particularly longer term) and return-on-investment results were mixed.[10] The distinction between "direct" health care cost savings and so-called "indirect" productivity-related costs (absenteeism, disability, workers' compensation, presenteeism, etc) is increasingly being blurred, because employers realize that unhealthy and distracted employees working in suboptimal or unsafe worksites are a risk to themselves and to the economic competitiveness of their company.

The earliest effort to define a unifying approach to integrated employee health that "bridged" the traditional "siloed" approach to health protection and health promotion was embodied in the Institute of Medicine report "Integrating Employee Health: A Model Program for NASA."[11] This framework was translated into more generalizable approach for all employers and organizations by the National Institute for Occupational Safety and Health[12] and the American College of Occupational and Environmental Medicine.[13] Critical to the Institute of Medicine report was the definition of a "healthy workforce" in practical and measurable terms (Table 1). These characteristics can assist employers to define goals, implement strategies, and execute policies, programs, and tactics to improve the health and performance of their employees.

As good as these models are, however, they lack a comprehensive strategy to incorporate and address (1) the epidemiology or true "determinants" of what causes poor or good health, disease, and disability; (2) the financing of health care through emerging insurance and benefit designs; and (3) innovations in the delivery of medical care. In short, how can employers "put it all together" to proactively address the core drivers of poor health, excessive medical costs, and lost productivity, leveraging best practices in aligned incentives, integrated employee-centric worksite programs, and emerging innovations in how care is paid for and delivered?

Employers, employees, and family members are not aware of the major impact that health behaviors have in improving health and preventing and even reversing chronic disease. Employers also do not realize how they can impact employee and family behaviors through the broadly defined "work environment" by using multiple levers they either control or influence. Canadian researchers Evans et al[14] created a "Determinants of Health and Disease Model," which demonstrated the multifactorial—and predominantly "nonmedical"—root causes of health, disease, and premature death. "Well-being," "prosperity," as well as social, physical, and genetic environments are interrelated and impact health and function, disease, and the need for health care. Employers can have a major impact on most of these determinants. More recently, the Robert Wood Johnson Foundation[15] echoed the findings of this predominantly nonmedical model by succinctly summarizing the determinants of health as "where and how we live, learn, work, and play."

Seventy percent of premature mortality has been attributed to behavioral and environmental causes, with only 10% being impacted by medical care.[16] Furthermore, it is estimated that 75% of health care costs are related to chronic diseases that are largely preventable through healthy eating, moderate physical activity, no tobacco use, and moderate (if any) alcohol consumption.[17] If US employees and their families adopted the successful preventive health behaviors, documented in health studies in other geographic regions and in American subpopulations (eg, 7th Day Adventists, Harvard physician and nurse studies), heart disease could be reduced by up to 83%, diabetes by 91%, and cancer by 60%.[17–19]

Compounding the burden of preventable disease that employers and employees bear is the realization that, conservatively, 30% of health care spending is wasteful, ineffective, or inefficient (Table 2).[20] Employers who purchase health insurance coverage for 60% of Americans struggle to address unnecessary services (overuse and misuse of visits, tests, and procedures), inefficient care practices, excessive prices, excessive administrative costs, missed prevention

From UPMC Health Plan and WorkPartners, Pittsburgh, PA.
The author declares no conflicts of interest.
Address correspondence to: Michael D. Parkinson, MD, MPH, UPMC WorkPartners, US Steel Tower, 7th Floor, 600 Grant St, Pittsburgh, PA 15219 (parkinsonmd@upmc.edu).

DOI: 10.1097/JOM.0000000000000049

TABLE 1. Characteristics of a Healthy Workforce*

Healthy
Demonstrating optimal health status as defined by positive health behaviors; minimal modifiable risk factors; and minimal illnesses, diseases, and injuries
Productive
Functioning to produce the maximum contribution to achievement of personal goals and the organizational mission
Ready
Possessing an ability to respond to changing demands, given the increasing pace and unpredictable nature of work
Resilient
Adjusting to setbacks, increased demands, or unusual challenges by bouncing back to optimal "well-being" and performance without incurring severe functional decrement

*Adapted from Institute of Medicine.[11]

TABLE 2. Excess Cost, Waste, and Inefficiency in US Health Care Spending[20]

Unnecessary services	Excessive prices
Overuse, misuse, defensive medicine, higher cost but no value	Prescription drugs, medical devices, physician and hospital services
Inefficient delivery	Missed prevention
Fragmentation, lack of coordination	Primary, secondary, tertiary
Excess administrative costs	Fraud

[20]Adapted from IOM 2011: The Healthcare Imperative: Lowering Costs and Improving Outcomes. http://www.iom.edu/Reports/2011/The-Healthcare-Imperative-Lowering-Costs-and-Improving-Outcomes.aspx.

opportunities, or fraud. Most of these known causes of excessive health care and productivity costs (stress and mental health, short- and long-term disability, workers' compensation, occupation-related illness and injuries, and presenteeism) can be addressed by an employer using a comprehensive and integrated strategy supported by targeted tactics, programs, and practices. By improving the health status of employees (and their families) and by directly targeting specific ineffective and inefficient medical practices and delivery methods, both the employer and employee can improve health and produce savings.

Within the past decade, in response to the challenges of rising costs, lack of prevention focus, underutilized preventive care, and lack of engagement in chronic care management, employers have increasingly deployed consumer-directed health plans (CDHPs).[21,22] Consumer-directed health plans typically include coverage for preventive care at 100% with no copayment or cost to the member; an account (either health reimbursement arrangement or health savings account) that pays for medical care and prescriptions; a higher deductible than traditional health plans; and above the deductible, coinsurance for medical services up to an annual out-of-pocket maximum amount. Account balances can be "rolled over" into the next year(s) to offset future health care expenses. Numerous studies have now documented the improvement in consumer and patient engagement, lowering of utilization, reduction in cost, and equal or improved quality compared with traditional insurance plan designs.[23]

Innovations in delivery of medical care have dramatically increased in recent years in response to rising costs, higher deductibles, and lack of convenience and timely access to traditional sources of care. Electronic records with enhanced patient–provider connectivity provide exchange of information and "electronic" or virtual visits.[24,25] Urgent or retail store–based clinics and employer on-site care[26] have created more convenient, accessible, and lower-cost options for preventive, urgent, and chronic care. On-site and "near-site" care options for employees (and in some cases their families) are growing and create an opportunity to better coordinate wellness, primary care, and disease management through linked electronic medical records.

THE NEED FOR AN INTEGRATED STRATEGY: AN EMPLOYER HEALTH AND PRODUCTIVITY ROADMAP™

The primary determinants of health and disease are related to our homes, schools, worksites, and communities. Similarly, health care needs are predominantly attributable to personal health behaviors in unhealthy environments. Employers, therefore, have a major role to play in both improving health and reducing total health-related costs. Integration of all health-, productivity- and safety-related efforts can create value to both the employer and employee. Specifically, creating simple, reinforcing messages in corporate vision, compensation and promotion and benefit alignment sends the message that employee and family health is core to the success of the organization. Healthier employees are safer employees. Properly designed workplaces and safety policies are reinforced by healthy, alert employees. Data from multiple vendors in silos (viz "health and wellness," medical claims, disability, absenteeism, etc) are rarely integrated to show new and actionable associations for intervention. Most often, the same employees and their family members have multiple but common challenges. For example, stress/depression and musculoskeletal injuries, often the most common causes for lost work time and disability cost, are related to obesity, physical inactivity, and tobacco use. Yet, in many cases, the root cause of the acute clinical issue is not addressed or even acknowledged because of disparate vendors or data sources. On-site services may be limited to traditional preemployment screening or occupational medicine, yet the employee has poor or delayed access to needed primary care services. Excessive but uncoordinated services, redundant cost, and nonprioritized interventions create employee confusion and wasteful expense for both the employer and employee. An *integrated*, employee-centric strategy is needed to create a maximally healthy and productive workforce in efficient and cost-effective manner by using best evidence and practices.

The University of Pittsburgh Medical Center (UPMC) Health Plan and WorkPartners have developed an integrated strategy, called the Employer Health and Productivity Roadmap™, to address the core drivers of poor health, excessive medical costs, and lost productivity (Fig. 1). Because UPMC is an integrated financing and delivery health care system, we have been able to define and coordinate interrelated insurance, benefits, and medical care delivery approaches to address the needs of an entire group of employees and their families. The use of the term "Roadmap" is deliberate, implying a journey and destination—toward a healthy and productive workforce. This roadmap strategy should not be exclusive to UPMC or even to only integrated delivery and financing health care systems. The approach can be used by all employers, working with their respective health plan and other benefits and medical care partners, to achieve maximal efficiency, effectiveness, and employee-centeredness for their workforce and dependents.

The Health and Productivity Roadmap™ defines the major elements or "milestones" understood by employers and their benefit-, medical- and occupation-related vendor partners to measure progress toward addressing unhealthy behaviors, excessive medical costs, and lost productivity. Each of the roadmap elements is tied to key metrics that will establish a shared action plan with milestones to leverage and implement best practices in policies, programs, and innovative

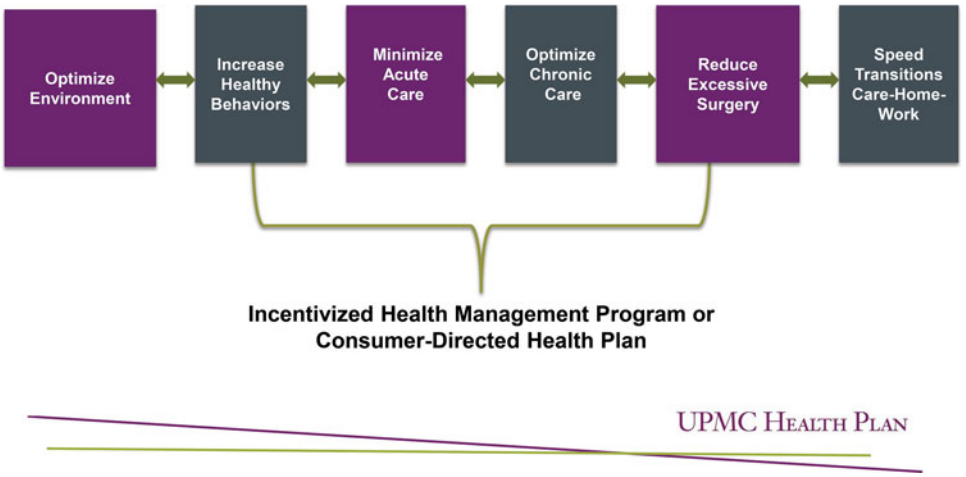

FIGURE 1. Employer Health and Productivity Roadmap™—understand, improve, and partner with your doctor. Copyright 2013 UPMC Health Plan. All rights reserved.

care delivery models. Each roadmap element represents an accountable and measured partnership with the employer, which is tracked quarterly to ensure progress to improved health, greater engagement, lower medical costs, and improved productivity.

From the perspective of the employees and their family, the goals and action steps are simple, incentivized, and tailored to their health and care needs, viz "understand your health, improve your health and care, and partner with your doctor." Each element and its associated metrics (Fig. 2) are reported quarterly to the employer to generate an action plan throughout the year, not just at benefits enrollment time as is most often the current practice.

ELEMENT 1: OPTIMIZE ENVIRONMENT

Building a culture of health, performance, and productivity has been shown to be a critical determinant of the health and competitiveness of any business. Studies further have demonstrated an association between health behaviors, physical health risks, work-related factors, social and emotional factors, and financial stress and employer absenteeism, presenteeism, and self-reported job performance.[6] A comprehensive assessment of environmental drivers of health and productivity is an essential first step to determine organizational strengths and needs. Environment is broadly defined to include not only the traditional safety-related physical characteristics and practices of the workplace but also attitudes, behaviors, policies, and even compensation schedules and promotion opportunities. Major domains include the following: leadership and culture; employee roles, responsibilities, and rewards alignment; absence management; wellness programs and resources, including health assessments and biometric screenings, cafeteria/vending machine options, physical activity, stress and resiliency, tobacco cessation, and weight management; engagement and communication channels; ergonomics, including a workplace environment assessment; and safety and wellness infrastructure. The assessment "gap analysis" identifies key areas for potential improvement and provides the basis for an action plan to move the organization toward best practices.

Typically, employers benchmark their products, services, and overall financial performance (eg, projected improvement in "earnings per share" if publicly traded) against peer competitor companies or "margin" in not-for-profit organizations. An employer-specific "Health and Performance Total Economic Opportunity" model is under development to estimate the aggregate financial impact of optimizing the roadmap elements. In other words, "What would be the total 'top line' and 'bottom line' financial performance if we instituted best practices shown to produce the highest performance from a healthy and productive workforce?" Similarly, where possible, select other roadmap element metrics (eg, alternative, less-expensive care delivery options) are calculated in potential cost savings to the employer.

Assisting employers to create the infrastructure to sustain health, wellness, and productivity is a key responsibility of the health plan and other vendor partner. Providing consultation, educational support, and skills acquisition through a "wellness committee" provides the infrastructure within the company to initiate and sustain improvement efforts. The wellness committee curriculum includes the culture of health, behavior change, population health management, and successful program evaluation. The employer's wellness committee becomes a group of representational, organizational team leaders both "vertically" and "horizontally" within the company to increase buy-in and successful implementation.

ELEMENT 2: INCREASE HEALTHY BEHAVIORS

The optimal health care and productivity-related cost reduction strategy is to improve the overall health of the population. Employees with healthy behaviors—healthy eating, physical activity, nonsmoking, moderate (or no) alcohol use—have been associated with the lowest possible total costs.[1,27] Measuring and rewarding healthy "champion" employees and stating clearly and frequently that assisting employees and their families to achieve health goals are key leadership messages. Typically based on self-reported periodic health assessments, employees and adult family members are classified into "low risk" (0 to 2 risks), "moderate risk" (3 to 4 risks), and "high risk" (5 or more risks) groups.[1] The risks and health behaviors typically include obesity, stress, existing medical condition, tobacco usage, seat belt usage, high cholesterol, elevated blood pressure, physical inactivity, poor self-perception of health, high-density lipoprotein, poor life satisfaction, excessive alcohol usage, and illness days. Keeping the low-risk group low and moving medium- and high-risk individuals to lower risk is essential to reducing total medical and productivity-related costs. Biometric measurements (height/weight, body mass index, blood pressure, and cholesterol levels) should be obtained and tracked over time to further motivate behavior change and self-care. Lifestyle coaching using multiple methods (on-line, telephonic, groups, or on-site) is monitored for both enrollment ("How many who should improve are enrolled?") and graduation ("How many of those enrolled have

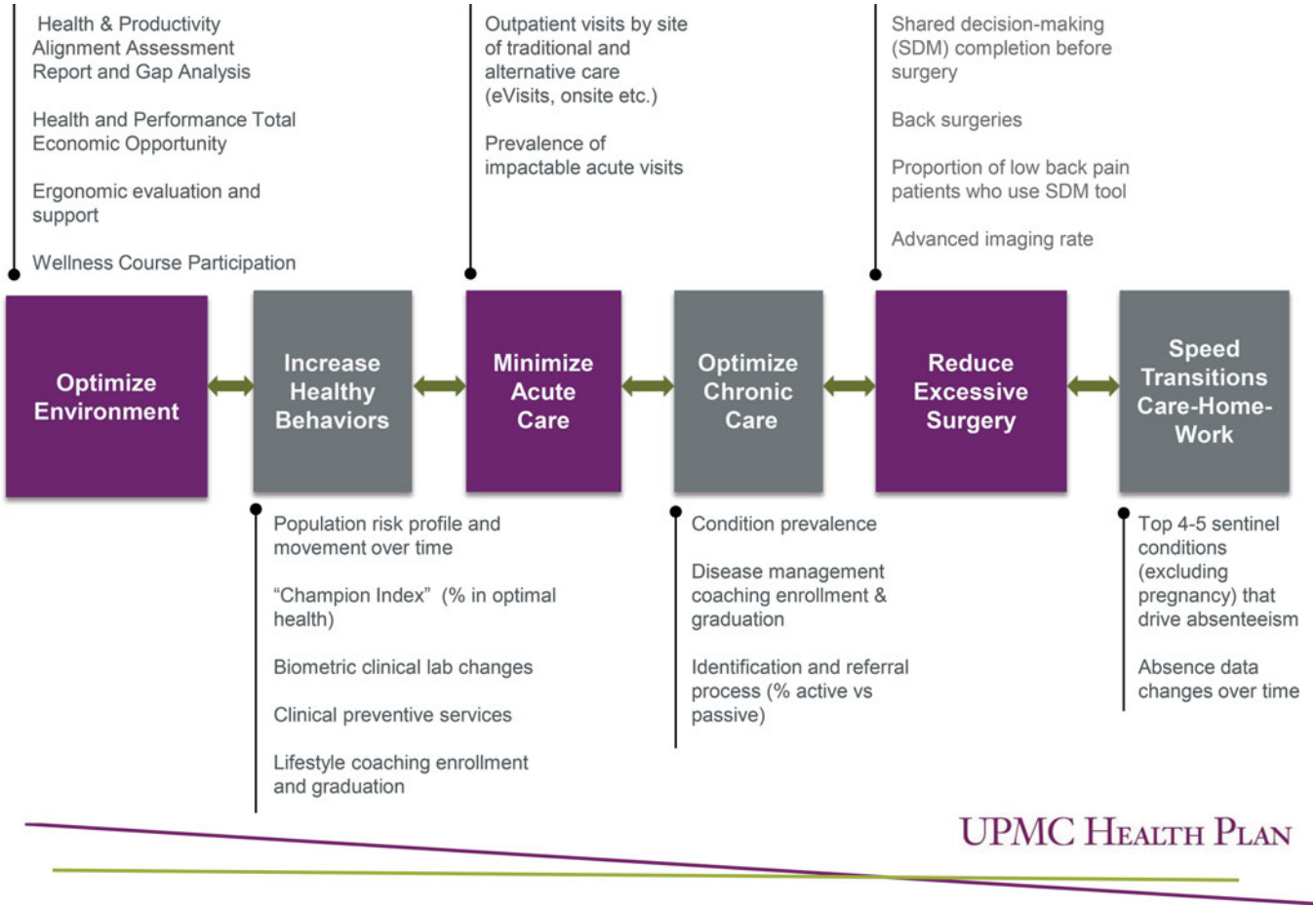

FIGURE 2. Employer Health and Productivity Roadmap™. Elements and metrics. Copyright 2013 UPMC Health Plan. All rights reserved.

acquired the knowledge, skills, and motivation to improve?"). Age- and gender-appropriate, evidence-based preventive services are incentivized with no cost to the employee in benefit designs. Additional financial incentives are offered for completion of periodic health examinations, screening tests, and immunizations.

ELEMENT 3: MINIMIZE AVOIDABLE OR INEFFICIENT ACUTE CARE

Avoidable illness, or inefficient and inconvenient access to health care, causes significant disruptions in an employee's life and that of his or her family—and result in unnecessary and avoidable medical and productivity costs for the employer. By improving health behaviors, employers reduce the prevalence of acute care and chronic conditions that drive medical care utilization.

When medical services are required, these are too often delivered at traditional sites of care and in ways that require excessive cost and absence time from the workplace. It is not uncommon for a 10- to 15-minute routine primary care visit to involve 4 to 8 hours of lost work time, given commuting and delays in being seen even when scheduled. The emergence of bilateral communication between patients and providers via electronic medical/health records, employer on-site or near-site clinics, and new virtual technologies to provide care creates more efficient, convenient, and less costly options compared with a traditional face-to-face provider visit.[24–26] Expanding existing traditional occupational medicine services can also provide more accessible and cost-effective care options. On-site health coaches (as opposed to telephonically-based) have been shown to be more effective in creating impactful employee relationships and to increase engagement in healthy behavior and care management programs.[28]

Confidentiality of employee health and medical information is always a concern. As collection of information and delivery of services expand at the worksite, the employer must take particular care to communicate clearly and frequently how personal information is securely protected to prevent individual identification of health conditions.

ELEMENT 4: OPTIMIZE CHRONIC CARE

Reducing the incidence and prevalence of the most common and costly chronic diseases is a major longer-term goal for employers. Self-reporting, claims, and pharmacy data are used to report the overall prevalence and annual incidence of hypertension, diabetes, asthma, depression/anxiety, and other conditions. *Patient activation*, defined and measured as actively being involved in one's health care decisions for chronic disease, has been associated with lower health care costs and better outcomes.[29] Competency-based "graduation criteria" can be defined for major chronic conditions, which include the following: education and engagement skills to improve health behaviors to prevent, treat, and even reverse the disease condition; self-monitoring for the disease; adherence to prescribed medications; and learning how to take a more active role in partnership with their provider in shared decision-making. As in all engagement programs,

both enrollment into and graduation from the health-coaching program are financially incentivized.

ELEMENT 5: REDUCE EXCESSIVE SURGERY

The increasing prevalence of chronic disease, rapid emergence and adoption of new technologies, and a largely fee-for-service payment system that "overvalues" diagnostic and therapeutic interventions as opposed to evaluation and management services have all led to an excess of "preference-sensitive" surgeries and more generally, capital-intensive procedure-driven medicine. Major categories include spinal and cardiac procedures, hip and knee replacements, and advanced imaging in absence of clinical "red flags."[30] Studies have consistently demonstrated a 25% to 30% reduction of preference-sensitive surgeries when a patient understands the full range of care options, the benefits and harms of each, expresses their value and preferences, and in turn, has those values and choices considered in dialogue with their physicians.[31–33] Given the prevalence of low back pain among all employers and its medical and productivity-related costs, the condition is a logical first target for a comprehensive approach using shared decision-making. An integrated patient, provider, plan, and employer program attempts to optimize patient shared decision-making for low back pain and maximize behavior change (nutrition, physical activity, weight loss, and smoking) and conservative therapies (medication and physical therapy).[34] Specific policies in certain programs (eg, workers' compensation state regulations) may be limiting and prescriptive, restricting employer leeway in proactively addressing misuse and overuse. Nevertheless, patient-centric shared decision-making should be the foundation for all health care decisions, particularly for high-cost discretionary procedures and diagnostic tests, regardless of type of benefit-related program.

ELEMENT 6: SPEED TRANSITIONS FROM CARE TO HOME AND WORK

Mental health, social concerns, and musculoskeletal conditions typically comprise the leading causes of absenteeism, disability, and workers' compensation. Monitoring the leading mental, physical, environmental, and medical conditions that drive time away from work is a necessary first step to reducing absenteeism and total productivity-related costs. Eliminating unnecessary, uncoordinated, and costly "gaps" in employee and family care or miscommunication among multiple providers can produce savings and contribute directly to the employer's "bottom line."[35] Isolated or "siloed" programs create underuse or confusion among employees, leading to excessive employer cost as well as lost income and emotional stress. Integrating primary, secondary, and tertiary prevention strategies in an "employee-centric" fashion can create better care coordination, leveraging worksite and community care models that produce earlier return to work, full functioning, and savings.

"POWERING" THE ROADMAP: INCENTIVIZED HEALTH MANAGEMENT PROGRAM, CDHP, OR BOTH

The roadmap is optimally "powered" (ie, produces the most rapid behavior change, care engagement, and cost savings) by incentivized comprehensive health management programs, consumer-directed health benefit designs, or both.[36] Improving elements 2 to 5—healthy behaviors, reducing acute care, optimizing long-term care, and reducing unnecessary surgery—are in large part the domain of group health insurance coverage purchased by employer. An articulated, targeted approach to each element has not been the focus of health plans. Medical and pharmacy costs alone, the traditional reporting metrics used by health insurers, do not capture the data necessary to monitor and improve these critical roadmap elements. Over the past decade, however, both incentivized comprehensive health management programs and "next generation" CDHPs have grown to promote the collection of relevant data and increase the engagement of employees.

Increasingly, employers, led by the experience of large employers, realize that the alignment of healthy behaviors and care engagement with transparency of cost and financial incentives can accelerate health improvement, more appropriate utilization, and economic savings. The growing awareness of the effectiveness of appropriately designed and communicated incentives and the emerging field of behavioral economics provide an evidence-based approach to improve behavior change and engagement.[36–39] Nationally, 73% of large employers (generally more than 1000 employees) offer CDHPs, and nearly 20% are "full replacement" CDHP account-based plans (health reimbursement arrangements or health savings accounts), meaning that they no longer offer traditional health maintenance organization or preferred provider organization options.[18] These employers offer on average $300 per individual employee and up to $700 per family for health and care engagement incentives.[40] Recent studies using premium cost reductions as opposed to cash incentives[41] (similar to UPMC's employee benefit plan) have shown that the structuring of the incentive is very important to both employee engagement and the potential for health care costs savings. In addition, creating transparency of cost (and increasingly quality) to the employee and employer and providing lower cost and more convenient care options drive more effective and efficient care delivery, consumer engagement, and significant savings.

SUMMARY

Employers and leaders of all organizations are increasingly challenged by growing competitive and economic forces. A core asset of any organization is the health and productivity of its workforce or its "human capital." Employers can have a major influence on the health and care behaviors of employees, their family members, and the community through both their direct impact and their role as visible leaders. The Employer Health and Productivity Roadmap™ provides an integrated and incentivized strategy for employers to address the core drivers of poor health, excessive medical costs, and lost productivity.

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From Worker Health to Citizen Health

Moving Upstream

Martin-Jose Sepulveda, MD

New rapid growth economies, urbanization, health systems crises, and "big data" are causing fundamental changes in social structures and systems, including health. These forces for change have significant consequences for occupational and environmental medicine and will challenge the specialty to think beyond workers and workplaces as the principal locus of innovation for health and performance. These trends are placing great emphasis on upstream strategies for addressing the complex systems dynamics of the social determinants of health. The need to engage systems in communities for healthier workforces is a shift in orientation from worker and workplace centric to citizen and community centric. This change for occupational and environmental medicine requires extending systems approaches in the workplace to communities that are systems of systems and that require different skills, data, tools, and partnerships.

Occupational and environmental medicine is based on a population health and environmental paradigm of using data for understanding patterns and distributions and for predicting exposures, risks, and outcomes. During the last century, major changes in materials (eg, chemicals, radiation), people (eg, demographics, skills), processes (eg, assembly line, automation), laws (eg, child labor, work hours, safety), and science and technologies (eg, electrification, transportation, communications, and computing) altered the nature of work on multiple occasions.[1,2] These transformations expanded the opportunity for occupational and environmental medicine to perform new services with added value to workers and employers beyond providing acute medical care for workplace injuries and diseases (Fig. 1). New services included improved approaches to prevention of occupational morbidity and mortality such as training, exposure monitoring and control, risk assessment, screening, wellness and behavioral health interventions, disability management, and rigorous health and safety management systems. More recently, longitudinal data collection on occupational and environmental exposures, economic and population health data, and analytics are identifying new opportunities to support prevention, environmentally sustainable operations, and returns on investments in health and safety.[3]

The purpose of this commentary is to explore a subset of major disruptive forces for change and discuss how these may influence the practice of occupational and environmental medicine and perhaps shift its focus from worker and workplace to citizen and community. The forces for societal change discussed are the rapid economic development in emerging economies, health care delivery system transformations, noncommunicable diseases, and massive data generation (big data) along with advances in information and communication technologies (Fig. 1). These forces will likely cause the next shift in occupational and environmental medicine's opportunity for value creation, here defined as healthier environments, better health, higher productivity, and competitive labor costs. Although the physician is the prime focus of the commentary, other health and safety professionals will be affected in a similar fashion.

From the Health Systems and Policy Research—Watson Laboratory, IBM Corporation, Southbury, Conn.
Conflict of interest: None.
Sources of funding: None.
Other sources of support: None.
Address correspondence to: Martin-J. Sepulveda, MD, IBM Corporation, 150 Kettletown Road, Southbury, CT 06488 (mjs851@us.ibm.com).

DOI: 10.1097/JOM.0000000000000033

DISRUPTIVE FORCES

Disruptive forces are affecting society and health through complex interactions and are challenging health systems and health care professionals at an unprecedented scale and speed.

Rapid Growth Economies

One such force is global economic development. Rapid economic growth has shifted from high-income countries such as the United States and Germany to middle-income countries such as China, India, and South Africa.[4,5] This has caused major changes in the market focus for global and domestic corporations including the sizes and locations of their operations in these middle-income countries. Rapid-growth middle-income countries present complicated admixtures of low-income country (eg, Chad, Cambodia, and Bangladesh) and high-income country health and environmental and safety challenges. For example, middle-income countries share many of the following health problems with low-income countries: poor access to basic medical care and essential drugs, effective communicable disease control, adequacy of essential public health services related to water, hygiene, sanitation, maternal and child health, unsafe sex, and indoor smoke from solid fuels. Problems of high-income countries are now also beginning to appear in middle-income countries. These often include violence, tobacco, alcohol and substance abuse, behavioral health, noncommunicable diseases, and environmental contamination from toxic discharges. A decade ago, occupational and environmental professionals in a limited number of industries such as textile, energy, and petrochemicals were challenged by occupational and public health threats in low- and middle-income countries. Today these are priorities for occupational and environmental medicine professionals in all major industries ranging from agriculture and construction to information technology and telecommunications because all are present in middle-income country markets.

Urbanization

Changes in the distribution of the world's population between rural and urban are also causing major disruptions in society and in health, creating additional opportunities for value from occupational and environmental medicine services. Urbanization is reshaping societies worldwide. Today more than half the world's population lives in cities, and each week approximately 1.5 million more people are added to the urban population.[6] It is projected that between 2011 and 2050, the global urban population will grow from 52% to 67% of the world's population. This massive urban growth will be driven primarily from increases in less-developed regions (from 47% to 64%) than from increases in the developed world (78% to 86%).[7] Urbanization is advantageous for economic development by increasing paid labor opportunities and by concentrating people for more

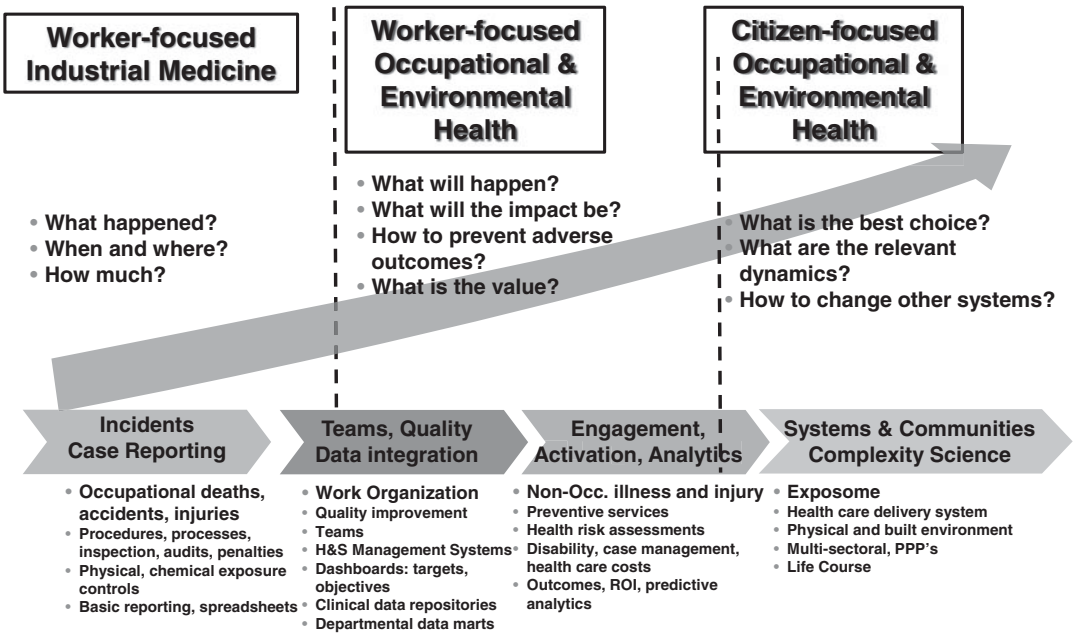

FIGURE 1. From worker to citizen health.

efficient services delivery such as education, health care, and transportation. Often, however, poor urban planning, limited resources, corruption, and other factors create urban conditions for slums, air pollution and excessive noise, poor built environments (eg, walkability), low nutritional value food sources, violence and crime, drug trafficking, and sexual exploitation and disease transmission.[8] These urbanization hazards can impede economic development in cities and produce major adverse impacts on the health, productivity, and costs of employed populations. Examples of such impacts include absenteeism, presenteeism, reduced flexibility due to transport or public safety, density-related communicable disease transmission, or rates of high-cost chronic conditions such as human immunodeficiency virus, hypertension, diabetes, and depression.

Noncommunicable Diseases

Noncommunicable diseases are adversely impacting economies, governments, and the private sector. These conditions are challenging existing systems and structures for health care delivery, wellness, and care management as well as economic development.[9] Noncommunicable diseases accounted for 63% of global mortality in 2008, affecting 36 million individuals, of which 25% or 9 million were in the working ages less than 60 years.[10] Noncommunicable diseases cause 86% of healthy years of life lost in high-income countries, 65% in middle-income countries, and 35% in low-income countries due to its impact on premature death and disability (DALY—disability-adjusted life years).[11] Although DALY from noncommunicable diseases will grow only 2.3% in high-income countries between 2008 and 2030, it will increase during this period by 17% in middle-income countries and 49% in low-income countries.[11]

The cost of noncommunicable diseases is staggering. In the United States, noncommunicable diseases account for more than three quarters of all national health expenditures, which are expected to increase from 17.8% of gross domestic product (USD$2.76 trillion) in 2013 to 19.6% of gross domestic product (USD$4.53 trillion) by 2021.[12] Annual executive survey data in the private sector reveal that half of executive leaders perceive noncommunicable diseases as a direct threat to their bottom line in the next 5 years and a bigger business threat than communicable diseases including human immunodeficiency virus/acquired immunodeficiency syndrome, tuberculosis, and malaria.[8]

Noncommunicable diseases are known to be related to addressable risk factors including tobacco use, physical inactivity, low nutritional diets, obesity, excess alcohol consumption, and exposure to environmental pollution. Many of these risk factors and others have been shown in two landmark occupational and environmental medicine studies to account for 22% to 25% of total health care expenditures in the companies studied.[13,14] Currently, occupational and environmental medicine workforce strategies to mitigate these noncommunicable diseases risks are employee-focused programs and services. Although this approach can be cost beneficial when high-quality wellness and health promotion interventions are delivered, the long-term maintenance of healthy behavior, improved health status, and cost control are unknown with this approach alone.[15] The challenge of durable risk modification is related to the determinants of risk for noncommunicable diseases, which are outcomes of complex interactions involving people in socioenvironmental systems of which the workplace is only one subsystem. Education, food sources, housing, the built environment, social networks and families, the media, and other subsystems interact continuously to influence healthy or unhealthy behaviors. Noncommunicable diseases challenge occupational and environmental medicine to redesign strategies for prevention and care management around communities to help impact the root determinants of risk.

Health Care Delivery System Transformation

Health care delivery system crises of cost, access, equity, and quality are causing significant changes in the organization, technology, financing, and delivery of care. This transformation will affect occupational and environmental medicine strategies for healthy workforces as well as occupational and environmental medicine skills and job functions. In the United States, changes to the organization of health services are well under way to shift from episodic fragmented medical care to comprehensive and coordinated care with outcomes-based payment. "Medical homes" for primary care and "accountable care organizations" are two examples of

current initiatives to accomplish this shift. In primary care "medical homes," physician-led teams are organized to provide enhanced access, comprehensiveness, coordination, and person-centered care.[16] Accountable care organizations are organizations of integrated health care providers (including primary care, specialist, and facilities) that receive specified payments with performance objectives and assume all health care and financial responsibilities for their patient populations.[17] These concepts of a single accountable locus for comprehensive care suggest that occupational health, wellness, fitness for duty, and work accommodation services will need to coordinate with or be integrated into these models. This change may be accelerated by the pursuit of employers for greater cost-efficiency by having one provider for all health-related services. Occupational and environmental physicians will be challenged by the need to engage these new models of care in productive ways, including supporting these new systems of care with an appropriate level of occupational and environmental health competency.[18]

Middle- and low-income countries are also undergoing health systems transformations to improve health equity, cost-efficiency, and service delivery. Primary care is a key delivery system priority in these countries and is increasingly being viewed as the means for providing basic occupational health services, which are generally unavailable to large proportions of working populations.[19] Training for community health workers, medical technicians, nurses, and general practitioners is a major challenge for occupational and environmental medicine in these countries. New models of service delivery that extend the reach of available resources and creative uses of mobile and other low-cost technologies for health are required to address these occupational and environmental medicine needs.

Retail and On-Site Clinics

Retail and on-site medical clinics are proliferating in the United States and are additional sources of care delivery system changes that will impact occupational and environmental medicine service models. Retail clinics located in pharmacies, large grocery stores, and other retailers grew from approximately 250 in 2006 to more than 1400 in 2013 and are projected to grow to 4000 by 2015.[20] These clinics began as sources of simple, protocol-driven nonurgent care such as vaccinations and upper respiratory tract infections but are expanding to include wellness, care management, and an array of primary care and other medical services for employers such as fitness for duty and periodic examinations. This trend is being fueled by employer needs to control health care costs and improve worker productivity.[21]

There are few comprehensive data on the number of on-site clinics, but one survey of 72 companies by World At Work reported that 25% of respondents representing more than a dozen industries had on-site clinics.[22] In a separate larger survey of on-site clinics, 66% offered occupational health services, 56% performed ergonomic assessments, and 55% performed US Occupational Safety and Health Administration required testing.[21] Occupational and environmental medicine services are only partially integrated into on-site clinics today but the potential exists for this to accelerate. Most on-site clinics are third party vendor arrangements that offer flexibility to employers for scaling up or down without incurring costs of adding or reducing employees. These outsourced clinics have the potential for integration of routine health, safety, and environmental services, which are often outsourced to environmental or site services companies.

Big Data

Scale of Data Generation

The quantity, variety, and speed of data generation today are unprecedented and growing at exponential rates. This is often referred to as "big data" because these exceed the capacity of existing information management systems to handle them. In 2010, it was estimated that the daily rate of global data generation was approximately 2.5 exabytes (2.5^{18} bytes) of information and growing at 40% or more per year. For purposes of comparison, one exabyte is more than four thousand times the information stored in the Library of Congress.[23] These data changes have been fueled by the pervasive instrumentation and interconnection of our world resulting from the enormous growth of networked sensors (fixed, mobile, and aerial), mobile devices and unstructured data from text, social media, images, video, voice, and multimedia. For example, in 2011, the United Nations reported that there were 86 mobile cellular phone subscriptions per 100 global inhabitants, 15.7 per 100 inhabitants with active cellular broadband subscriptions, and 34 per 100 households with home Internet access.[24] More than 30 million networked sensor nodes are now present in the transportation, automotive, industrial, utilities, and retail sectors and are increasing at a rate of more than 30% a year.[23] Today, Twitter generates more than 7 terabytes of data per day and FaceBook more than 10 terabytes per day.[25]

Value From Big Data

The generation of massive quantities of diverse forms of data, together with new technologies to aggregate, integrate, and analyze these data, is transforming every sector of society and will transform public health and occupational and environmental medicine. Value domains being exploited in industries include improving operational efficiency such as with radio frequency identification tracking of product movement for automated supply chain management. Other major areas for data and analytics that enabled value creation include labor productivity, effectiveness of product and service marketing and delivery, and accelerating discovery and innovation. The rapid ingestion, transformation, and integration of multisource data are coupled to advanced analytics to pursue improved quality and reliability, lower unit cost, accelerate research and development, transform processes, and create new business models. Use cases (practical applications of big data use to achieve specific user prioritized goals) are abundant in many industries such as (1) real-time fraud detection in the banking and insurance industries using pattern recognition, (2) modeling and simulation for risk management in enterprise functions from supply chain to facilities management optimization, and (3) real-time product performance monitoring for quality improvement using embedded sensor, geospatial, video, and other data.

Health Data

The health care delivery system and public health, including occupational and environmental medicine, are repositories of large quantities of heterogeneous data. For example, data in medical images, pathology specimens, surgical videos, telemetry, text in records, and social and Web-based exchanges are high-density data sources in health care delivery. In public health, large volumes of data are captured from vital statistics, surveys, biometric screening, biological, toxicological, and environmental testing, inspections, and numerous programs. In occupational and environmental medicine, similar types of data are collected or used as well as fixed and mobile sensor data from equipment, effluents, accidents, medical monitoring, and industrial hygiene and safety surveillance. Data challenges for occupational and environmental medicine related to the aggregation and analysis of integrated sets of occupational, medical, and environmental data will be overcome as these technologies become available and affordable for practitioners and researchers.

The Opportunity

Big data in health care and public health are capable of being accessed with new communication and information technologies

that are better able to collect, curate, analyze, and share them. This provides a transformative opportunity for generating information and creating knowledge with increased speed, collaboration, and personalization. In public health, for example, surveillance intelligence, which is essential for prevention, protection, and assessment of health, could be vastly improved in currency (eg, real time), quality, and speed of dissemination by rapid coupling of existing public health and medical data to (1) geospatial sensor data from mobile and aerial devices, (2) observation, intent, and sentiment data from social networking, and (3) Internet traffic patterns. The value of such real-time insights from the aggregation of these varied and high frequency data flows has been demonstrated. For example, very strong correlations have been found between content-usage patterns with Twitter tweets and Google searches for infectious disease outbreaks and responses to natural disasters.[26] Open data initiatives such as those by state and federal are another good example. These freely accessible data repositories facilitate gathering and integrating multisectoral data from communities and are extremely valuable for population health and environmental assessments or research, particularly with regard to social determinants of health and environmental exposures.

In the health care delivery system, multisource data are increasingly being used for outcomes improvement. Approaches to therapeutics and care management are being redefined by combining large clinical data repositories with administrative data sets and sensor data to personalize care plans. New insights are being generated from these data using advanced quantitative methods such as patient similarity analytics that identifies cohorts of similar individuals based on large numbers of clinical and nonclinical feature vectors or indicators.[27] For example, Optum Health (a United Health Care business) and the Mayo Clinic formed Optum Labs in 2013. This new collaborative enterprise provides infrastructure and tools for the health care industry, academic institutions, and other organizations to aggregate information for large-scale analytics to improve patient care, cost, and quality.[28]

Some Dependencies

Realizing the full potential of big data in health has many dependencies such as data skills requirements. For occupational and environmental medicine as for other disciplines, the need to develop professionals who understand data and have moderately advanced analytical skills will become acute. These skills are required for using such data for program design and evaluation, impact assessments, and new models for services delivery, operational efficiency, and research. There exist additional challenges to achieving broad-based value from big data. Some examples include greater standardization of protocols for the transmission and sharing of data with different formats, compliance with existing and evolving privacy and security requirements, and the development of sustainable business models that fund freely accessible big data infrastructure.

FROM WORKER HEALTH TO CITIZEN HEALTH

Moving Upstream

This commentary has explored a subset of major forces that are causing fundamental transformations in many societal sectors. The demographic shift to urban centers, the burden of noncommunicable diseases, challenges in rapid economic growth countries, changes in health care delivery systems, and the rapid pace of data generation and use were selected because their effect on occupational and environmental medicine is likely to be significant and sustained. All are contributing to changes in the health status and productive capacity of people before they enter the workforce and as workers. All are also challenging the ability of worker-focused interventions to further advance prevention at all levels. Advancing the health of workers will increasingly involve moving upstream of the workplace to involve multiple community sectors that, together with the workplace, nurture human resilience and vitality and contain the "real" causes of death and disability.[29]

How to Move Upstream

Moving upstream requires extending the systems approach that has been applied successfully inside the workplace to the broader ecosystem in which workers live and interact. Participation and leadership are needed in the development of strategies and interventions directed at shared pathways that impact social, environmental, and physical conditions in communities. New analytic methods and use of new forms and varieties of data will be essential to identify with greater confidence and precision where the best opportunities exist for intervention and what the next best choice for action is at given points in time.

We need to create the same strong and effective partnerships with multisectoral leaders and communities that we have for safety and health at work with management, government, workers, unions, and suppliers. Forging and sustaining these complicated partnerships, however, will be significantly more challenging. Unlike partnerships created in the pursuit of healthy workplaces and safe products, community public–private partnerships involve relatively autonomous parties, the need for compromise in strategies and tactics, demanding leadership and governance requirements, and challenging liability, funding, and other requirements. But these challenges can be overcome when motivated by shared significant hardship and when objectives are aligned, communication and accountability are clear, and collaborative ways of working are established.[30] Effective community public–private partnerships have addressed various community-wide needs ranging from infrastructure development to natural disasters, terrorism preparedness, infectious disease pandemics, and deaths from motor vehicle accidents.[31,32]

Employers have been deeply engaged historically in community improvement and crisis preparedness and are now increasingly becoming active participants in community health and environmental improvement partnerships. An early example is the Mid-America Coalition on Health Care in the Kansas City/Missouri area.[33] It began as an employer coalition focused on health care costs and outcomes of employees and their families and has since expanded to include diverse health stakeholders and broader initiatives in depression, cardiovascular disease, nutrition, fitness, and tobacco. Other partnerships have pursued a range of community health priorities ranging from water fluoridation and oral health to obesity, walkable communities, schools, chronic diseases, and access to primary care and medical homes.[34]

Community Partnerships

The role of social determinants in the health of populations including workers has been recognized for many years in the public health community,[29,35] but sustained and effective multisectoral partnerships for addressing these have been limited. Nevertheless, the threat to national economies and economic development from health care cost, equity, and access issues has garnered the attention of government and private sector leaders in an unprecedented fashion.[36] Government and private sector leaders now recognize that noncommunicable diseases, including cardiovascular, respiratory, cancer, diabetes, and injuries, are driving health care cost increases and disease burdens, are rooted in interactions among multiple sectors, and require community-based approaches for mitigating these impacts. Examples of such initiatives include the Million Hearts campaign sponsored by the US Department of Health and Human Services, the City of Philadelphia's campaign to reduce smoking and childhood obesity, and the Ripple Foundation's new ReThink Health initiative.

The Million Hearts Campaign involves extensive public–private partnerships to improve health care delivery system performance related to improved aspirin use, blood pressure control, cholesterol disorders control, and smoking reduction

("ABCS").[37] The campaign targets health care providers and outpatient health care facilities and uses reporting, measurements, and communication to promote engagement and change. Health insurers, pharmacy chains, and health care delivery systems are prominent employer partners in the campaign.

The "Get Healthy Philly" initiative of the City of Philadelphia is a multisectoral initiative designed to reduce smoking, increase physical activity, improve nutritious food consumption, and reduce rates of childhood obesity. Extensive collaboration is occurring in this initiative between diverse community sectors including the business community, city government agencies, community groups, health care payers and providers, the school system, and the media. Targets for improving the healthiness of the community in support of easy, healthy behaviors include changes to the physical environment (walkability, bike ability, parks, and recreation), school nutrition, retail food outlet stocks of fruits and vegetables, restaurant industry and food preparation, and tobacco control policies.[38]

The Ripple Foundation's mission is to bring innovation and systems thinking to major challenges in health and its main initiative is ReThink Health.[39] ReThink Health supports multisectoral collaboration strengthening leadership and the use of evidence-based approaches to stewardship of community resources along with training and tools for using systems science and taking action. In 2011, it began the Healthy Columbia, South Carolina campaign in zip code 29203 to improve access to primary care, reduce emergency department visits, and improve the health of the population. This region is characterized by high rates of uninsurance, hypertension, overweight, and diabetes and high rates of emergency department visits. The initiative has recruited strong participation and leadership from health care providers, private sector insurers and employers, the City of Columbia, South Carolina, the South Carolina Health Department and Environmental Control, and faith-based and other community organizations. Early priorities have included successfully recruiting and training leaders, engaging community members and initiating work to develop community-based wellness activities, health literacy interventions, and planning for improving access to primary care.

Citizen Health: A New Paradigm

The view of worker health as an outcome of more than the workplace has roots in our specialty of occupational and environmental medicine as alluded to by Jean Spencer Felton, MD, one of the most revered occupational medicine teachers and historians, when he wrote more than 50 years ago: "No patient-employee, when seen in the industrial dispensary or in the office of the consulting surgeon, can be viewed as the possessor of a single clinical entity unrelated to the life events which he experiences every day, day after day, in a continuum."[40] Social, environmental, and physical interactions outside the work environment are key to the initial development of healthy behaviors and to long-term health behavior change.[29] This suggests a need for a new paradigm for advancing the health of working people from workplace and worker-focused to community- and citizen-focused (Fig. 1). Citizen-centered health is a concept that has been used to frame the approach to healthy behavior that is dependent on changes to social and environmental enablers and inhibitors to " . . . bring about a way of life—at home, work, and school—that makes it easier for members of a community to adopt and maintain healthful practices."[41]

Workers as citizens challenge occupational and environmental professionals to extend further the boundaries and partnerships for better health of working populations by engaging communities. Achieving better health for greater productivity and lower health-related cost is dependent on the creation of healthier community environments and not just excellence in workplace health, wellness, and safety programs.

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Examining National Trends in Worker Health With the National Health Interview Survey

Sara E. Luckhaupt, MD, MPH and John P. Sestito, JD, MS

Objective: To describe data from the National Health Interview Survey (NHIS), both the annual core survey and periodic occupational health supplements (OHSs), available for examining national trends in worker health. **Methods:** The NHIS is an annual in-person household survey with a cross-sectional multistage clustered sample design to produce nationally representative health data. The 2010 NHIS included an OHS. **Results:** Prevalence rates of various health conditions and health behaviors among workers based on multiple years of NHIS core data are available. In addition, the 2010 NHIS-OHS data provide prevalence rates of selected health conditions, work organization factors, and occupational exposures among US workers by industry and occupation. **Conclusions:** The publicly available NHIS data can be used to identify areas of concern for various industries and for benchmarking data from specific worker groups against national averages.

The magnitude and correlates of work-related health conditions and potentially hazardous working conditions need to be more-fully understood before we can mitigate them, and this understanding requires collection and interpretation of data followed by the dissemination of these data to stimulate public health action (public health surveillance). The data sources that are traditionally used for surveillance of occupational injuries and illnesses include case reports to state public health agencies, the Bureau of Labor Statistics Survey of Occupational Illness and Injury, workers' compensation records, and the National Institute for Occupational Safety and Health (NIOSH) National Electronic Injury Surveillance System Work-Related Injury and Illness Supplement. These data sources provide important information, especially regarding the causes of occupational injuries, but they have many limitations such as incomplete coverage (eg, exclusion of self-employed workers, workers on small farms, and some government employees in the Bureau of Labor Statistics Survey of Occupational Illness and Injury), and most sources only capture occupational injuries and illnesses that are reported to employers or health care professionals.

Many of these limitations can be addressed by using a periodic household-based survey that is representative of the entire civilian noninstitutionalized US population, to examine national trends in worker health. The National Health Interview Survey (NHIS) fits this description and has been used to examine national trends in worker health. One of the most important features of the NHIS is that the data are publicly available on-line.

From the Division of Surveillance, Hazard Evaluations, and Field Studies, National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention, Cincinnati, Ohio.

Both the authors are federal government employees, and the National Health Interview Survey and the preparation of this manuscript were completely funded by the US government.

The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health or the National Center for Health Statistics.

The authors declare no conflicts of interest.

Address correspondence to: Sara E. Luckhaupt, MD, MPH, National Institute for Occupational Safety and Health, 4676 Columbia Pkwy, R-17, Cincinnati, OH 45226 (pks8@cdc.gov).

DOI: 10.1097/JOM.0000000000000034

Data about workers from the NHIS can be used to track the burden of morbidity, disability, and specific health conditions among all US workers; compare these burdens among worker subgroups to prioritize limited public resources for occupational health; and provide industry-specific estimates to industry stakeholders to prioritize industry-wide interventions and to employers to benchmark the health of their workers against industry averages to prioritize organization-level interventions.

METHODS

The National Health Interview Survey

The NHIS is an annual in-person household survey that has been conducted by the National Center for Health Statistics (NCHS) since 1957. It uses a cross-sectional multistage clustered sample design to produce nationally representative health data. Approximately 35,000 to 40,000 households are surveyed annually. The NHIS consists of a core set of questions that remain relatively unchanged from year to year and supplemental questions that vary from year to year. The National Institute for Occupational Safety and Health sponsored occupational health supplements (OHSs) in 1980, 1988, and 2010. It plans to sponsor another NHIS-OHS in 2015.

Some basic demographic and health information is collected about each family member in each household. Detailed demographic and health questions are asked about 1 sample adult (and 1 sample child, if applicable) from each family. More information about the NHIS can be found at http://www.cdc.gov/nchs/nhis.htm.

Data Available From Core Sample Adult Questionnaire

The core Sample Adult Questionnaire collects sociodemographic information, such as the respondent's sex, age, education, race/ethnicity, and household income. Respondents are asked about several specific health conditions, including injuries/poisonings (3-month recall period), acute conditions (eg, head/chest cold in past 2 weeks), and chronic conditions (eg, hypertension, diabetes, and low back pain). The health status section includes questions about days spent in bed and activity limitations. Health behaviors addressed include tobacco and alcohol use, physical activity, and influenza vaccination, while the health care utilization section addresses issues such as insurance coverage and whether the respondent has a usual place to go for health care.

The NHIS's utility for examining national trends in worker health comes from the fact that the core Sample Adult and Family Questionnaires include questions about the respondent's employment status and several other factors related to his or her current job (or longest-held job in the case of retired workers), such as industry and occupation, class of worker (eg, self-employed, government, and private), the average number of hours worked per week, duration of employment, the number of workers employed at the respondent's workplace, wage/salary, and the availability of certain benefits (eg, employer-sponsored health insurance and paid sick leave). Workers are also asked about the number of days of work they missed because of illness or injury during the past 12 months.

Data Available From the 2010 OHS

The National Institute for Occupational Safety and Health sponsored an OHS to the 2010 NHIS to provide current, national estimates on the prevalence of common workplace exposures and health conditions that are often work-related. The supplement was designed to collect information relevant to worker health beyond what is available from the core NHIS questions.

Information was collected on workers' longest-held jobs to supplement the information about workers' current jobs already available through the core NHIS Sample Adult Questionnaire. Because many occupational hazards have long latent periods or the effects are greatest with cumulative exposure, it is important to know about a person's longest-held job.

Data were also collected on employment arrangements and work schedules and on several key hazardous occupational psychosocial and physical exposures for which recent data were not previously available at a national level. All exposures were assessed with regard to the respondent's current/most-recent job, except for exposure to vapors, gas, dust, or fumes, which was assessed for the respondent's longest-held job.

Finally, information was collected on three health conditions that are commonly related to work (asthma, skin conditions, and carpal tunnel syndrome) to estimate the burden of work-related illness. For these conditions, occupational origin was assessed by asking survey respondents specific questions about their clinicians' opinions of the work-relatedness of the conditions and whether they filed for workers' compensation for these conditions. These were similar to questions included in the 1988 NHIS-OHS.

RESULTS

Using recent NHIS data, NIOSH staff have published analyses of the prevalence of several targeted health conditions and health behaviors by industry and occupation categories, including hearing difficulty attributable to employment,[1] short sleep duration,[2] asthma,[3] and chronic obstructive pulmonary disease.[4]

New Set of NIOSH Documents Based on Core NHIS Data, 1997–2007

The National Institute for Occupational Safety and Health has also partnered with researchers from the Occupational Research Group at the University of Miami (see http://www.umiamiorg.com/index.htm) to produce several reports about worker health on the basis of NHIS core data, including a recently released series of reports developed to describe the prevalence of disability and morbidity among current workers within eight National Occupational Research Agenda (NORA) sectors (Table 1).

Each sector report includes charts and tables for 27 outcomes, showing the prevalence of the outcomes by NORA sector and the prevalence of the outcomes by demographic subgroup within the specific NORA sector. Demographic subgroups include sex, race, ethnicity, age group, education, and insurance status. The outcomes described in these documents, which are all based on self-report, fall into 5 categories: health status, physical activity limitations, chronic conditions, health care utilization, and health risk factors or behaviors.

Figure 1 is an example of the type of results included in these documents. Among workers in all NORA sectors, 5.3% rated their health fair or poor. The highest prevalence rates of fair/poor self-rated health by sector were in mining (6.5%); agriculture, forestry, and fishing (6.2%); and health care and social assistance (5.8%).

Results Based on the 2010 NHIS-OHS

Although data from the 2010 NHIS-OHS have been available only since July 2011, these have already been extensively used in several articles. Six reports describing the prevalence of the key workplace exposures and work-related health conditions covered in the 2010 NHIS-OHS have been published.[5–10]

Data from the 2010 NHIS-OHS were also the basis for a *Morbidity and Mortality Weekly Report* article about short sleep duration among workers that attracted much national media attention because it provided the first national estimates of the magnitude of the problem of short sleep duration among workers working alternative (eg, night) shifts.[11] *Morbidity and Mortality Weekly Report* also published two QuickStats features based on 2010 NHIS-OHS data in December 2011.[12,13] We used 2010 NHIS-OHS data to perform an updated assessment of the relationship/correlation between current/most recent job and longest-held job,[14] which is important because many sources of occupational health surveillance data do not make a clear distinction between these job constructs.

We also prepared profiles for each NORA sector presenting key outcomes from the 2010 NHIS-OHS, which are available on-line (Table 2; http://www.cdc.gov/niosh/topics/nhis/). These include the eight sectors represented in the NIOSH documents based on core NHIS data, 1997–2007, described earlier, plus public safety, which became a separate NORA sector in 2008. (Oil and gas extraction has also become a separate sector, but it was combined with the mining sector for these profiles because of small sample sizes.) These

TABLE 1. Information About NIOSH Documents Based on Core National Health Interview Survey Data, 1997–2007

NORA Sector	Link	# in NHIS Sample, 1997–2007	Estimated Annual Population Represented by Sample	Weighted % of Sample Adults Employed at Time of Survey
Agriculture, forestry, and fishing	http://www.cdc.gov/niosh/docs/2012-154/	4,378	2,694,267	2.12
Mining	http://www.cdc.gov/niosh/docs/2012-155/	726	514,699	0.41
Construction	http://www.cdc.gov/niosh/docs/2012-156/	13,626	9,442,958	7.44
Manufacturing	http://www.cdc.gov/niosh/docs/2012-157/	26,679	17,581,632	13.85
Wholesale and retail trade	http://www.cdc.gov/niosh/docs/2012-158/	33,505	21,885,852	17.25
Transportation, warehousing, and utilities	http://www.cdc.gov/niosh/docs/2012-159/	12,871	8,317,014	6.55
Services	http://www.cdc.gov/niosh/docs/2012-160/	77,835	49,913,381	39.33
Health care and social assistance	http://www.cdc.gov/niosh/docs/2012-161/	27,304	16,548,227	13.04
Total		196,924	126,898,030	100

NIOSH, National Institute for Occupational Safety and Health; NORA, National Occupational Research Agenda.

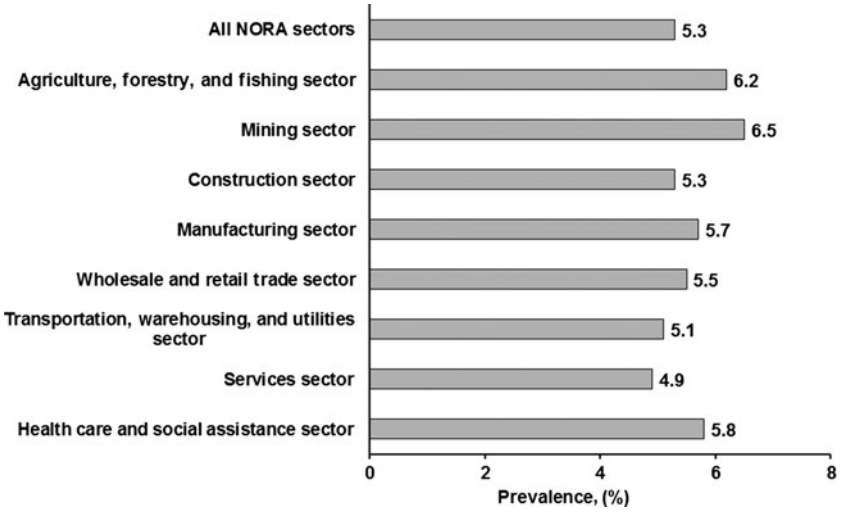

FIGURE 1. Sample chart of prevalence of fair or poor self-rated health status estimated for workers aged 18 years and older by NORA sectors from the National Institute for Occupational Safety and Health documents based on core National Health Interview Survey data, 1997–2007. NORA, National Occupational Research Agenda.

TABLE 2. Information About Sector Profiles Based on the 2010 National Health Interview Survey Occupational Health Supplement*

NORA Sector	Link	# in NHIS Sample, 2010 (Sample Adults Employed in Past 12 mo)	Estimated Annual Population Represented by Sample	Weighted % of Sample Adults Employed in Past 12 Mo
Agriculture, forestry, and fishing	http://www.cdc.gov/niosh/topics/nhis/agriculture.html	269	2,307,864	1.5
Mining and oil and gas extraction	http://www.cdc.gov/niosh/topics/nhis/mining.html	75	720,938	0.5
Construction	http://www.cdc.gov/niosh/topics/nhis/construction.html	1,115	10,639,327	7.0
Manufacturing	http://www.cdc.gov/niosh/topics/nhis/manufacturing.html	1,590	14,555,583	9.5
Wholesale and retail trade	http://www.cdc.gov/niosh/topics/nhis/wholesale.html; http://www.cdc.gov/niosh/topics/nhis/retail.html	2,191	20,994,763	13.7
Transportation, warehousing, and utilities	http://www.cdc.gov/niosh/topics/nhis/transind.html; http://www.cdc.gov/niosh/topics/nhis/transocc.html	854	7,638,934	5.0
Services	http://www.cdc.gov/niosh/topics/nhis/service.html	8,467	73,941,622	48.3
Health care and social assistance	http://www.cdc.gov/niosh/topics/nhis/healthcareind.html; http://www.cdc.gov/niosh/topics/nhis/healthcareocc.html; http://www.cdc.gov/niosh/topics/nhis/healthcareoccsa.html	2,478	20,520,877	13.4
Public safety	http://www.cdc.gov/niosh/topics/nhis/public.html	204	1,771,159	1.2
Total	http://www.cdc.gov/niosh/topics/nhis/allnora.html	17,227	152,978,419	100

*All sectors were defined by industry codes, except for *public safety*, which was defined by occupation codes. Public safety workers in service industries ($n = 188$) are excluded from the services sector estimates, but public safety workers in other industries are included in the estimates for those industry sectors in addition to being included in the public safety sector estimates. The mining and oil and gas extraction sectors were combined because of small sample sizes.

NORA, National Occupational Research Agenda.

profiles each contain charts and tables describing the prevalence of 14 outcomes.

Results are categorized by industry, occupation, or both subgroups within each sector profile on the basis of the subgroup preferences/requests of the sector leadership. These subgroups are defined by US Census Bureau industry and occupation codes (see http://www.census.gov/hhes/www/ioindex/crosswalks.html). Some of these subgroups are included in the public use NHIS data sets described hereafter, but others are only available through the NCHS Research Data Center (see http://www.cdc.gov/rdc/). An additional

profile compares sector-level results and includes some additional outcomes that cannot be shown for subsectors because of small subsamples.

Sample results from the articles and NORA sector profiles include that among US workers in 2010,

- 9.8% experienced dermatitis in the past year;
- 3.1% experienced carpal tunnel syndrome in the past year and 67.1% of these cases were attributed to work;
- 7.2% experienced asthma in the past year and 6.6% of these cases were attributed to work;
- 18.7% of those with one job worked 48 or more hours per week and 7.2% worked at least 60 hours per week;
- 18.7% had nonstandard work arrangements;
- 7.2% had temporary positions;
- 28.7% worked nonstandard shifts (eg, nights);
- 16.3% reported having trouble combining work and family responsibilities;
- 31.7% worried about becoming unemployed;
- 7.8% had been threatened, bullied, or harassed on the job;
- 20.6% experienced frequent occupational skin contact with chemicals;
- 24.7% frequently worked outdoors;
- 10.0% of nonsmokers were regularly exposed to secondhand smoke at work; and
- 25.0% reported chronic exposure to vapors, dust, gas, or fumes on the job.

Figure 2 shows the prevalence of nonstandard shifts by NORA sector as an example of the type of charts included in the on-line sector profiles. Preliminary analyses (unpublished) suggest that all of the hazardous occupational psychosocial and physical exposures covered in the 2010 NHIS-OHS are associated with increased odds of fair/poor self-rated health among exposed workers compared with unexposed workers.

DISCUSSION

Accessing and Analyzing NHIS Data

One of the most important features of the NHIS is that the data are publicly available on-line. Therefore, anyone can download the data and analyze it according to their specific surveillance or research interests rather than having to rely only on published reports. The public data sets are available on the NCHS Web site at http://www.cdc.gov/nchs/nhis/quest_data_related_1997_forward.htm. All direct identifiers, as well as any characteristics that might lead to identification (eg, 4-digit industry and occupation codes), are omitted from the public use data files. The public use files recode workers into 20 simple and 78 detailed industry groups, and 22 simple and 93 detailed occupational groups. There are multiple data sets for each year because of the organization of the survey into household, family, sample adult, and sample child components. Extensive survey documentation and sample analysis programs are also available.

The complex sample design of the NHIS requires special analytic procedures. The National Center for Health Statistics provides sample SAS (SAS Institute Inc, Cary, NC), Statistical Package for the Social Sciences (SPSS, Chicago, IL), and Stata Statistics/Data Analysis (Stata Corp, College Station, TX) input statement programs for each data file and information about how to merge the data files so that variables from more than one data set can be combined for analysis. The 2010 NHIS-OHS questions are embedded within the Sample Adult Questionnaire, and the data are embedded within the sample adult data set.

The NHIS data are also available through the Integrated Health Interview Series (IHIS) Web site created by the University of Minnesota: http://www.ihis.us/ihis/. The IHIS is a harmonized set of data for more than 40 years (1969–2011) of the NHIS. The IHIS facilitates creation of multiyear NHIS data files by coding variables identically across time. The IHIS also provides some on-line analytic capability through the IHIS Online Data Analysis System, which uses high-speed tabulation software developed at University of California Berkeley's computer-assisted Survey Methods Program.

CONCLUSIONS: IMPLICATIONS FOR TOTAL WORKER HEALTH

The NHIS is a valuable tool for examining national trends in worker health. Published findings from the NHIS can be used to estimate the burden of morbidity, disability, and specific health conditions among US workers; prioritize limited public resources for occupational health; and prioritize industry-wide interventions. Researchers and others can also use the public NHIS data sets to calculate other national estimates of interest. The National Institute for Occupational Safety and Health investigators continue to examine the data from the NHIS-OHS for relationships between workplace exposures and health conditions or health behaviors, such as whether women who work alternative shifts are more or less likely than day-shift workers to be screened for breast cancer. We invite readers to perform analyses using their own unique knowledge and background. In addition, researchers and employers should consider

FIGURE 2. Sample chart of prevalence of nonstandard shifts among US adults who worked in the past 12 months from profile comparing all NORA sectors based on the 2010 National Health Interview Survey occupational health supplement. NORA, National Occupational Research Agenda.

including questions from the NHIS in workplace surveys to allow benchmarking of the health of their study population/workers against NHIS national estimates.

ACKNOWLEDGMENTS

The authors express their appreciation to the many other persons, both within and outside of NIOSH and NCHS, who contributed to study planning, questionnaire development, and/or review of previous drafts of this article. They include, but are not limited to, Geoff Calvert, Marie Haring Sweeney, Toni Alterman, Aaron Sussell, Jacek Mazurek, Jim Dahlhamer, and Brian Ward. The authors thank current and former members of the Occupational Research Group at the University of Miami who contributed to the reports based on 1997–2007 NHIS data, including David Lee, Evelyn Davila, William LeBlanc, Alberto Cabán-Martinez, Lora E. Fleming, Sharon Christ, Kathryn McCollister, and Kris Arheart. Finally, Jia Li, Jun Ju, and Yuping Han of NIOSH were instrumental in producing the 2010 NHIS-OHS on-line sector profiles.

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Characterizing the Needs of a Young Working Population

Making the Case for Total Worker Health in an Emerging Workforce

Diane S. Rohlman, PhD, Megan Parish, MPH, Diane L. Elliot, MD, FACSM, Dede Montgomery, MS, CIH, and Ginger Hanson, PhD

Objective: Young workers are at increased risk for occupational injuries. Many lack appropriate skills to avoid workplace hazards. In addition, existing safety programs neither address total worker health principles nor align with the relatively high technological expectations of young workers. This article aimed to identify the content and process for an on-line total worker health training for young workers. **Methods:** During the summer of 2012, an on-line survey ($n = 187$) assessed young workers' behavior, knowledge, and attitudes on total worker health topics and on-line training delivery methods. **Results:** Forty-five percent of the workers indicated this was their first job; new workers demonstrated lower safety knowledge scores than returning workers. In addition, results demonstrated that workers would benefit from health behavior interventions delivered through technology-based means. **Conclusions:** Findings characterize the work-related needs for this population and demonstrate the utility of using on-line training.

The work-related injury rate for workers younger than 25 years is approximately twice that of older workers.[1] The primary method of reducing risk to young workers is through the provision of effective and relevant training. Although employers are required to provide basic safety training to these new and younger workers, few implement programs designed to address the special needs of this workforce; furthermore, they do not include training on health promotion topics.[2]

Young workers are at an increased risk for on-the-job injuries, because they lack valuable skills and experience.[1,3] They are less likely to recognize hazards, speak up regarding safety concerns, or be aware of their legal rights as workers.[1] Adolescents, in particular, may have little or no knowledge of their rights at work and may be hesitant to report injuries to their supervisors.[3] Furthermore, the United States Occupational Safety and Health Act requires employers to provide health and safety information and instruction to all employees; however, a survey of young workers found that 84% of workers received little or no training related to health and safety in the workplace.[4] Inadequate knowledge about their rights can lead to underreporting of injuries experienced at work and consequently, unintended social, health care, and financial burdens on workers and their families.

Injury and illness are not the only risks to younger workers. Although young workers have similar stressors as older workers, they also face unique cultural expectations. For example, this population frequently juggles a combination of school, homework, family responsibilities, and social activities along with the demands of their jobs. A recent study of working students found that working 20 hours or more a week during the school year was associated with higher levels of emotional distress, more substance abuse, and earlier onset of sexual activity than experienced by students working less than 20 hours a week or not at all.[5]

From the Center for Research on Occupational and Environmental Toxicology (Dr Rohlman, Ms Parish, and Ms Montgomery) and Health Promotion and Sports Medicine (Dr Elliot), Oregon Health & Science University, Portland; Occupational and Environmental Health (Dr Rohlman), University of Iowa, Iowa City; and Kaiser Permanente Northwest (Dr Hanson), Center for Health Research, Portland, Ore.

Funding for this project was through the Oregon Healthy Workforce Center (www.ohsu.edu/ohwc), a National Institute for Occupational Safety and Health Total Worker Health Center of Excellence (grant: U19OH010154).

The authors declare no conflicts of interest.

Address correspondence to: Diane S. Rohlman, PhD, Occupational and Environmental Health, University of Iowa, Iowa City, IA 52242 (diane-rohlman@uiowa.edu).

DOI: 10.1097/JOM.0000000000000039

USE OF SOCIAL MEDIA

Survey data provide evidence of technologically savvy adolescents and young adults.[6] Adolescent and young adults typically own more gadgets (cell phones, mp3 players, computers, game consoles, and portable gaming devices) than adults, and they utilize these devices, in addition to computers, to allow them access to the Internet. By 2009, 93% of adolescents and young adults reported going on-line, and nearly two thirds report going on-line every day. While on-line, 82% of teens (14 to 17 years) report using social networking Web sites. The main motivation behind these activities seems to be for creative self-expression and to document and share personal experiences.[7] Therefore, incorporating social media methods (viral videos, images, and memes) into on-line trainings and promoting training opportunities through social networks already frequented by the young workforce would provide a mechanism to capitalize on already established, normative methods of communication in this group.

TOTAL YOUNG WORKER HEALTH

PUSH (Promoting U through Safety & Health) is a translational project, which blends existing programs into an on-line curriculum addressing both health promotion and occupational health protection. As part of the Oregon Healthy Workforce Center, PUSH addresses the National Occupational Research Agenda priority to "define the nature and magnitude of risks experienced by special populations," specifically in this case, young workers. The paper-based, instructor facilitated NIOSH-developed training, *Youth @ Work: Talking Safety*, has been combined with evidence-based curriculum on lifestyle factors[8] into an on-line, interactive training program.

The overall health of workers is impacted by both "work" and "nonwork" factors. A newer approach supported by the NIOSH Total Worker Health™ (TWH) initiative[9] is to integrate workplace health protection and health promotion principles to improve the overall quality of life of workers. In this report, we provide preliminary data on young workers' general health, occupational history, and social media habits. This study is the first to assess the utility and acceptability of an on-line TWH training for young workers.

METHODS

Participants

Young workers, 14 through 24 years of age, employed as staff in the aquatics division of a city park and recreation program, were recruited during the summer of 2012. A letter describing the study was provided to the workers during the staff orientation meeting.

Procedure

Participants were e-mailed a Web address to a 133-item on-line survey administered through Survey Gizmo. On completion of the survey, participants received a $5 gift card. The Oregon Health & Science University institutional review board approved the study materials and procedures.

Materials

Questionnaire items were used to collect demographic information, work history, lifestyle characteristics (sleep, diet, and substance use), risk-taking behavior, and social media use (Table 1). Specific measures were selected to complement data being collected in other projects in the Oregon Healthy Workforce Center to allow the development of a common database of information across industry, age ranges, and intervention methods.

RESULTS

During the summer of 2012, 348 young workers from the aquatics division at a city park and recreation program were recruited during the orientation meeting held before the start of the summer work season. E-mail invitations, with a link to the Web address of the on-line survey, and periodic reminder e-mails were sent in June. Seventy-three were invalid e-mail addresses, leaving a total of 275 invitations sent to young workers. One hundred eighty-seven completed the survey for a response rate of 68%. Because of the developmental changes occurring during adolescence and young adulthood, participants were stratified by age (younger than 18 years, and 18 years and older).

Work History

Most workers who completed the survey were female workers (65%), and the mean age of the participants was 17.9 (2.3) years. Those younger than 18 years, consisting primarily of high school students, were compared with workers aged 18 years and older, who may be entering college or their first full-time job. Participants aged 18 years and older had more work experience than workers younger than 18 years; this was the first job for 63% of workers younger than 18 years (Table 2). Older participants were also more likely to have a second job or to work during the school year. For those participants working during the school year, there was no difference by age on reported conflict from work, school, or family activities. The primary source for workplace safety information was employers (96%), followed by peers and coworkers (75%). For those who had worked previously, 34.7% reported receiving no safety training at work.

Health

Most participants were experiencing positive physical health; 35.6% reported their general health as good, 44.2% as very good, and 14.4% as excellent. Nevertheless, 20% reported "accomplishing less than they would like in their normal daily activities as a result of emotional problems, such as feeling depressed or anxious." Body mass index ranged from 15.02 to 35.86 kg/m^2, with a mean of 22.1 kg/m^2 (Table 2). Physical activity decreased with age, although most workers younger than 18 years (86%) and 18 years and older (72.3%) met or exceeded the aerobic activity recommendations from the CDC for adults, exercising at least 2.5 hours per week. Seventy-three percent got 7 or more hours of sleep a night, and 11.7% reported daytime sleepiness.

A surprisingly small number of participants ate sugary snacks (23.5%) or drank sugar-sweetened drinks (17.1%) on a daily basis, and most reported eating a meal from home (66.9%), for example, packing a lunch for work. Although a small number reported ever smoking a cigarette (18.2%), approximately a third had smoked marijuana at least once (33%). Only 4.2% reported smoking cigarettes or marijuana (5.7%) on a weekly basis. Alcohol consumption was higher, 27.8% reported drinking to the point of getting drunk in the last 30 days, and of them, 69.2% were younger than 21 years.

Social Media Use

Not surprisingly, all participants engaged in on-line activities, and 97% reported using the Internet at least once a day. Social

TABLE 1. Questionnaires and Assessment Tools Used to Measure Workplace and Wellness Factors

Worker Background	
Work history	Previous work history and training
Demographics	Age, sex, ethnicity, and education level
Social media habits	Internet use and access, social media habits, social networking activity, and attitudes about on-line content and information delivery[1]
School–family–work conflict	Conflict between school, family, and work demands[2]
General Well-being	
General health*	General health[3]
Psychological well-being*	Psychological health[3]
Body composition	Weight and height (BMI[4])
Nutrition*	National Cancer Institute Fruit and Vegetable Screener[5] and High Fat and High Sugar Food Intake 3-item survey[6]
Exercise*	The number of days of moderate or heavy exercise or strength training
Sleep*	Modified items from Pittsburgh Sleep Quality Index, including sleep duration, latency, and quality[7]
Lifestyle*	Frequency of various behaviors, such as alcohol, tobacco, and illicit substance use
Personality	
Emotional intelligence	Questionnaire of expression of emotion, regulation of emotion, and utilization of emotions in problem solving[8]
Risk behaviors	Assessed self-reported frequency of thrill-seeking, rebellious, reckless, or antisocial behaviors[9]
Knowledge	
Health protection	Content items related to *Talking Safety* curriculum
Health promotion	Content related to nutrition, physical activity, sleep, and mental resilience

*Common measures among projects in the Oregon Healthy Workforce Center.
BMI, body mass index.

TABLE 2. Survey Responses by Age, Presented as Group Percentage Total or Means and Standard Deviations

	Younger Than 18 yrs ($n = 93$)	18 yrs or Older ($n = 94$)
Grade point average (GPA)	3.7 (0.43)	3.4 (0.53)
Work history		
First job	63.4%	28.7%
<1 yr	7.5%	2.1%
1-3 yrs	26.9%	18.1%
> 4 yrs	2.2%	51.1%
Working more than 1 job	7.5%	24.5%
Work during school year	38%	73%
School–work–family conflict*	3.7 (0.8)	3.6 (0.8)
BMI†	21.39 (2.75)	22.76 (3.15)
Underweight	2.2%	2.1%
Healthy	89.1%	80.9%
Overweight	6.5%	13.8%
Obese	2.2%	3.2%
Physical activity, d/wk		
Strength training	4.2 (2.3)	3.7 (2.1)
60-min cardio†	5.7 (2.0)	5.0 (2.1)
Work up a sweat†	5.5 (1.9)	4.9 (1.9)
Emotional intelligence‡	74.1 (14.9)	73.2 (11.2)
Risk-taking total§	0.59 (0.30)	0.79 (0.40)
Knowledge, % correct†	63%	71%

*For participants who report working during the school year; scale of 1 to 5, with 5 indicating greater conflict.

†Significant differences between workers younger than 18 years and workers aged 18 years and older ($P < 0.05$).

‡Self-reported measure of general emotional intelligence.

§Measure of real-world adolescent risk-taking behavior.

BMI, body mass index.

networking sites were frequently used: 74.3% checked Facebook daily, 42.8% checked YouTube daily, 19.8% checked Twitter daily, and 13.9% checked Tumbler daily. These workers used the Internet to find information; most had gone on-line to find health-related information (71.7%), and a smaller number had also gone on-line to find safety-related information (18.2%). Approximately half of the workers were willing to receive workplace safety information delivered electronically, either by e-mail or text message (50.3%), presented on laptop, cell phone, iPod, or other portable device (52.4%), or to go on-line to find this information (52.4%).

Knowledge

Workers were asked 35 multiple-choice questions related to health promotion and safety topics, such as rights, safety protocols, professional communication, nutrition, and sleep. Workers aged 18 years and older had significantly more correct responses to the knowledge questions than workers younger than 18 years (Table 2). Both younger and older workers (51% and 56% correct, respectively) had difficulty with general safety questions taken directly from the *Talking Safety* curriculum, addressing topics such as identifying and controlling hazards in the workplace. Workers younger than 18 years also had more incorrect responses on items related to workers' rights than older workers (63% compared with 77% correct, respectively). In addition, there were differences between the groups on questions addressing general health and other health promotion topics such as the impact of sleep, caffeine, and alcohol consumption on health (65% correct for younger and 72% correct for older workers).

DISCUSSION

Young workers have unmet needs—many arrive to the workplace with no safety training or knowledge about their rights and responsibilities. Almost half were first-time workers, and of those who had worked previously, more than one third lacked safety training. Knowledge of workplace safety practices was low, particularly for the youngest workers; workers younger than 18 years were less familiar with their legal rights and lacked information about identifying and controlling hazards in the workplace.

Overall, general health in these workers was good; most exercised regularly, limited unhealthy food options, and got adequate sleep. Nevertheless, a subset of respondents reported poor mental health, inadequate exercise, and engagement in risky behaviors, including substance abuse. A subset of participants, including those underaged, report drinking to the point of getting drunk, indicating specific areas for improvement identified by this survey. Programs that promote healthy behaviors in adolescents have been shown to have durable positive outcomes that can lead to the development of habits that persist into adulthood.[10–12]

A limitation of the study is that the population consisted primarily of lifeguards and swim instructors with a narrow demographic background (mostly white with high grade point averages), who may be more active because of the nature of their work, and less representative of all young workers. Furthermore, the employer we partnered with to recruit participants includes both safety and health promotion as part of their training, potentially contributing to the high knowledge scores and overall trend toward health. One strength of this project is that it is the first study to look at the feasibility and utility of developing and disseminating an on-line health and safety training for young workers. This exploratory research project has given researchers useful data that will drive the development of the PUSH training curriculum.

Adolescents and young adults are major consumers of technology and three quarters of our population reported frequenting social networking sites daily. The Internet was a source of health-related information for most participants and for workplace safety information for some. Participants indicated that they would be willing to learn from a technologically delivered health and safety curriculum. Safety information is not being provided in the school setting but rather through the employer and peers. An on-line training would serve as an appropriate companion training to the job-specific safety training young workers should receive when beginning a new job. Using technology and social networking sites has been recognized as a way to deliver health protection and health promotion information to this at-risk group.[13,14]

The focus of the NIOSH TWH initiative is to integrate workplace health protection and health promotion principles to improve the overall quality of life of workers. PUSH utilizes an on-line curriculum for total young worker health that combines an existing safety curriculum with health promotion aspects relevant to young individuals. Establishing their needs allowed us to prioritize content; furthermore, findings confirmed that e-TWH is an appropriate delivery method for today's emerging adult workers.

ACKNOWLEDGMENTS

We thank Portland Parks and Recreation for their enthusiastic support of this project, particularly Barbara Aguon, Larissa Doty, and Nancy Roth. We also thank our summer interns, Eric Serres and Hannah White, for their contributions to the project.

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An Employee Total Health Management–Based Survey of Iowa Employers

James A. Merchant, MD, DrPH, David P. Lind, CEBS, Kevin M. Kelly, PhD, and Jennifer L. Hall, EdD, MCHES

Objective: To implement an Employee Total Health Management (ETHM) model–based questionnaire and provide estimates of model program elements among a statewide sample of Iowa employers. **Methods:** Survey a stratified random sample of Iowa employers, and characterize and estimate employer participation in ETHM program elements. **Results:** Iowa employers are implementing less than 30% of all 12 components of ETHM, with the exception of occupational safety and health (46.6%) and workers' compensation insurance coverage (89.2%), but intend modest expansion of all components in the coming year. **Conclusions:** The ETHM questionnaire-based survey provides estimates of progress Iowa employers are making toward implementing components of Total Worker Health programs.

The case for change for transforming employee health programs into integrated employee well-being programs has been articulated by three interrelated reports.[1–3] The 2004 National Institute for Occupational Safety and Health *Steps to a Healthier U.S. Workforce Conference* influenced the foundation of the National Institute for Occupational Safety and Health WorkLife Initiative, since transitioned to the National Institute for Occupational Safety and Health Total Worker Health™ (TWH) Program (www.cdc.gov/niosh/TWH), which supports The University of Iowa Healthier Workforce Center for Excellence (HWCE).[4] The concept of worker well-being, which underpins TWH, has gained recognition globally over the last decade and was the subject of the 2010 *Towards Better Work and Well-being Conference* in Helsinki, drawing 190 participants from 30 countries.[5] Despite this widening recognition, the concept of TWH is not well understood by the vast majority of employers. In the United States, this is particularly so among small employers (fewer than 50 employees), which constitute more than 97% of Iowa employers. Although small employers are still primarily motivated by workplace regulations, incentives offered by the public health and prevention provisions of the Patient Protection and Accountable Care Act will likely influence future behavior.

The University of Iowa HWCE has sought, through its outreach conferences, surveys, technical reports, and electronic bulletins, to make Iowa employment stakeholders more aware of the benefits of fully integrated employee health protection and promotion, or TWH, programs. We have partnered with David P. Lind Benchmark (DPLB), an Iowa health benefit evaluation company, which has conducted 14 annual Iowa Employer Benefit Studies (www.dplindbenchmark.com), first to enhance the DPLB Health and Wellness Initiatives module, and for its 2012 study to develop and implement an expanded Health and Wellness Initiatives module based on elements of the Employee Total Health Management (ETHM) model, as articulated by the Institute of Medicine (IOM) (Fig. 1).[1] This model seeks to describe the components of an integrated and sustainable approach to total employee health management, while the IOM also makes the case that such programs must be integrated and measurable to be effective and sustainable. Hence, TWH programs must include health protection and health promotion program components, which together include several modifiable risk factors that have been linked to increased sickness absenteeism, increased presenteeism, and reductions in preventable health care costs.[6–8] Nevertheless, these findings are based on studies of large employers that include many if not all of these program components, but which also organize their employee health programs to ensure integration of health protection and health promotion programs. Although available evidence makes clear that integration of employee health programs is important, the methodology for defining and measuring integration is still developing and is not the focus of this study.[9,10]

To fully describe employer adoption of TWH would require assessment of both ETHM program components and measures of program organization and integration. The goal of this 2012 survey of a sample of Iowa employers was to translate the ETHM into a 12-item questionnaire suitable for use for a statewide survey of employers of all sizes, and to provide estimates of the ETHM model component adoption among these employers.

METHODS

A total of 107,940 eligible employers were identified from the Iowa Dun & Bradstreet database for employers with two or more employees (2012). Organizations were stratified by the number of employees (2 to 9, 10 to 19, 20 to 49, 50 to 249, 250 to 999, and 1000 or more), using proprietary randomization software developed by Data Point Research under contract with DPLB. A stratified random sample of 5606 employers was selected for the 2012 survey. Data were collected from a total of 1206 organizations through Web-based questionnaires and with telephone follow-up.

The ETHM questionnaire is an elaboration of eight previous DPLB Health and Wellness Initiatives modules included in Iowa Employer Benefit surveys of more than 7400 employers. Items used in previous surveys included medical information (Web site, newsletter, etc), blood pressure/cholesterol screening, chronic disease management, smoking cessation/weight control wellness programs, health risk assessment, and health club discount or other incentives. The HWCE provided collaboration on the design of the previous questionnaire and contracted with DPLB to administer the current ETHM questionnaire, which used the same format and many of the same items included in previous DPLB surveys (see Table 1 for the full questionnaire). Survey data included employment sector, organization size, rural or urban location as defined by United States Department of Agriculture Rural–Urban Continuum Codes,[11] insurance coverage, and health and wellness module responses. All analyses were conducted at the HWCE using SAS, version 9.2 (SAS Institute, Inc, Cary, NC).

RESULTS

A total of 888 organizations with fewer than 50 employees, 232 with 50 to 249 employees, and 91 with 250 or more employees participated in the survey. The response rate was 21.5%. The margin

From the Healthier Workforce Center for Excellence (Drs Merchant, Kelly, and Hall), Department of Occupational and Environmental Health, College of Public Health, University of Iowa, Iowa City; and David P. Lind Benchmark (Mr Lind), Clive, Iowa.

This study received funding from the National Institute for Occupational Safety and Health grant 5U19OH008868.

The authors declare no conflicts of interest.

Address correspondence to: James A. Merchant, MD, DrPH, Healthier Workforce Center for Excellence, Department of Occupational and Environmental Health, College of Public Health, University of Iowa, 118 IREH, University Research Park, Iowa City, IA 52242 (james-merchant@uiowa.edu).

DOI: 10.1097/JOM.0000000000000045

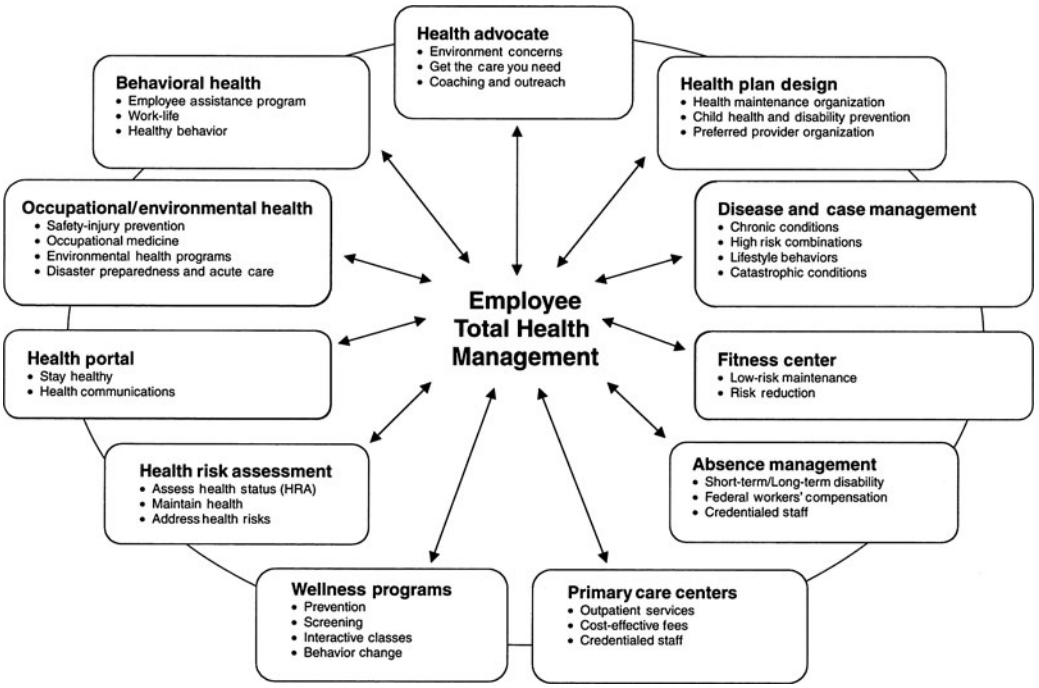

FIGURE 1. Institute of Medicine Employee Total Health Management model. Reprinted with the permission from the National Academies of Sciences. HRA, health risk assessment.

TABLE 1. Employers Offering or Considering Health and Wellness Programs

Employer Total Health Management Questionnaire Items	Currently Offers	Plans to Offer in the Next 12 mo
Does your organization currently offer health or medical information, such as a Web site or newsletter?	28.4% (340/1199)	7.0% (84/1199)
Does your organization currently offer health advocacy, such as health counseling or coaching?	16.3% (195/1199)	3.3% (40/1199)
Does your organization currently offer a health risk assessment program either on paper or computer?	16.8% (201/1199)	3.5% (42/1199)
Does your organization currently offer a health screening program, such as one that would include screenings for blood pressure, obesity, blood sugar, cholesterol, lung function, vision, or hearing?	19.0% (228/1199)	2.8% (33/1199)
Does your organization currently offer a chronic disease management program, such as one that addresses heart disease, diabetes, hypertension, or COPD?	13.3% (159/1199)	2.1% (25/1199)
Does your organization currently offer a wellness program, such as one that addresses smoking cessation, weight control, or exercise and fitness routines?	18.3% (219/1199)	3.5% (42/1199)
Does your organization currently provide or sell healthy food options to employees?	16.6% (199/1199)	1.4% (17/1199)
Does your organization currently offer a health incentive program, such as health club membership, cash bonuses for participation, or insurance premium discounts?	14.8% (178/1199)	2.9% (35/1199)
Does your organization currently retain or contract with a health care provider, such as a physician, physician assistant, or nurse practitioner?	7.4% (89/1199)	1.1% (13/1199)
Does your organization currently offer an occupational safety and health program, such as programs on worksite safety, industrial hygiene, ergonomics, environmental exposure control, or disaster preparedness?	46.6% (559/1199)	1.8% (21/1199)
Does your organization currently offer a behavioral health program to provide employees with counseling for alcohol, drugs, depression, or work-life assistance?	21.4% (257/1199)	1.2% (15/1199)
Does your organization currently provide workers' compensation insurance?	89.2% (1069/1199)	1.2% (15/1199)
Does your organization currently have a credentialed disability management specialist?	3.2% (38/1199)	0.6% (7/1199)

COPD, chronic obstructive pulmonary disease.

of error for all organizations employing fewer than 250 employees was 2.9%, and for all employers with 250 or more employees, the margin of error was 9.3%.

Employers by organization size and Standard Industrial Classification code, which distributes the population over eight employment sectors, are summarized in Table 2. Seven employers did not fall within any of these Standard Industrial Classification codes and were eliminated from further analysis. As is evident within all employment sectors, this sample provides employee distributions that are predominantly small, nearly a third employing 9 or fewer employees and nearly three quarters employing fewer than 50 employees. The largest employment sectors are services, retail trade, and manufacturing, which together constituted two thirds of the sample.

More than half of the organizations participating in this survey are located in rural counties, which include 55% of companies with 9 or fewer employees (Table 3), while organizations employing at least 250 employees are located primarily in urban counties. Only 51% of the smallest organizations offer health insurance, while organizations employing at least 50 employees reported nearly universal health care coverage (96%). Organizations employing at least 250 employees were frequently self-insured, while organizations employing less than 50 employees (of those which offer health insurance) offered fully insured policies more than 85% of the time.

The prevalence of organizations offering ETHM program components are summarized in Table 1. The most frequent response (89%) was provision of workers' compensation insurance, required by law for most Iowa employers. Nearly 47% of employers reported having an occupational safety and health program, an essential element of TWH programs. Other program elements were much less prevalent, led by programs on health or medical information, behavioral health, wellness, having a health risk assessment, and health advocacy. Employers collectively indicated that they intended to increase offering all ETHM program components

TABLE 2. Employers by Employment Sector and Organization Size

Major Employment Sectors Frequency Percentage	Organization Size						
	2–9	**10–19**	**20–49**	**50–249**	**250–999**	**1000+**	**Total**
Construction	4	10	10	5	0	1	30
	0.33	0.83	0.83	0.42	0.00	0.08	2.50
Manufacturing	66	50	43	38	10	2	209
	5.50	4.17	3.59	3.17	0.83	0.17	17.43
Transportation and public utilities	8	8	11	12	1	0	40
	0.67	0.67	0.92	1.00	0.08	0.00	3.34
Wholesale trade	3	13	15	8	6	0	45
	0.25	1.08	1.25	0.67	0.50	0.00	3.75
Retail trade	104	68	32	11	2	1	218
	8.67	5.67	2.67	0.92	0.17	0.08	18.18
Finance, insurance, and real estate	40	46	25	19	10	6	146
	3.34	3.84	2.09	1.58	0.83	0.50	12.18
Services	76	88	71	95	30	13	373
	6.34	7.34	5.92	7.92	2.50	1.08	31.11
Public administration	48	19	25	38	7	1	138
	4.00	1.58	2.09	3.17	0.58	0.08	11.51
Total	349	302	232	226	66	24	1199
	29.11	25.19	19.35	18.85	5.50	2.00	100.00

TABLE 3. Location and Insurance Coverage by Organization Size

	Organization Size						
	2–9	**10–19**	**20–49**	**50–249**	**250–999**	**1000+**	**Total**
Rural	55.0% (191/347)	14.1% (168/301)	53.2% (123/231)	55.8% (126/226)	38.5% (25/65)	20.9% (5/24)	53.4% (638/1194)
Offers health insurance	51.3% (179/349)	77.2% (233/302)	87.5% (203/232)	96.5% (218/226)	96.7% (64/66)	91.7% (22/24)	46.6% (556/1194)
Offers a self-insured health insurance policy*	11.8% (20/169)	10.7% (24/224)	16.9% (32/189)	36.0% (71/197)	66.7% (40/60)	90.0% (18/20)	23.9% (205/859)
Offers a fully insured health insurance policy†	88.2% (149/169)	89.3% (200/224)	84.1% (159/189)	66.0% (130/197)	33.3% (20/60)	10.0% (2/20)	76.8% (660/859)

*A self-funded plan in which employer assumes financial risk for health care benefits.
†Employee health insurance plan provided through a health insurance carrier.

in the next 12 months, most frequently planning to offer new health information programs (7%). Larger employers (more than 50 employees) planned to offer new program components more frequently than did small employers; organization responses by Standard Industrial Classification code found inconsistent participation across industrial sectors, led by public administration (see www.hwce.org for these additional results).

The distribution of program participation by company size found only organizations employing nine or fewer employees to have less than 90% workers' compensation insurance coverage (Table 4). Only a third of 2- to 9-employee organizations reported having occupational health and safety programs, a prevalence that increased to nearly 80% among organization employing 1000 or more employees. Similar progressions in prevalence by organization size were observed for all other ETHM program components.

DISCUSSION

Development of the ETHM questionnaire, based on a model described by the IOM,[1] provides a framework to describe and quantify employer participation in providing individual components of this model. As Iowa begins to implement the prevention provisions of Patient Protection and Accountable Care Act, this questionnaire will provide a TWH tool to assess statewide progress as employers provide the building blocks for a TWH approach to safer and healthier workplaces

Very few population-based data are available for small employers, especially for companies employing two to nine employees; yet 90% of workplaces are of this size in Iowa and many other more rural states. As has been documented by all previous Iowa Employer Benefit Studies, these smaller employers are usually not able to offer health insurance, so the modest number of small employers offering health and wellness program components is not surprising. The ETHM questionnaire contained several Health and Wellness Initiative questions included in previous DPLB surveys, and the annual survey-to-annual survey results on these large samples of Iowa employers are remarkably consistent—in general, finding increasing participation with time. Consistent with previous results, employers intend, for all ETHM program elements, to extend their offerings in the coming year.

This survey estimates only employer participation in offering the 12 ETHM program components, but did not seek to measure integration of these employee health programs. Nevertheless, several of these program components are essential for measurement of modifiable risk factors known to be important predictors of preventable health care costs, sickness absenteeism, and presenteeism.[6–8] Among large employers participating in the cited studies, risk has been found to decrease because employees actively engage in more complete prevention programs, the most successful of which include individual coaching to optimize individual employee behavior[8] Exactly how even large employers organize and administer their integrated employee health programs, while known to be important and advocated by the IOM, is less clear.[1] The first organizational priority recommended by the IOM was transformational leadership, which has recently been shown to have a positive effect on employee well-being.[12] Development of valid and reliable methods to assess organizational measures of integrated employee health programs continues to be an important research priority.[9] Another research priority necessary to fully realize the benefits of TWH programs is go beyond measurement of risk factors to base program impact on measures of employee well-being, absenteeism, and presenteeism.

LIMITATIONS

The generalizability of the results of this study is limited by the response rate of this survey. Nevertheless, this health and wellness survey is a further iteration of eight previous annual surveys of large, random samples of predominantly small Iowa employers for which there is an acceptable margin of error of 2.9%. For the six items common to the previous DPLB survey module and ETHM questionnaire, the year-to-year results are remarkably consistent, suggesting this instrument is providing reliable and valid results for these items. The study has a number of strengths, including assessment of a large random statewide sample of predominantly small Iowa employers for which little research is available, and population-based employer estimates of adoption of components of an IOM-endorsed ETHM model.

CONCLUSIONS

This statewide survey of health and wellness program activities provides useful estimates from a random statewide sample of employers. This is important because it provides unique data about small employers, the employment segment that faces the greatest challenge in both providing employees with health insurance and health and wellness benefits. These data build on previous annual DPLB surveys and provide a benchmark for future adoption of TWH program components in Iowa. As the United States shifts to a more health-based model of health care, this survey instrument may be

TABLE 4. Employee Total Health Management Element Adoption by Organization Size

Program	2–10 Employees ($n = 349$), %	11–19 Employees ($n = 302$), %	20–49 Employees ($n = 232$, %	50—249 Employees ($n = 226$), %	250–990 Employees ($n = 66$), %	1000+ Employees ($n = 24$), %
Health or medical information	12.3	18.5	29.3	47.4	68.2	87.5
Health advocacy	6.6	11.6	14.2	25.2	42.4	79.2
Health risk assessment	4.6	10.3	12.5	31.0	56.1	75.0
Health screening	4.6	11.6	15.1	36.7	62.1	75.0
Chronic disease management	3.2	6.3	9.9	23.0	54.6	75.0
Wellness program	4.6	8.9	18.1	31.4	65.2	83.3
Healthy food options	8.0	10.6	12.1	25.2	56.1	70.8
Health incentive program	3.2	7.6	12.9	26.6	59.1	62.5
Health care provider on retainer	4.0	3.6	6.5	12.4	16.7	41.7
Occupational health and safety program	33.5	44.0	52.2	53.5	72.7	79.2
Behavioral health	5.7	9.6	19.1	33.5	77.3	91.7
Workers' compensation insurance	82.8	91.4	91.8	91.6	92.4	95.8
Credentialed disability specialist	2.0	2.0	2.6	3.5	9.1	20.8

useful for other population-based assessments of employer participation in building employee health programs.

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Value of Social Media in Reaching and Engaging Employers in Total Worker Health

Heidi Hudson, MPH, CHES, and Jennifer Hall, EdD, MCHES

Objective: To describe the initial use of social media by the National Institute for Occupational Safety and Health (NIOSH) Total Worker Health™ (TWH) Program and the University of Iowa Healthier Workforce Center for Excellence (HWCE) Outreach Program. **Methods:** Social media analytics tools and process evaluation methods were used to derive initial insights on the social media strategies used by the NIOSH and the HWCE. **Results:** The on-line community size for the NIOSH TWH Program indicated 100% growth in 6 months; however, social media platforms have been slow to gain participation among employers. **Conclusion:** The NIOSH TWH Program and the HWCE Outreach Program have found social media tools as an effective way to expand reach, foster engagement, and gain understanding of audience interests around TWH concepts. More needs to be known about how to best use social media to reach and engage target audiences on issues relevant to TWH.

Inexpensive, instant and borderless, social media provides opportunities for health professionals to engage with wider and more diverse audiences and create meaningful ways to share and access scientific health information.[1] For government public health initiatives, social media provides the leverage to increase visibility, form collaborations, and establish transparency and trust among broad and diverse audiences.[2] Ostensibly, social media offers the power to build social capital and to influence the rate at which workplace safety and health knowledge is diffused and consumed, posing the potential to change health behaviors and the conditions of work and impact health outcomes among workers and in workplaces. Little has been published about how public health organizations use social media and social networking tools to increase awareness of or engage and interact with their stakeholders, especially among worker and employer populations with regard to health protection and health promotion. Much less has been written about the effectiveness to reach, engage, and influence targeted populations, such as employers, with workplace safety and health information via social media and social networking.

Although most government agencies are considered in the early adoption stage on the use of social media, the National Institute for Occupational Safety and Health (NIOSH) has been actively involved in using social and new media for many years.[3] In 2007, when the NIOSH launched a Science Blog on its Web site,[4] it recognized the leveraging power of social media to transfer workplace safety and health research. In 2009, the NIOSH evaluated its Science Blog and found that it is a useful communication channel to provide workplace safety and health information and expand the Institute's reach to new consumers.[5] In addition to the Blog, the NIOSH communicates with stakeholders using four main social media channels: Twitter, Facebook, YouTube, and LinkedIn. As of April 2013, the NIOSH reached more than 200,000 combined followers on Twitter via 13 feeds targeting various industry segments (eg, construction, transportation, and manufacturing); its two Facebook profiles have more than 16,000 combined likes; the NioshSafetyVideos channel on YouTube contains 82 videos viewed annually for more than 142,000 times; and the Total Worker Health Group on LinkedIn has 340 professional members. Each channel provided the NIOSH an opportunity to expand its reach and its opportunities for meaningful interaction for those interested in workplace safety and health.

With the launch of the Total Worker Health™ (TWH) Program in 2011, the NIOSH broadened and attracted a new audience—health promotion professionals—as well as maintained the NIOSH's mainstay of workplace safety and health professionals.[6] The broader workplace health and safety audience creates a new avenue in addressing the twenty-first century workforce needs and modernizes the responsibility for promoting safer and healthier workplaces.

The objectives of this article were (1) to describe the initial social media and social networking strategies of the NIOSH TWH Program and the University of Iowa Healthier Workforce Center for Excellence (HWCE) for creating an on-line presence for the concept "Total Worker Health"; (2) to share results and insights from their use of social media tools such as eNewsletters, Facebook, LinkedIn, Twitter, Pinterest, and the NIOSH Science Blog; and, (3) to provide recommendations to organizations interested in using social media to promote the adoption of integrated worker health programs.

OUTREACH AND COMMUNICATION METHODS

Early on in the launch of the NIOSH TWH Program, leadership recognized the potential of social media for leveraging the visibility of TWH and for engaging with a broader stakeholder base, beyond the traditional audience of occupational safety and health professionals. Because of the growing national interest in TWH, the development of a quarterly eNewsletter and the establishment of a social media presence were deemed priority 2011 goals by the NIOSH. As a result, a comprehensive communication and outreach plan and two-phased strategy were established. The TWH Program's goals align with the Institute's communication goals and include the following:

1. To improve the awareness and recognition of and the NIOSH TWH Program
2. To disseminate information and research relevant to TWH
3. To discover, contact, and collaborate with existing and potential partners
4. To receive feedback from stakeholders and other potential partners

In 2011, phase one of the strategy was launched and included developing the brand identity for the NIOSH TWH Program and a TWH web page. The brand identity included a common law trademark, the tagline, and a design graphic. In 2012, phase two of the strategy was launched and the Program expanded its focus on building an on-line presence for TWH, targeting health protection and health promotion professionals. To build the on-line presence, the Program implemented an integrated social media strategy.

From Total Worker Health (Ms Hudson), National Institute for Occupational Safety and Health, Cincinnati, Ohio; and University of Iowa Healthier Workforce Center for Excellence (Dr Hall), Iowa City, Iowa.

The findings and conclusions in this article are those of the authors and do not necessarily represent the views of the National Institute for Occupational Safety and Health.

The authors declare no conflicts of interest.

Address correspondence to: Heidi Hudson, MPH, Total Worker Health, National Institute for Occupational Safety and Health, 4676 Columbia Parkway, MS C-27, Cincinnati, OH 45226 (hlhudson@cdc.gov).

DOI: 10.1097/JOM.0000000000000035

The first part of the strategy was to develop three primary mediums or drivers for content that would engage the interests of the broad and diverse audiences for TWH. The primary content drivers included the NIOSH TWH web page—a quarterly electronic newsletter called *TWH in Action!*—and case studies that illustrate employer approaches toward integrating health protection and health promotion called Promising Practices for TWH.

The second part of the strategy was to create social networks to share and exchange content, to create dialogue, and to foster partnerships with health protection and health promotion professionals interested in TWH. As a result, the Program created two social networks: @NIOSH_TWH on Twitter and the NIOSH TWH LinkedIn Group. The Program also aimed to further create interest and attract new audiences by working to include their content on other NIOSH channels (ie, NIOSH Science Blog) and third-party channels (ie, radio podcasts, Medscape, and Wikipedia).[7–11]

The University of Iowa HWCE Outreach Program supports the TWH Program's outreach and communication goals as well as the Center's goals to promote best and promising TWH practices and to serve as a state and national resource center for employee health programs, services, and policy.[12] To accomplish this, the HWCE has embraced social media as an integrated communication strategy for engaging target audiences. Overall goals for the Outreach Program's communication plan have been adapted from the five broad purposes of using social media in public health and health promotion to gather market insights, establish brand/presence, disseminate critical information, expand reach, and foster engagement and partnerships.[13] They are as follows:

- Communicate with employers and stakeholders for market insights.
- Establish the HWCE's presence as a resource center for employee health programs, services, and policy and promote best and promising TWH practices.
- Disseminate evidence-based information and resources.
- Expand reach to include employers and stakeholders from diverse sectors.
- Foster engagement and partnerships with employers and stakeholders.

In 2011, the HWCE Outreach Program worked on building relationships with stakeholders and employers who were part of the Healthier Workforce Learning Network, a statewide distribution list that included more than 1000 key contacts throughout Iowa that were interested in workplace health protection and health promotion. Activities included meetings, committee memberships, surveys, presentations, conferences, and coordinating and hosting the 2012 Total Worker Health™ Symposium in Coralville, Iowa.

The HWCE Outreach Program specifically targets small- and medium-sized businesses and those with limited resources. Smaller businesses often lack the resources that make corporate integrated employee health programs successful and cost-effective. In a 2012 report from the National Small Business Association and Humana, over half of small businesses stated insufficient information availability for introducing health and wellness programs and only one third reported having confidence in their actual ability to help employees manage their well-being.[14] By using social media and on-line communication channels, the HWCE is able to gain a more nuanced understanding of their needs and help bridge the information and resource gap they face.

To further engage stakeholders and employers, including health promotion and human resource professionals, the HWCE uses social media as a *low-cost* integrated communication strategy and engagement tool for employee health programs. Current HWCE activities include sharing information, resources, health tracking tools, promotional materials, and events through on-line channels that employers can use to complement their employee health and safety programs. Communication channels include the HWCE Web site, a monthly Healthier Workforce e-Bulletin, Twitter (@UIHWCE), Facebook (Healthier Workforce Center for Excellence), and an *IOWA Total Worker Health* Pinterest page.[15–19]

SOCIAL MEDIA METRICS AND EVALUATION

Using first-level social media metrics recommended by the Federal Social Media Community of Practice, the NIOSH TWH social media strategy was assessed at two points: October 2012 and April 2013.[20] The metrics include breadth and direct engagement. Breadth is the most standard social media metric and includes two components: community size (ie, followers, subscribers, and unique visitors to a web page) and community growth (eg, change in the community size). Engagement volume (ie, likes, mentions, retweets, e-mails, and Google alerts) is a component of direct engagement and allows you to identify trends in what your community values, and what elicits engagements in response. In addition, a Google search was collected and compared at two points—June 2011 and May 2013—to estimate the on-line presence of TWH.

The social media strategy of the HWCE Outreach Program used process evaluation methods with formative research uses to monitor levels of audience engagement and gain a better understanding of the information and resource needs of smaller employers. Process evaluation, recommended as an overarching evaluation strategy for social media,[13] was most appropriate because it allowed the HWCE to track participant's activity by observing where, what, and how social media and on-line platforms were engaging the target audience, which in turn helped guide current and future social media actions. Audience activity and metrics were observed along a continuum (low, medium, high) to determine engagement levels and considered activity on the HWCE Web site, the e-bulletin, and social media platforms (ie, Pinterest, Twitter, and Facebook). Engagement, a core attribute, if not central purpose in social media,[13] assesses the degree and depth of participation that people have around specific topics.[21] Low engagement was identified when people viewed content and acknowledged a preference or agreement with posted information (eg, views, clicks, likes, and dislikes). When people shared content and became involved in creating content that could influence others (eg, posts, pins, repins, times a post or link had been shared, and times a newsletter was forwarded/clicked), they demonstrated a medium level of engagement. High engagement was observed when people started participating in off-line activities and interventions as a result of exposure from a social media channel (eg number of people who register for an event, attend off-line events).[13]

SOCIAL MEDIA INSIGHTS: RESULTS

The social media strategy of the NIOSH TWH focused on building an on-line presence for TWH to target health protection and health promotion professionals and to create avenues for expanding reach and stakeholder base. From June 2011 to April 2013, the TWH Program established more than 49,000 subscribers for its quarterly eNewsletter, *TWH in Action!* In October 2012, the on-line community size for the TWH Program was estimated to be more than 70,000, and in April 2013, the community size was estimated to be more than 140,000. This indicates 100% community growth in 6 months. The engagement volume for the TWH Program from July 2012 to October 2012 was more than 700 and from November 2012 to April 2013 was estimated to be more than 950. In a retroactive Google search of "Total Worker Health" during the month of June 2011, when the NIOSH launched the TWH Program, search results that included references to the NIOSH TWH Program appeared in three pages of up to eight citations per page. In May 2013, when searching "Total Worker Health" on Google, 12 pages of search results referred to activities and outputs derived from the NIOSH TWH Program.

In the first 5 months of expanding the HWCE Web site, more than 15 new web pages were added with more than 20 links to related Web sites and more than 15 direct links to evidence-based resources. Since launching the expanded Web site and the e-bulletin (<1300 subscribers), 200 additional unique visitors have visited the HWCE Web site each month. The Total Worker Health Symposium web page (which includes presentation slides and opening comments from the NIOSH Director, Dr John Howard) has had the highest level of interest among stakeholders with more than 2200 views.[22] High interest was also observed (low–medium engagement) on both the Web site and e-bulletin related to incentive-based wellness programs in the workplace—model employer programs/promising practices—and the concept of TWH, respectively.

When analytics and observations from the HWCE Web site, e-bulletin, and social media platforms were combined, the highest levels of engagement occurred among audience members who linked and/or downloaded workplace health and wellness promotional materials (medium engagement), linked to register for webinars or events (medium–high depending on whether they actually participated), or engaged the HWCE in upcoming events (high engagement). HWCE social media platforms (Pinterest, Twitter, and Facebook) have been slow to gain participation among employers and stakeholders; however, initial user's on-line activity has confirmed their desire for information and resources supporting issues relevant to *total worker health* programs in the workplace. Of the three platforms, the Iowa Total Worker Health Pinterest page has had the highest number of people reached, with the most popular repins (medium engagement) being of evidence-based resources in the form of guides, programs, tools, and promotional materials that support worksite employee health and wellness programs. Twitter has been most successful for understanding employer's challenges and successes, and was achieved through the distribution of a short-on-line employer survey. Audience reach was broadened with the support from the NIOSH Total Worker Health LinkedIn Group and the @NIOSH_TWH Twitter page.

DISCUSSION

In May 2013, twenty-three months after the TWH Program was announced, the term "Total Worker Health," its rationale, emerging research, and promising practices regularly appear in social media and on-line through Twitter, LinkedIn, Pinterest, Facebook, eNewsletters, and blogs. This may be indicative that the TWH Program is expanding the stakeholder base for the NIOSH. Much more needs to be known and shared about how to best use social media, particularly among organizations, such as NIOSH, HWCE, and smaller employers. The slow uptake of social media by smaller employers is reportedly not uncommon and will require the NIOSH and the HWCE to work together on their social media ideas and concepts.[21]

To effectively use social media for engaging employers in TWH, a business case will need to be developed and shared. Privacy issues and other negative perceptions of using social media in the workplace need to be addressed. This includes attention to leading barriers that prevent employers from embracing social media such as lack of knowledge and understanding about social media, failure to accept new ways of thinking, loss of control, fear of the unknown, lack of resources, and difficulty in showing return on investment.[23]

When the TWH Program first entered social media, much of the time was spent in assessing the value of social media for extending the reach and understanding the potential for an increased stakeholder base. A more comprehensive and coordinated implementation plan combined with a systematic review of the literature on social media approaches for organizational adoption of worker safety, health, and wellness programs is needed to better understand the impact of social media in enhancing TWH Program visibility, fostering stakeholder engagement, and ultimately promoting an integrated approach to workplace health and safety. Coordinated communication goals and measures are needed to understand how the outreach efforts of the NIOSH and the TWH Centers of Excellence, such as HWCE, can effectively reach and engage with target audiences and influence changes in organizational health.

CONCLUSIONS AND RECOMMENDATIONS

In the initial efforts by the NIOSH TWH Program and HWCE, it has been observed that social media is an effective way to expand reach, build interest, and gather insights about stakeholders' awareness and perceptions of TWH. Although much more needs to be known about how to best use social media to reach and engage with target audiences, some lessons learned can be applied as practical recommendations for other organizations wishing to pursue a similar endeavor. Before developing a strategic communication plan, create a trial period for understanding target audiences—who they are, where they are, what they are interested in, what they want to know more about, and how they like to access information—this information is critical and will guide communication strategies and evaluation plans. When leaning toward committing to creating a social media presence, be willing to start small. It is easy to underestimate the amount of time and resources it takes to understand, build, and engage a community of followers. Create and maintain a tailored, credible, and engaging content strategy. Understand the difference between quantity and quality of engagement as you evaluate your efforts. One hundred followers with 50% interacting are far better than 10,000 followers with no interaction.

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Effect of Ergonomics Training on Agreement Between Expert and Nonexpert Ratings of the Potential for Musculoskeletal Harm in Manufacturing Tasks

Nathan B. Fethke, PhD, Linda Merlino, MS, and Fred Gerr, MD

Objective: To evaluate the effect of ergonomics training on nonergonomists' ability to recognize and characterize the potential for musculoskeletal harm in manufacturing tasks. **Methods:** Ergonomics training was delivered to members of a participatory ergonomics team in a manufacturing facility. Before and after training, participatory ergonomics team members and the research team rated the potential for musculoskeletal harm for each of 30 tasks. Measures of agreement included Pearson, concordance, and intraclass correlation coefficients. **Results:** Measures of agreement generally improved after training. The greatest agreement was observed for ratings of the potential for musculoskeletal harm to the low back. The greatest improvement in agreement was observed for ratings of the potential for musculoskeletal harm to the neck/shoulder. **Conclusions:** The training seemed to improve nonexperts' ability to identify the potential for musculoskeletal harm.

Occupational exposure to physical risk factors, such as forceful muscular exertions, awkward postures, and highly repetitive activities, has been associated with increased risk of work-related musculoskeletal disorders.[1–3] Many employers have adopted participatory ergonomics (PE) methods to guide efforts to control exposure to physical risk factors. The hallmark of PE is the meaningful contributions of workers in both the identification/analysis of risk factors and the development of controls.[4] Worker participation capitalizes on their knowledge and experience, and may promote acceptance of workplace changes.[5]

Reported benefits of PE interventions include reductions in musculoskeletal symptom prevalence,[6–8] musculoskeletal disorder claims rates and claims costs,[7,9–12] sick leave and absenteeism,[7,9,10,13] and exposure to physical risk factors.[6,14,15] The PE framework has also been suggested as a viable model for integrating workplace health protection activities with workplace health promotion activities, a core concept of the Total Worker Health program of the National Institute for Occupational Safety and Health. In particular, the scope of PE (which has typically focused on physical aspects of the work environment) can be broadened to also address psychosocial and organizational factors that influence worker health and well-being.[16,17]

Despite considerable acceptance of the PE approach and applicability of PE to the Total Worker Health paradigm, only one previous study was identified that empirically examined the ability of nonergonomists to learn and apply newly acquired knowledge and skills within a PE framework.[18] Although the results suggested that ergonomics training could lead to improved working conditions, the participants were college students without industrial experience. Because some members of a PE team in a real-world setting are experienced workers intimately familiar with industrial processes, some inherent baseline understanding of ergonomics can be expected, even if only informal or anecdotal. To better characterize the value of PE, the specific objective of this study was to evaluate the effect of ergonomics training (delivered as a component of a PE intervention) on nonergonomists' ability to characterize the potential for musculoskeletal harm in manufacturing tasks.

METHODS

We implemented a PE intervention at a manufacturing facility in Iowa. The facility manufactures vinyl-sided window assemblies for residential construction applications. The facility employs 250 to 400 production workers, depending on seasonal variation in product demand. Most workers perform cyclic, light assembly tasks (mean cycle time ~65 seconds) involving manual manipulation of parts, use of powered and nonpowered hand tools, and some lifting. The Institutional Review Board at the University of Iowa approved all study procedures.

Description of the Training Program

The training component of the PE intervention included two distinct activities: (1) *ergonomics process training*, and (2) *support meetings*. The purpose of the ergonomics process training was to provide relevant, practical information on how to create an ergonomics process within their organizational structure. Content included (a) didactic instruction in musculoskeletal anatomy, physical risk factors, dimensions of exposure, and exposure–effect relationships; (b) instruction in the use of formal exposure assessment instruments (eg, the Strain Index,[19] the Rapid Entire Body Assessment,[20] and the NIOSH Lifting Equation[21]); (c) hands-on, team-based assessments of tasks performed at the facility; (d) discussion of ergonomics process implementation, with the goal of developing the framework of a strategic plan; (e) examples of the development, implementation, and evaluation of controls; and (f) cost–benefit analyses. The ergonomics process training was delivered by a Certified Professional Ergonomist (NF) over two one-half day workshops.

The purpose of the support meetings was to reinforce training; refine the ergonomics process implementation plan; prioritize development and implementation of controls; discuss control options with PE team members, management, and affected workers; and discuss issues related to workplace ergonomics. Research team members met with the PE team for 2 hours once per month for 1 year after the ergonomics process training.

Composition of the PE Team

The PE team included the facility's safety manager, two additional safety personnel, the production manager, the human resources manager, a representative from maintenance, and three production employees ($n = 9$ from the facility). The general manager served as

From the Department of Occupational and Environmental Health, College of Public Health, the University of Iowa, Iowa City, Iowa.

This research was supported by a pilot project grant from the Healthier Workforce Center for Excellence (HWCE) at the University of Iowa. The HWCE is supported by Cooperative Agreement No. U19OH008858 from the Centers for Disease Control and Prevention (CDC)/National Institute for Occupational Safety and Health (NIOSH). The contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC, NIOSH, or the HWCE.

The authors declare no conflicts of interest.

Address correspondence to: Nathan B. Fethke, PhD, Department of Occupational and Environmental Health, College of Public Health, the University of Iowa, 105 River Street, CPHB S347, Iowa City, IA 52242 (nathan-fethke@uiowa.edu).

DOI: 10.1097/JOM.0000000000000038

an ex-officio member of the PE team, but did not contribute data to the current analyses.

Study Procedures

Our evaluation of training effectiveness was based on pre- and posttraining agreement between the research team's consensus rating and the PE team's median rating of the potential for musculoskeletal harm associated with specific production tasks. Furthermore, we evaluated pre- and posttraining interrater agreement between the PE team members' ratings.

Before the ergonomics process training, we randomly selected 30 cyclic production tasks and obtained representative 10-minute video recordings of each task (or a minimum of five cycles). For each task, a separate worker was filmed and recordings were obtained simultaneously of the frontal and sagittal planes.

During a meeting convened 1 week before the ergonomics process training, each PE team member viewed each task video and provided his/her ratings of the potential for low back, neck/shoulder, elbow, and hand/wrist musculoskeletal harm on 10-cm visual analog scales (VAS) provided by the investigators. For the upper extremity, ratings were made only for the body side clearly within the sagittal plane camera field of view. Employees at the facility referred to the potential for musculoskeletal harm as an "ergonomic hazard." Therefore, we used descriptive anchors on the VAS to reflect such informal terminology. A VAS rating of 0 cm was used to indicate "no ergonomic hazard" and a VAS rating of 10 cm was used to indicate a "very harmful ergonomic hazard." The PE team members were instructed to complete the scales independently and not to communicate while the task videos were played. No identifying information (eg, PE team member name or job title) was collected with the VAS rating. Before this meeting, the research team viewed the same video recordings and rated (by consensus) each of the 30 tasks using identical scales.

After the ergonomics process training and 1 year of monthly support meetings, and with procedures identical to those used just before the ergonomics process training, the research team and the PE team again completed VAS ratings for a second set of 30 randomly selected cyclic production tasks.

Statistical Analyses

During the year after the ergonomics process training, four of the original nine PE team members left the facility because of reassignment or termination. Therefore, the posttraining VAS ratings completed by the five remaining members of the original PE team were used for the current analyses.

For each task and body region, we computed the median of the PE team members' VAS ratings. We then calculated, for each body region separately, Pearson correlation coefficients between the PE team's median VAS rating and the research team's consensus VAS rating for the set of 30 task videos obtained before the ergonomics process training (r_{pre}). Similarly, we calculated Pearson correlation coefficients between the PE team's median VAS rating and the research team's consensus VAS rating for the set of 30 task videos obtained after the ergonomics process training and 1 year of support meetings (r_{post}). The one-sample t test for a correlation coefficient was used to test the null hypotheses that $r_{pre} = 0$ and $r_{post} = 0$. Fisher's z-transformation was used to estimate 95% confidence intervals for the Pearson correlation coefficients.[22] We also used Fisher's z-test for comparing two correlation coefficients to test the null hypothesis that $r_{pre} = r_{post}$. Because we expected training to improve agreement in VAS ratings between the PE team and the research team, this test was one sided (ie, the alternative hypothesis was $r_{post} > r_{pre}$).

We also estimated the pre- and posttraining concordance between the PE team's median VAS ratings and the research team's consensus VAS ratings by computing the concordance correlation coefficient (P_c).[23] In contrast to the Pearson correlation coefficient, P_c incorporates corrections for shifts of the linear relationship away from the ideal model (ie, least-squares linear regression slope = 1.0, and offset = 0.0). Methods described in Lin[23] were used to estimate 95% confidence intervals for the concordance correlation coefficients ($P_{c\text{-}pre}$ and $P_{c\text{-}post}$). Fisher's z-test for comparing two correlation coefficients was used to test the null hypothesis that $P_{c\text{-}pre} = P_{c\text{-}post}$. As above, this test was one sided and separate analyses were performed for each body region.

Finally, the intraclass correlation coefficient (ICC; two-way, random effects model with absolute agreement) was used to estimate the pre- and posttraining agreement in the VAS ratings among PE team members. Confidence limits and tests of significance (null hypothesis: ICC = 0) for the pre- and posttraining ICC estimates were calculated.[24] Because (1) posttraining VAS ratings were available for only five of the original nine PE team members and (2) we did not collect identifying information with the VAS, we examined the possibility that a difference between the pre- and posttraining ICCs was an artifact of the five remaining PE team members and not a training effect. Specifically, in addition to the pretraining ICC for all nine original PE team members, we estimated the distribution (mean, standard deviation) of the pretraining ICC for all possible combinations of five original PE team members.

Statistical procedures were performed using Microsoft Excel (version 2010, Microsoft Co, Redmond, WA) and SPSS (version 21, IBM Co, Armonk, NY).

RESULTS

In general, measures of agreement between the PE team's median VAS ratings and the research team's consensus VAS ratings were improved after the ergonomics process training and 1 year of support meetings (Table 1). The largest improvements were observed for the neck/shoulder region ($r_{pre} = 0.13$ vs $r_{post} = 0.46$; $P_{c\text{-}pre} = 0.07$ vs $P_{c\text{-}post} = 0.36$). Nevertheless, no posttraining agreement value was statistically significantly different from its corresponding pretraining agreement value.

For the low back, a small decrease was observed for the posttraining Pearson correlation compared with the pretraining Pearson correlation, whereas a small increase was observed for the posttraining concordance correlation compared with the pretraining concordance correlation. In this case, the improvement in the posttraining concordance correlation was the result of a reduced offset (ie, smaller intercept) of the least-squares regression line (Fig. 1).

The ICCs of the VAS ratings among the PE team members also improved after the ergonomics process training and 1 year of support meetings. Before the training, only the ICC of the VAS ratings of the potential for musculoskeletal harm to the low back was significantly greater than zero. After training, all ICC estimates were significantly greater than zero. Inspection of Table 1 shows that for the elbows, the 95% confidence intervals around the pre and posttraining ICCs did not overlap, suggesting an improvement not likely because of chance.

The distributions (mean, standard deviation) of the pretraining ICCs for all possible combinations of five PE team members were, 0.16 (0.06) for the low back, 0.04 (0.07) for the neck/shoulder, −0.06 (.06) for the elbow, and 0.02 (0.08) for the hand/wrist. For all body areas except the low back, the estimate of the posttraining ICCs from the five remaining original PE team members exceeded the mean of the distribution of pretraining ICC estimates for all possible combinations of five PE team members by more than one standard deviation.

DISCUSSION

Considerable methodological heterogeneity is apparent in available literature describing the delivery and evaluation of ergonomics training, in general, and PE interventions, in

TABLE 1. Pretraining and Posttraining Pearson, Concordance, and Intraclass Correlation Coefficients, by Body Region

	Pretraining		Posttraining		Pre-/Postcomparison
	Estimate (CI)	P*	Estimate (CI)	P*	P†
Low back					
r	0.80 (0.62–0.90)	<0.01	0.72 (0.49–0.86)	<0.01	0.24
P_c	0.50 (0.31–0.65)	<0.01	0.64 (0.41–0.79)	<0.01	0.22
ICC	0.16 (0.07–0.32)	<0.01	0.21 (0.06–0.25)	<0.01	–
Neck/shoulder					
r	0.13 (−0.25–0.46)	0.25	0.46 (0.12–0.70)	<0.01	0.09
P_c	0.07 (−0.14–0.28)	0.36	0.36 (0.10–0.57)	0.03	0.13
ICC	0.05 (−0.01–0.15)	0.07	0.15 (0.03–0.33)	<0.01	–
Elbow					
r	0.50 (0.18–0.73)	<0.01	0.50 (0.18–0.73)	<0.01	0.96
P_c	0.29 (0.10–0.46)	0.06	0.42 (0.15–0.64)	0.01	0.29
ICC	− 0.03 (−0.06–0.03)	0.87	0.20 (0.06–0.39)	<0.01	–
Hand/wrist					
r	0.55 (0.24–0.76)	<0.01	0.61 (0.32–0.79)	<0.01	0.37
P_c	0.47 (0.21–0.67)	<0.01	0.58 (0.31–0.77)	<0.01	0.29
ICC	0.02 (−0.03–0.11)	0.26	0.27 (0.09–0.48)	<0.01	–

*For *r* and P_C, results of one-sample *t* tests for correlation coefficients. For ICC, results of F tests as described in Shrout and Fleiss.[24]

†Results of Fisher's z-test for comparing two correlation coefficients.

CI, 95% confidence interval; ICC, intraclass correlation coefficients; P_c, concordance correlation coefficient; *r*, Pearson correlation coefficient.

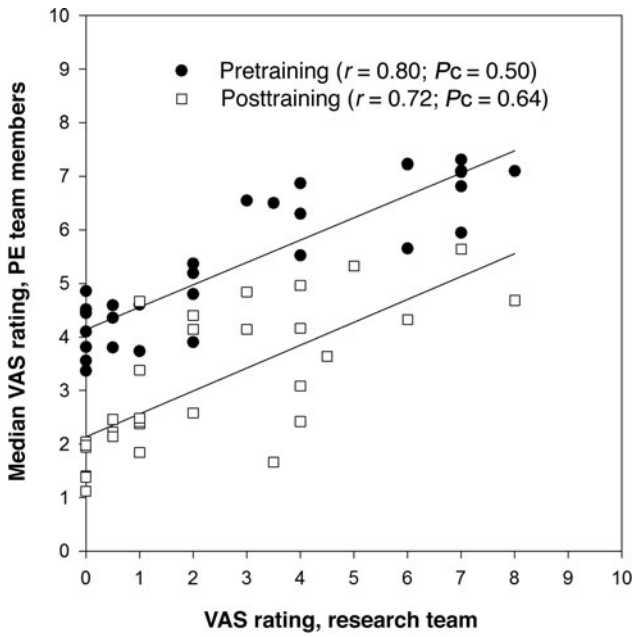

FIGURE 1. Pretraining and posttraining VAS ratings of the potential for musculoskeletal harm to the low back. P_c, concordance correlation coefficient; PE, participatory ergonomics; *r*, Pearson correlation coefficient; VAS, visual analog scales.

particular.[25,26] Several studies report evidence of training effectiveness as improvements of scores on tests of knowledge about physical risk factors, the design of workspaces using ergonomics principles, and other ergonomics-related constructs.[27–29] In contrast, we evaluated a PE team's ability to characterize by observation the potential for musculoskeletal harm, using a process on the basis of a conceptual understanding of ergonomics rather than the rote application of any particular formal exposure assessment instrument. In general, the agreement in VAS ratings of the potential for musculoskeletal harm to the low back, neck/shoulder, elbows, and hand/wrist improved after training activities, although the observed effects were modest in size.

The agreement (Pearson and concordance) between the PE team's median VAS ratings and the research team's consensus VAS ratings was highest for the low back for both the pre and posttraining analyses. Because we did not instruct PE team members to focus on physical risk factors (eg, posture, force, and repetition) when completing the VAS ratings, we are unable to evaluate specific drivers of the observed results. Nevertheless, discussion of the results with the PE team suggested several circumstances unique to the facility that may have contributed to this result. Specifically, many of the production tasks involve manual handling of products weighing up to 100 lb and a facility policy requires team lifts of more than 51 lb. Furthermore, employees receive a brief orientation to ergonomics upon hire and complete a 30-minute web-based ergonomics training module annually. The orientation and web-based materials contain substantial information about lifting biomechanics. Therefore, the training may not have increased knowledge about factors associated with low back musculoskeletal outcomes to the same extent as knowledge about factors associated with neck/shoulder, elbow, or hand/wrist musculoskeletal outcomes.

Improvement in the ICCs of VAS ratings suggests that the training was at least partially effective in transferring knowledge to PE team members. Estimates of the ICC depend strongly on the specific model (eg, two-way, random effects vs two-way, mixed effects) and type (absolute agreement vs consistency) selected.[30] The ICC model we used treated the PE team members as a random sample of a larger population of similar individuals.

The results of this study should be interpreted cautiously. The ergonomics process training and support meetings seemed to improve the PE team's ability to characterize the potential for musculoskeletal harm over a 1-year time frame. The effectiveness and impact of the PE intervention over a longer period have not been evaluated. The loss of four original PE team members during the year after the ergonomics process training affected our analytical strategy. Nevertheless, negative long-term effects of PE team member turnover have been minimized through adoption of a strategic plan to guide ongoing intervention activities, which includes provisions for maintaining "institutional memory" of ergonomics.

The PE intervention is a component of an ongoing study of the combined effects of PE and workplace health promotion on exposure to physical risk factors, musculoskeletal symptom prevalence, musculoskeletal injury rate, workers' compensation claims costs, health insurance costs, and indicators of chronic disease risk (eg, hypertension, obesity, and cholesterol). The health promotion component uses motivational interviewing to encourage health behavior change and a participatory approach to implement facility-wide wellness activities.

ACKNOWLEDGMENTS

The authors acknowledge Mr Steven Hanson for his contributions to data collection and analysis and Ms Marie Yanacek for her assistance with data collection.

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The Intervention Design and Analysis Scorecard: A Planning Tool for Participatory Design of Integrated Health and Safety Interventions in the Workplace

Michelle Robertson, PhD, Robert Henning, PhD, Nicholas Warren, ScD, Suzanne Nobrega, MS, Megan Dove-Steinkamp, MS, Lize Tibirica, MS, Andrea Bizarro, MA, and the CPH-NEW Research Team

Objective: As part of a Research-to-Practice Toolkit development effort by the Center for the Promotion of Health in the New England Workplace, to develop and test a structured participatory approach for engaging front-line employees in the design of integrated health protection and promotion interventions. **Methods:** On the basis of a participatory ergonomics framework, the Intervention Design and Analysis Scorecard (IDEAS) provides a stepwise approach for developing intervention proposals, including root cause analysis and setting evaluation criteria such as scope, obstacles, and cost/benefit tradeoffs. The IDEAS was tested at four diverse worksites with trained facilitators. **Results:** Employees were able to develop and gain management support for integrated interventions at each worksite. **Conclusions:** The IDEAS can be used effectively by front-line employees to plan integrated interventions in a program dedicated to continuous improvement of employee health protection/promotion and Total Worker Health.

The Center for the Promotion of Health in the New England Workplace[1] (CPH-NEW) is a Total Worker Health (TWH) Center of Research Excellence dedicated to conducting translational research on integrated workplace health promotion and occupational safety and health interventions at the programmatic level.[2] A primary focus of the CPH-NEW research effort has been to develop a way to fully engage front-line employees and managerial/supervisory personnel in the collaborative, iterative design of workplace interventions. The benefits of this engagement over "top-down" approaches include as follows:

- Identification of workplace health promotion and occupational safety and health issues that are most salient to front-line employees.
- Identification of a wider range of intervention possibilities. Employees are usually much more aware than health and safety professionals or upper management of the complex interactions between how their work is organized and the physical design factors in their workplace.[3,4] Also, employees are able to factor lifestyle and other behavioral influences into solution activities that go beyond the immediate workplace, in keeping with the TWH concept.
- Better identification of potential barriers and facilitators to interventions.
- Enhanced buy-in to problem definition and intervention design from all parties, resulting in greater sustainability.
- Establish a supportive organizational culture and dynamics for a self-correcting and sustainable program.

The CPH-NEW initially developed and field-tested an approach to intervention planning modeled after best practices in participatory ergonomics (PE) programs.[5–8] In conventional PE programs, small "design teams" of front-line employees develop ergonomic interventions, usually with the help of a program facilitator. Throughout the design process, a "steering committee" of management and supervisory personnel acts as a sounding board and provides company-level knowledge to help select the best interventions developed through the participatory design process. The CPH-NEW's novel approach expanded the PE process to encompass integrated health protection and health promotion interventions. This new participatory ergonomics and health promotion ("PE×HP") programmatic approach[9] supports continuous improvement of employee protection and promotion as a way to achieve TWH.

THE INTERVENTION DESIGN AND ANALYSIS SCORECARD TOOL

The Intervention Design and Analysis Scorecard (IDEAS) Tool is part of a larger suite of Research-to-Practice (R2P) tools developed by the CPH-NEW to support PE×HP programs. Its current, seven-step format was developed through iterative design during field testing. As its name implies, the key feature of the IDEAS Tool is the use of a stepwise, scorecard approach to develop, evaluate, rank, and select the most practical and effective intervention ideas and solutions. Bringing this structured process to the consideration of an intervention's costs, barriers, resources, scope of impact, and benefits makes it possible to develop an internal justification (ie, business case) for an intervention that is specific to the context of the organization. This results in intervention proposals that the program steering committee and upper management are more likely to support, in part because of the greater alignment of interventions with organizational goals.[10]

The IDEAS Tool is closely modeled after an intervention planning process developed for use by professional macroergonomists as described in a case study by Robertson and Courtney[11] that was based on previous work of Robertson and Rahimi.[12] Nevertheless, the IDEAS Tool can be used by masters-level professionals without extensive backgrounds in ergonomic, occupational safety and health, or health promotion. Use of the IDEAS Tool fulfills four key scientific and programmatic needs: (1) to address the multiple contributing root causes of health/safety issues/concerns, (2) to provide balanced interventions integrating both health protection and health promotion principles and approaches, and involving combinations

From the Center for the Promotion of Health in the New England Workplace (Drs Robertson, Henning, and Warren, Ms Nobrega, Ms Dove-Steinkamp, Ms Tibirica, Ms Bizarro, and the CPH-NEW Research Team), University of Connecticut, Storrs, Conn, and University of Massachusetts Lowell, Lowell, Mass; Liberty Mutual Research Institute for Safety (Dr Robertson), Hopkinton, Mass; University of Connecticut (Dr Henning, Ms Dove-Steinkamp, Ms Bizarro), Storrs, Conn; University of Connecticut Health Center (Dr Warren), Farmington, Conn; and University of Massachusetts Lowell (Ms Nobrega, Ms Tibirica), Lowell, Mass.

This work was supported by Grant No. U19-OH008857 from the National Institute for Occupational Safety and Health (NIOSH) at the Centers for Disease Control and Prevention. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH.

The authors declare no conflicts of interest.

Supplemental digital contents are available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.joem.org).

Address correspondence to: Robert Henning, PhD, Center for the Promotion of Health in the New England Workplace, Psychology Department, University of Connecticut, 406 Babbidge Rd, Storrs, CT 06269 (robert.henning@uconn.edu).

DOI: 10.1097/JOM.0000000000000036

of behavioral changes and training initiatives as well as changes to work organization and the workplace, (3) to propose a range of intervention options for the steering committee to consider for any specific health/safety issue, and (4) to develop intervention proposals aligned with business decision-making practices and strategic goals that consider return-on-investment metrics.[13]

Regarding return-on-investment metrics, these are not limited to estimating a return-on-investment in purely financial terms, and are instead consistent with best practices when organizations consider any new initiative.[14,15] Employees are asked to consider a wide range of measures associated with each of their intervention ideas, for example, the number of employees who are likely to benefit from this intervention (scope) and potential obstacles/barriers to implementing this intervention. Thus, the IDEAS Tool supports prioritization and systematic comparisons of competing intervention ideas through a structured, scorecard approach.[14,16] Once a design team has successfully completed at least one complete intervention planning cycle, it has acquired skills that also will support collaboration on interventions that are initiated by the steering committee.

METHODS

The CPH-NEW field-tested the IDEAS Tool within PE×HP programs over a 2-year period at four diverse worksites. Employee design teams were formed with a representative group of between 5 and 10 front-line employees. As part of their orientation and training provided by the PE×HP program facilitator, employee perceptions of workplace health and safety problem areas and concerns gathered through surveys and focus groups were shared with the design team members. Members of the design team then prioritized these problems and concerns to focus their initial intervention design efforts. Once a focus area was identified, the program facilitator guided the employee design team through the intervention planning process using the IDEAS Tool. As detailed later, the process began with identifying the multiple contributing and underlying root causes of the problem, and ended by generating a set of intervention proposals that were submitted to the program steering committee.

Steps in the IDEAS Planning Process

The seven planning steps of the IDEAS Tool planning process, and the respective roles of the design team and steering committee, are depicted in a flow diagram (see Figure, Supplemental Digital Content 1, http://links.lww.com/JOM/A134). Solid-lined boxes show Steps 1 to 5A in which the design team independently identifies a workplace issue/concern and then initiates and completes the intervention planning process. Steps 5B to 7 show the independent steering committee activities, in which sets of intervention proposals from the design team are received, reviewed, and then either approved and implemented or rejected. The roles of the steering committee are to provide the design team with constructive feedback about the proposals and any needed resources for refining, implementing, and evaluating interventions. Each of the IDEAS Tool steps has an accompanying worksheet that is designed to assist the program facilitator and the design team or steering committee in the intervention planning process for that step (see IDEAS Worksheets, Supplemental Digital Content 2, http://links.lww.com/JOM/A135). Some worksheets are filled out with reference to a hypothetical job in health care to demonstrate their use. The activities associated with each step are as follows:

Step 1: Once the design team has selected a focus problem or issue, the design team engages in a systems analysis process. This process begins by breaking the problem/issue down into *subissues*, and then continues by identifying the multiple *contributing factors* associated with each subissue. As in the example, it is important to identify subissues from the domains of workplace design, work organization, and health behaviors. Completing Step 1 is an iterative process; extra worksheets are used as needed until the team is satisfied that all or most contributing factors have been identified.

Step 2: The design team develops an initial set of *intervention alternatives* that will address each subissue identified in Step 1. Each alternative includes a proposed set of *activities*, with measurable objectives that address the major *health and safety goal/objective.* A balanced set of activities is sought for each intervention involving ergonomic workplace changes as well as behavior or lifestyle changes. The design team uses brainstorming to generate as many activities as possible until it is agreed that the most important contributing factors identified in Step 1 have been addressed.

Step 3: Before evaluating each intervention, the design team creates a mutually agreed upon set of selection criteria to help prioritize proposals identified in Step 2; these will eventually be used to evaluate each set of intervention activities in Step 4. Criteria address four broad categories: (1) scope of project in regard to numbers of employees impacted, (2) benefits/effectiveness, (3) obstacles/barriers, and (4) resources/costs. These criteria will allow the design team to consider important trade-offs among the various sets of activities being considered for an intervention alternative.

Step 4: The design team uses the selection criteria to review and compare the intervention activities under consideration (separate Step 4 worksheets for each intervention proposal). The goal is to combine the most viable activities into three intervention alternatives for further development and eventual presentation to the program steering committee. Having at least three viable alternatives allows the steering committee flexibility, including the formation of a new subset of activities that the design team had not considered, and this increases the likelihood that an intervention in some form will be supported.

Step 5A: The *design team* rates the set of proposed interventions on a scorecard, assigning "low," "medium," or "high" to each selection criterion developed in Step 3, after an overall prioritization of alternatives and possible notes to the steering committee. Worksheet 5A, along with Worksheets 1 to 4 as background, is shared with the steering committee when the intervention alternatives are presented.

Step 5B: The *steering committee* reviews the intervention alternatives proposed by the design team, provides feedback on reratings as necessary, and then selects which intervention, or new set of activities, to implement, and then communicates with the design team. Several exchanges with design team members may be needed to clarify any differences between ratings. These exchanges can be more fruitful in person.

Step 6: Once an intervention is selected, the steering committee develops a schedule of activities for successful implementation of the intervention, with consideration of the selection criteria. Step 6 is mostly a checklist of factors to consider for successful implementation because organizations will typically have their own planning and scheduling tools.

Step 7: The last step involves monitoring and evaluating the implemented intervention, and making modifications if needed. Collection of process and outcome measures is crucial, and it is likely that some adaptation of the intervention will be needed. An iterative cycle for refining interventions is considered essential to any continuous improvement process, and this process promotes organizational learning on how to protect and promote employee health and safety in the face of changing demands and the evolution of the workplace.[8]

A complete set of the IDEAS Tool (fillable) worksheets and quick reference guides to assist with their use, along with assessment tools and other support materials in the R2P Toolkit for PE×HP programs, are available on the CPH-NEW Web site.[1]

RESULTS

A sampling of the interventions that were both proposed and implemented is provided here as evidence that use of the IDEAS Tool by the employee design team resulted in integrated health protection/promotion interventions that were supported by management.

At a small realty and property management firm (worksite size 160), a comprehensive set of interventions focused on a host of operational issues that unnecessarily contributed to high workload, frustration, and stress, largely because of communication breakdowns among renters, front-office staff, and workers. An example intervention was developing training materials for renters on the proper operation of apartment appliances and how to correctly report maintenance issues. A second intervention focused on discomfort and overheating caused by the bulky company uniforms.

At a nonprofit site of office workers (worksite size 350), a PE program was put in place primarily to address musculoskeletal discomfort. Actions included setting ergonomics policy that included guidelines and standards in the areas of workstation assessment, hazard identification, and ergonomic controls; the assignment, training, and deployment of internal ergonomic "champions" to provide individual consultation to office employees with a focus on maximizing computer workstation ergonomic fit even in the face of limited workstation resources; ergonomics education for all employees; roles for employee involvement in office renovations/moves; and roles for management support and endorsement.

At a state government agency of office workers (worksite size 260), training-focused ergonomic interventions occurred as part of a PE program: workstation ergonomics training for all staff, ergonomics information selected and disseminated by the design team via a weekly newsletter, a workstation self-adjustment guide, and ergonomic training provided for newly purchased office equipment.

At a state prison site (worksite size 289), design team meetings were suspended for a long period because of layoffs associated with labor negotiations. Nevertheless, a health fair was organized on the basis of health/safety issue/concern areas identified and prioritized by the design team. Experts were brought in to provide information and educational materials about sleep disorders and how best to adjust to shift work, healthy eating and weight loss, preventive measures in a new state health care plan that many correction officers were confused about, stretching exercises presented by a physical therapist who had experience working with correction officer injuries and rehabilitation, and support options offered by the Employee Assistance Program. Correction officers were systematically relieved throughout the prison so that they all could attend.

DISCUSSION

On the basis of the results of the field testing reported on here, front-line employees were able to use the IDEAS Tool with the help of a PE×HP program facilitator to generate intervention proposals that upper management could support. In addition, the interventions that resulted were aligned with the host organization's goals and integrated so that employee health protection and promotion were both benefited.

One factor that in some cases prevented the IDEAS Tool from being used most effectively was the lack of regular meetings of the design team because of scheduling issues or staff shortages. This impeded progress in intervention planning, resulting in frustration within both the design team and the steering committee. Progress was also slowed in some instances because of the lack of communication between the design team and steering committee regarding available resources, and the role of the design team when interventions were implemented. Although these limitations can be addressed through additional training, the CPH-NEW continues to explore new ways to expedite intervention planning through improvements in the IDEAS Tool itself.

CONCLUSIONS

The IDEAS Tool offers a number of strategic benefits to the host organizations. Use of the IDEAS Tool allows the TWH model to be realized within an integrated health protection and health promotion PE×HP program, and for this to occur without a large up-front commitment of resources for a set of top-down initiatives that are usually found in conventional programs. Furthermore, this "grassroot" intervention planning approach incorporated company-specific employee demographics, physical infrastructure, workplace culture, organizational practices, leadership style, regional norms, and so forth that are known to impact intervention effectiveness. The IDEAS Tool also allowed for adoption of outside models and approaches (R2P) when these were determined within the IDEAS planning process to be a good fit for the organization.

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