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# Integrating worksite health protection and health promotion: A conceptual model for intervention and research

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ABSTRACT

There is increasing recognition of the value added by integrating traditionally separate efforts to protect and promote worker safety and health. This paper presents an innovative conceptual model to guide research on determinants of worker safety and health and to inform the design, implementation and evaluation of integrated approaches to promoting and protecting worker health. This model is rooted in multiple theories and the premise that the conditions of work are important determinants of individual safety and health outcomes and behaviors, and outcomes important to enterprises such as absence and turnover. Integrated policies, programs and practices simultaneously address multiple conditions of work, including the physical work environment and the organization of work (e.g., psychosocial factors, job tasks and demands). Findings from two recent studies conducted in Boston and Minnesota (2009–2015) illustrate the application of this model to guide social epidemiological research. This paper focuses particular attention on the relationships of the conditions of work to worker health-related behaviors, musculoskeletal symptoms, and occupational injury; and to the design of integrated interventions in response to specific settings and conditions of work of small and medium size manufacturing businesses, based on a systematic assessment of priorities, needs, and resources within an organization. This model provides an organizing framework for both research and practice by specifying the causal pathways through which work may influence health outcomes, and for designing and testing interventions to improve worker safety and health that are meaningful for workers and employers, and responsive to that setting's conditions of work.



## 1. Introduction

There is a paradigm shift underway in protection and promotion of worker health. Leading health organizations have recommended better integration of the traditionally separate efforts to address occupational safety and health, and worksite programs and policies intended to reduce chronic disease risk through worksite-based health promotion (Carnethon et al., 2009; European Network for Workplace Health Promotion, 1997; Hymel et al., 2011; Institute of Medicine Committee to Assess Worksite Preventive Health Program Needs for NASA Employees, 2005; International Association for Worksite Health Promotion (IAWHP), 2012; World Health Organization, 1997, 1999). Vanguard employers are demonstrating how this approach works in practice (Anderson and Stoltzfus, 2001; Dell Computer Corporation, 2014; Isaac and Flynn, 2001; Roberts, 2009; van de Ven, 2004; Whitehead, 2001). The concept of integration of protection and promotion efforts is not new: it was advanced several decades ago in multiple reports (DeJoy and Southern, 1993; Sorensen et al., 1995; Walsh et al., 1991). The recent trend toward adoption of this approach underscores the need for defining best practices and processes to ensure optimal results (Carnethon et al., 2009; Hammer and Sauter, 2013; Schulte and Vainio, 2010; Sorensen et al., 2011a).

These efforts have been bolstered by the National Institute for Occupational Safety and Health (NIOSH) through its Total Worker Health® (TWH) Initiative, (Schill and Chosewood, 2013, 2016) which has facilitated a broadening dialogue among researchers, practitioners, business leaders and organized labor representatives about testing, implementing and disseminating integrated approaches to health

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protection and health promotion. Attention to this emerging field of research was highlighted in a recent workshop co-sponsored by the National Institutes of Health (NIH) and NIOSH, which reviewed evidence and provided recommendations for research aimed at better understanding the effectiveness of integrated interventions (Bradley et al., 2016). This work builds on growing evidence about the potential benefits of integrated approaches for improvements in health behaviors (Bertera, 1990, 1993; Elliot et al., 2007; Maes et al., 1998; Okechukwu et al., 2009; Olson et al., 2009; Sorensen et al., 2005; Sorensen et al., 2007; Sorensen et al., 1998; Sorensen et al., 2002); enhanced rates of employee participation in programs (Hunt et al., 2005); potential reductions in pain, occupational injury and disability rates (Hlobil et al., 2007; Pronk et al., 2012; Robertson et al., 2013; Shaw et al., 2006; Shaw et al., 2003; Tsutsumi et al., 2009); strengthened health and safety programs (Goetzel et al., 2001; LaMontagne et al., 2004); potentially reduced costs (Goetzel et al., 2001); and support for market performance of companies (Fabius et al., 2016; Malan et al., 2009). These findings are supported by multiple reviews of integrated interventions (Anger et al., 2015; Cherniack, 2013; Cooklin et al., in press; Goetzel, 2012; Institute of Medicine Committee to Assess Worksite Preventive Health Program Needs for NASA Employees, 2005; National Institute for Occupational Safety and Health, 2012; Pronk, 2013; Sorensen et al., 2011a), although a recent systematic review concluded that while integrated interventions may improve health behaviors, there remains a significant need for further evidence on their impact on injuries and overall quality of life (Feltner et al., 2016).

Despite growing evidence, this field of inquiry is still in its infancy, needing further evaluation of the effectiveness of this approach. A common conceptual model can structure intervention research to elucidate the pathways through which occupational factors influence safety and chronic disease risk. Thus, a conceptual model is useful in making explicit the underlying assumptions of integrated interventions. The purpose of this manuscript is to present a conceptual model for worker health embedded within the work environment with a focus on the conditions of work, and to illustrate its application to both social epidemiological and intervention research.

## 2. Methods

This conceptual model was developed by the Center for Work, Health and Well-being at the Harvard T.H. Chan School of Public Health, a Center for Excellence within NIOSH's TWH Program. Based on the Center's previous research and to guide future research, investigators developed and used this conceptual model to specify the causal pathways through which integrated policies, programs and practices are expected to influence worker safety and health outcomes (see Fig. 1). The figure represents the evolution of this model based on revisions informed by the Center's ongoing research. The research was approved by the Harvard Chan School's Institutional Review Board.

### 2.1. Conceptual model for integrated approaches to protection and promotion of worker health

Our conceptual model is based on the premise that addressing multiple pathways in an integrated manner within the conditions of work will contribute to greater improvements in health outcomes than addressing each pathway separately. Policies, programs and practices may concurrently operate through many pathways affecting the conditions of work, including the physical work environment and the organization of work. Conditions of work are centrally located in the model as determinants of health and safety outcomes, also mediating the effects on health behaviors. Conditions of work are themselves influenced by enterprise and workforce characteristics, which are also likely to affect implementation of policies, programs and practices. These integrated policies, programs, and practices may contribute to improvements in enterprise outcomes such as turnover and health care costs. It is important to recognize, in addition, that these relationships occur within the context of labor market and economic trends, legal and political forces, and social mores, norms and influences.

Our conceptual model represents diverse theoretical perspectives, including the social ecological model (McLeroy et al., 1988; Stokols, 1996), social contextual model of health behavior change (Sorensen et al., 2004; Sorensen et al., 2003), hierarchy of controls (Levy et al., 2006; Office of Technology Assessment, 1985; Roelofs et al., 2003), organizational ergonomics (McLeroy et al., 1988; Stokols, 1996), participatory frameworks (*Community-based participatory research for health: From process to outcomes*, 2008; Punnett et al., 2009; Rivilis et al., 2008), job strain (Karasek et al., 1998; Karasek and Theorell, 1990), and socio-technical systems theory (Cooper and Foster, 1971; Murphy et al., 2014; Sauter et al., 2002). These theoretical foundations underscore the complex interplay of factors involving individual workers and the immediate work environment, characteristics of the larger contexts in which both the worker and the worksite are embedded, and proximal outcomes, such as individual health and safety behaviors and related factors of self-efficacy and risk perceptions that support improvements in these behaviors (Bandura, 1977; Walsh et al., 1991). Examples of feedback pathways are included in Fig. 1, which underscore the complexity of the system and interrelationships across multiple dimensions. Each of the model's components is presented below.

#### 2.1.1. Indicators of integrated workplace policies, programs and practices

Optimally, an integrated approach extends beyond simple summation of health protection and promotion to reflect a workplace culture that supports and protects worker safety, health and wellbeing. We consider four indicators of integration: (1) leadership commitment, (2) coordinated efforts, (3) supportive organizational policies and practices, and (4) comprehensive program content (Sorensen et al., 2013). We have operationalized these indicators in a measure of integrated approaches, which was validated in a limited number of settings. See

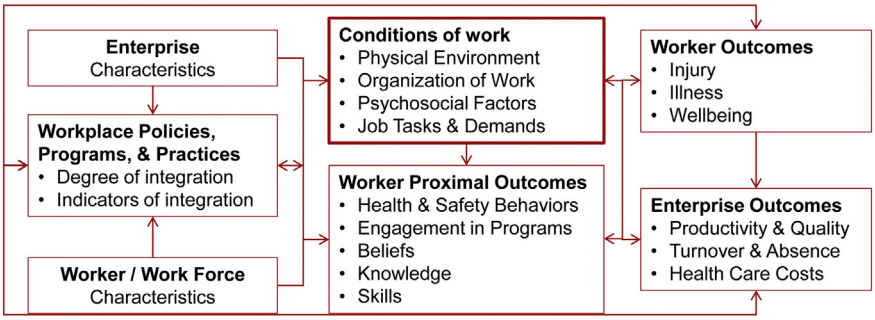


**Fig. 1.** Conceptual model for integrated approaches to the protection and promotion of worker health and safety. Studies conducted in Boston and Minnesota (2009–2015).

Williams et al. for details on the measure (Williams et al., 2015; Williams et al., 2016). We conceptualize implementation as operating on a continuum, recognizing that organizations may implement change in varying sequences, and may respond differently by industry sector, size of workplace, and extent of leadership and labor engagement (D. L. McLellan et al., 2015a, b). These indicators include, first, organizational leadership and commitment, a necessary foundation for an integrated approach, reflecting the key role top management plays in articulating the vision for worker and worksite health and ensuring availability of resources (human, financial, physical) (Centers for Disease Control and Prevention, 2011; Institute of Medicine Committee to Assess Worksite Preventive Health Program Needs for NASA Employees, 2005). Second, rather than functioning independently, coordination among health protection, worksite health promotion and other workplace functions is needed to optimize benefits for worker safety and health (Institute of Medicine Committee to Assess Worksite Preventive Health Program Needs for NASA Employees, 2005; National Institute for Occupational Safety and Health, 2012). This indicator, for example, is measured by items that assess coordinated decision-making across departments; processes to coordinate interdepartmental budgets; and inclusion of both policies about the work environment and organization as well as programs for individual workers. Third, supportive organizational policies and practices can provide operational supports for worker safety and health. These include participatory approaches, which may take advantage of existing mechanisms for involving workers and managers in decision-making and planning concurrently for both health protection and promotion (Institute of Medicine Committee to Assess Worksite Preventive Health Program Needs for NASA Employees, 2005; McLellan et al., 2012). To ensure accountability, responsibility for an integrated approach can be built into job descriptions and performance metrics; skills for implementing this approach can be incorporated into training and capacity building plans (Kruse, 2009). Benefits and incentives may be instituted that protect and promote worker health and well-being (Blumenthal, 2006; Boden et al., 2012), and include attention to improvements in salary and overall benefits, which may present a barrier for some employers (Lax, 2016). Workplace programs, policies and practices can be monitored and evaluated for both occupational health exposures and health-related behaviors and the relationships of exposures and behaviors to health outcomes (Boden et al., 2012; Institute of Medicine Committee to Assess Worksite Preventive Health Program Needs for NASA Employees, 2005). Finally, the effectiveness of health protection and promotion messages for workers may be enhanced through comprehensive program content and coordinated messages that acknowledge and describe additive and sometimes synergistic effects of exposures to worksite hazards and individual health behaviors, such as the importance of controlling exposures to respiratory hazards at work while encouraging tobacco use cessation.

#### 2.1.2. Conditions of work

We hypothesize and report below that these integrated policies, programs, and practices will influence worker health outcomes through several pathways based primarily within the conditions of work. First, integrated policies and practices have a direct impact on the *physical work environment*, including on potential exposures on the job. For example, policies may impact physical demands related to biomechanical sources of strain, or may include purchasing policies that influence selection of safer versus more hazardous chemicals or equipment used in some work processes. The work environment may also support healthy behaviors among workers, for example, through worksite tobacco control policies or availability of healthy foods in cafeterias and vending machines. Second, the *organization of work* has been consistently shown to influence worker health and safety outcomes (Amick et al., 2003; Eriksen et al., 2004; Lipscomb et al., 2004; Lipscomb et al., 2002; Tullar et al., 2010) as well as health behaviors (Albertsen et al., 2006; Brunner et al., 2007; Caruso et al., 2004; Choi et al., 2010; Jones et al., 2007; Kouvonen et al., 2006; Trinkoff et al., 2001). *Psychosocial factors,* part of the organization of work, broadly include job strain, psychological demands and control (Karasek and Theorell, 1990), rewards (Siegrist, 1996), social support, harassment and discrimination (National Institute for Occupational Safety and Health, 2008). For example, supervisor and co-worker support and social norms that support health and safety behaviors are associated with improved health behaviors (Belkic and Nedic, 2007; Choi et al., 2010; Hannerz et al., 2004; Kouvonen et al., 2007; Nishitani and Sakakibara, 2010; Siegrist and Rodel, 2006) and reduced risk of musculoskeletal disorders (MSDs) (Bongers et al., 2002; Macfarlane et al., 2009; Nahit et al., 2003). *Job tasks and demands,* including the extent to which high physical exertion is a requirement of the job, work hours and shift, and the pace of work, have been shown consistently to influence a range of safety and health outcomes (Heaney and Fujishiro, 2005; Karsh et al., 2005; Lipscomb et al., 2002; Trinkoff et al., 2001). *Health and safety climate*—workers' shared perceptions about organization practices—is associated with work satisfaction, injury and accident risk, and enterprise outcomes (Beus et al., 2010; Christian et al., 2009; Hemingway and Smith, 1999; Hofmann and Mark, 2006; Huang et al., 2006; Law et al., 2011; Probst et al., 2008; Sparer et al., under re-review; Zohar and Polachek, 2014). Changes in the conditions of work may ultimately contribute to transformational change in the organization toward a culture of worker safety, health and wellbeing (Sorensen et al., 2013), by which we mean one that anticipates and mitigates potential workplace health risks, encourages worker identification and reporting of health and safety concerns without fear of reprisal, and provides health supportive programs, policies, and practices.

#### 2.1.3. Enterprise characteristics

Enterprise characteristics, such as industry sector and size, influence the conditions of work and the types of exposures workers face, and are likely to play significant roles in the uptake of integrated approaches (Harris et al., 2014; Institute of Medicine and Committee on the Health and Safety Needs of Older Workers, 2004; Krieger, 2010). Employers also set pay scales and work hours, further shaping the resources and health outcomes workers experience (Baron et al., 2014; Krieger et al., 2008).

#### 2.1.4. Work force/worker characteristics

It is also important to understand, for example, the changing needs of an aging workforce, the potentially differing work-family intersections for men compared to women workers, and potential vulnerabilities of immigrant workers compared to US-born workers. Similarly, young workers are twice as likely as older workers to be injured on the job (Estes et al., 2010), and often lack sufficient training in workplace safety practices and legal rights on the job (Rohlman et al., 2013).

#### 2.1.5. Outcomes

Both individual- and organization-level outcomes are included in the model. At the individual level, proximal outcomes include participation in programs, as well as health and safety behaviors that are associated with changes in risk of poor health and safety outcomes. The conditions of work contribute to health-related behaviors (e.g., job stress is associated with increased tobacco and alcohol use (Hammer and Sauter, 2013)) as well as increased risk of illness and injury. At the organizational level, enterprise outcomes can include financial and economic outcomes, such as absenteeism, turnover, employee expenditures on health care, and intervention return on investment (ROI). Given that worksite interventions require employer support and commitment of resources, consideration of enterprise outcomes can help make the business case for integrated interventions.

## 3. Results

Findings from two recent studies illustrate the application of this model to social epidemiological and intervention research.

### 3.1. Understanding determinants of health and safety outcomes

In a study of hospital patient care workers, we examined data from three surveys of patient care workers along with an integrated administrative database linking employees' administrative records on outcomes such as injury with their survey responses. Three cross-cutting themes emerged from this body of work, with important implications for interventions (Fig. 2).

#### 3.1.1. Theme 1

Injury, musculoskeletal pain, and health behaviors share diverse determinants within the work environment and vary by socioeconomic status of workers.

*3.1.1.1. Injury.* Injury rates varied by both structural and social factors within work units. Compared to nurses, aides were more likely to have injuries, both those that required days away and those that did not result in lost days (Boden et al., 2012; Reme et al., 2014). We documented differences in injury rates by patient care unit, with higher rates in the operating room and emergency department, and lower rates in step-down and pediatric settings (Boden et al., 2012). We also found that several dimensions of the psychosocial work environment were associated with injury risk, including workplace harassment (both on an individual and unit level) (Sabbath et al., 2014) and supervisor support (Tveito et al., 2014), as well as organizational policies and practices (Reme et al., 2014; Tveito et al., 2014).

*3.1.1.2. Pain.* Worker perceptions of the overall work environment—particularly poor perceptions of organizational practices to reduce ergonomic strain (Dennerlein et al., 2012) and perceived staffing inadequacy (Kim et al., 2014)—were associated with increased risk of pain. The relationship between perceived inadequate staffing and pain was attenuated by work-related psychosocial factors, including stress and supervisor support, suggesting that these psychosocial factors may play an important role in this relationship.

*3.1.1.3. Common pathways to health behaviors, pain, and injury.* We found that workplace culture reflected in policies and practices, such as effective ergonomic and other safety practices, jointly predicted lower back pain, improved sleep, and to a lesser extent, physical activity (Sorensen et al., 2011b). Although inadequate sleep and physical inactivity were associated, unexpectedly we did not find an association between these behaviors and low back pain.

#### 3.1.2. Theme 2

The psychosocial work environment shapes safety and health behaviors and health outcomes.

*3.1.2.1. Supervisor support.* Supervisor support was associated with a range of health outcomes (Caspi et al., 2013; Hurtado et al., 2015b; Reme et al., 2014; Sembajwe et al., 2013; Sorensen et al., 2011b). We found lower injury rates in units where workers reported better supervisor support and more favorable organizational policies and practices (Tveito et al., 2014).

*3.1.2.2 Work-family conflict and job flexibility.* Nurses working on units with more shift flexibility had relatively less depression and anxiety (Hurtado et al., 2015a). Higher levels of work-family conflict were also significantly associated with sleep deficiency in the short term and nearly two years later (Jacobsen et al., 2014a), and with multiple types of musculoskeletal pain (Kim et al., 2013).

*3.1.2.3 Harassment at work.* Being sworn at, screamed at, and receiving hostile or offensive gestures from patients, coworkers, or supervisors were associated with increased risk of chronic injury (Sabbath et al., 2014). Harassed workers were also more likely to be obese and have low levels of physical activity (Nelson et al., 2014; Sorensen et al., 2011b).

*3.1.2.4 Decision latitude and job demands.* We found that higher job demands were associated with musculoskeletal pain (Sembajwe et al., 2013), that low decision latitude was associated with obesity (Nelson et al., 2014), and that job strain was associated with sleep deficiency and cardiometabolic risk (H.B. Jacobsen et al., 2014b).

*3.1.2.5 Individual and organization-level exposures.* We found both contextual and compositional group-level exposures contribute to

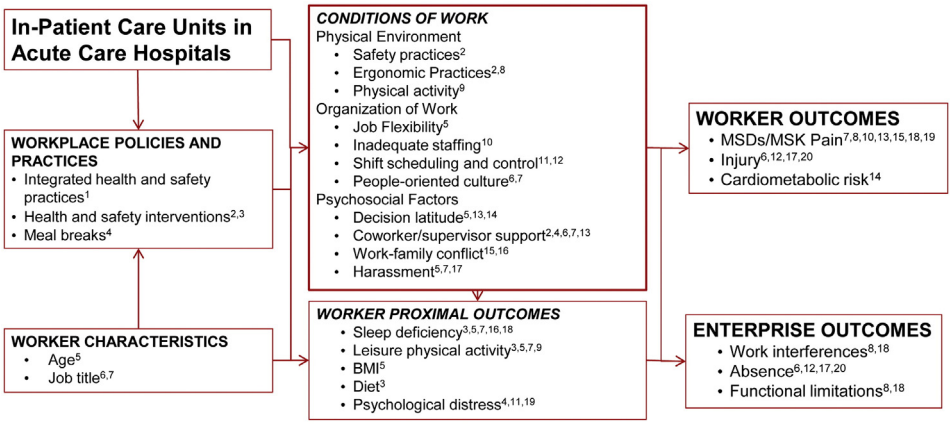


**Fig. 2.** Application of the conceptual model. Studies conducted in Boston (2012–2015).

individual workers' outcomes. For example, shift flexibility at the unit level translated to lower depression and anxiety at the individual level (Hurtado et al., 2016), and high levels of ambient harassment (regardless of individual harassment) were associated with greater injury risk (Sabbath et al., 2014).

*3.1.3. Theme 3*

Health behaviors are partially rooted in conditions of work, suggesting that conditions of work need to be addressed if health-related behaviors are to improve.

*3.1.3.1 Physical activity.* Workers with low decision latitude and low job flexibility were less likely to meet guidelines for adequate physical activity (Nelson et al., 2014).

*3.1.3.2. Sleep.* We found especially strong evidence that sleep and sleep inadequacy were predicted by adverse conditions of work (Buxton et al., 2012; Jacobsen et al., 2014a, b; Nelson et al., 2014; Sorensen et al., 2011b). For example, sleep deficiency was associated with nearly all psychosocial exposures examined in Theme 2. Simultaneously, broader policies and practices within the work environment also predicted improved sleep, including people-oriented culture, ergonomic practices, and safety practices (Sorensen et al., 2011b).

Collectively, these findings underscore the need for a comprehensive approach to safety and health interventions, consistent with our integrated model.

*3.2. Intervention design: a case study in small- to medium-sized businesses*

We also used our conceptual model to design an integrated intervention in response to specific settings and conditions of work, based on a systematic assessment approach conducted within organizations (Pronk et al., 2016). We tested the feasibility of the intervention in three small- and medium-sized businesses (SMBs) in manufacturing in Minnesota.

As part of planning, we used the conceptual model to guide assessment of employee health indicators and the physical and organizational environment, and provided feedback on the assessments to the sites. Because back pain was prevalent, the intervention placed a high priority on reducing back pain and increasing safe movement at work and at home.

This program used four major strategies: (1) Worksite-wide events promoted changes in the conditions of work such as environmental supports for ergonomic and health promotion practices; for example, participating sites used technology to address ergonomic and physical hazards related to back pain, such as improved lifting or moving devices on factory floors and sit-to-stand devices in some office spaces. (2) A worksite-level intervention focused on consultation and training with mid-level and upper management and included committees comprised of those responsible for protecting and promoting worker health and safety. The management intervention was the primary intervention focus. (3) A learning collaborative convened company leaders, including the CEOs from the participating sites, to share their experiences with other executives (Pronk et al., 2015). (4) Although the intervention focused mostly on working conditions, telephone health coaching and web-based resources that included integrated messages on back pain and safe movement were available for employees as part of this comprehensive integrated program.

We identified factors critical to successful implementation of policies, programs and practices, including multi-level management support and articulation of that support throughout the enterprise; allocation of dedicated staff, budgets, and committees; collaborative organizational cultures that prioritized employee health and safety; existing organizational processes that could be leveraged for new approaches; and realistic implementation timelines to account for organizational changes (D. McLellan et al., 2015a, b; Pember et al., 2015; Pronk et al., 2016). Results indicate that both employee-rated health culture and safety culture improved in two companies, self-reported back pain decreased in one company and remained the same in two; safety hazards were reduced in all companies; and organizational resources, as measured by the CDC Worksite Health Scorecard and related to organizational support, physical activity and nutrition, all improved across all companies (Pronk et al., 2016).

## 4. Discussion

This model responds to the ongoing dialogue on the importance of a conceptual framework to guide research and intervention design related to worker health (Bradley et al., 2016; Punnett et al., 2009; Schulte and Vainio, 2010; Schulte et al., 2012). This conceptual model provides a framework for research and intervention by specifying how the conditions of work can shape worker safety and health. The model serves as a valuable and evidence-based guide for prioritizing research questions, framing a standard approach to interventions, and steering practical applications toward effective processes to protect and improve worker health. Specifying the pathways through which the intervention is intended to affect worker safety and health can clarify the priorities for both the intervention and evaluation. A conceptual model can also guide mediation analyses for testing specific pathways (Anger et al., 2015; MacKinnon, 2008).

This model highlights priorities for ongoing research that explores, for example, the extent to which integrated workplace policies, programs and practices determine safety and health outcomes; the ways in which these policies, programs and practices may shape physical and psychosocial work exposures; and the roles of worker and enterprise factors influencing these pathways. Research presented by other researchers further illustrates the applicability of this model. For example, Schulte and colleagues emphasized how shared pathways focusing on conditions of work could impact enterprise and worker outcomes such as occupational hazards and obesity. Although prior research has examined ways in which the conditions of work influence chronic disease and its behavioral antecedents (Johansson et al., 1991; Marchand, 2008) and risks associated with hazards on the job (Huang et al., 2003; Landsbergis et al., 2014), additional research is needed to examine the synergies and interactions in these relationships, as well as their associations with improved enterprise outcomes. In addition, few studies in this nascent field have successfully modified organizational factors; there is a significant need for systematic research directed at changes in the work organization (Lax, 2016). Responding to recommendations from a recent NIH-NIOSH workshop (Bradley et al., 2016), this model can also guide further development of measures to assess the effects of an integrated approach, inform the design and testing of future integrated approaches to worker health, and offer a framework for increased attention to organizational change, central to the TWH approach yet underrepresented within research findings reported to date (Lax, 2016; McLellan, 2016). Use of a common conceptual model offers a platform for bridging these diverse perspectives and suggests shared vocabularies for understanding the influences on worker health (Sorensen et al., 2004; Sorensen et al., 2003).

This model also informs translation from research to practice by outlining key components of effective implementation of TWH approaches. Although a growing array of guidelines and tools are available to support adoption of TWH approaches (Burton, 2010; Center for the Promotion of Health in the New England Workplace, 2013; International Labour Office, 2012; McLellan et al., 2012; Velazquez et al., 2010), implementation of these integrated policies, programs, and practices remains concentrated primarily among a select group of vanguard employers (Loeppke et al., 2015). There is an urgent need for effective dissemination of evidence-based best practices and resources to build capacity in worksites across size and sector to improve the conditions of work and transform the work organization, thus improving worker health. Our work has shown, however, that employers often

turn first to providing programs for individual workers, rather than tackling system-level policies and practices, a tendency we have labeled "regression to the individual" (Cooklin A et al., 2013; D. L. McLellan et al., 2015a, b; Sorensen et al., 2016). Effective implementation of TWH interventions requires that employers have the capacity to identify and modify features of the work organization that are a risk to worker health (DeJoy et al., 2010; Mellor and Webster, 2013). This conceptual model provides a framework for employers to identify, develop and implement interventions and strategies that will enable system-level changes in the conditions of work.

## 5. Conclusions

Traditionally, a focus on the conditions of work has been the domain of occupational safety and health; here, we aim to underscore the central role of the conditions of work, not only for classic occupational safety and health outcomes, but also for chronic disease risk. An increasing number of workplaces are adopting integrated approaches to worker health that should be carefully evaluated. We have proposed a conceptual model to guide this inquiry and to frame the focus on the conditions of work as central to building a culture of safety, health and wellbeing. This model further illustrates the potential for synergy in integrated approaches to worker health, offering opportunities for improvements in the conditions of work as well as for multiple worker health outcomes (Anger et al., 2015). Thus, this conceptual model may provide a valuable tool for future research aimed at testing the effectiveness of integrated approaches to worker health protection and health promotion, as well as a framework for translating research to practice.

### Conflict of interest statement

The authors declare that there are no conflicts of interest.

## Transparency document

The Transparency document associated with this article can be found in the online version.

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