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# A framework for evaluating OSH program effectiveness using leading and trailing metrics

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ABSTRACT

*Introduction:* Many employers and regulators today rely primarily on a few past injury/ illness metrics as criteria for rating the effectiveness of occupational safety and health (OSH) programs. Although such trailing data are necessary to assess program success, they may not be sufficient for developing proactive safety, ergonomic, and medical management plans. *Methods:* The goals of this pilot study were to create leading metrics (company self-assessment ratings) and trailing metrics (past loss data) that could be used to evaluate the effectiveness of OSH program elements that range from primary to tertiary prevention. The main hypothesis was that the new metrics would be explanatory variables for three standard future workers compensation (WC) outcomes in 2003 (rates of total cases, lost time cases, and costs) and that the framework for evaluating OSH programs could be justifiably expanded. For leading metrics, surveys were developed to allow respondents to assess OSH exposures and program prevention elements (management leadership/ commitment, employee participation, hazard identification, hazard control, medical management, training, and program evaluation). After pre-testing, surveys were sent to companies covered by the same WC insurer in early 2003. A total of 33 completed surveys were used for final analysis. A series of trailing metrics were developed from 1999-2001 WC data for the surveyed companies. Data were analyzed using a method where each main 2003 WC outcome was dichotomized into high and low loss groups based on the median value of the variable. The mean and standard deviations of survey questions and 1999-2001 WC variables were compared between the dichotomized groups. Hypothesis testing was performed using F-test with a significance level 0.10. *Results/Discussion:* Companies that exhibited higher musculoskeletal disorder (MSD) WC case rates from 1999-2001 had higher total WC case rates in 2003. Higher levels of several self-reported OSH program elements (tracking progress in controlling workplace safety hazards, identifying ergonomic hazards, using health promotion programs) were associated with lower rates of WC lost time cases in 2003. Higher reported exposures to noise and projectiles were also associated with higher rates of WC cases and costs in 2003. *Impact on Industry:* This research adds to a growing body of preliminary evidence that valid leading and trailing metrics can be developed to evaluate OSH effectiveness. Both the rating of OSH efforts and the regular trending of past loss outcomes are likely useful in developing data-driven improvement plans that are reactive to past exposures and proactive in identifying system deficiencies that drive future losses.

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## 1. Introduction

Many occupational safety and health (OSH) personnel, workers compensation (WC) insurance carriers, and governmental regulators today rely solely on a few past injury/illness data metrics (incidence/ severity rates and experience ratings) to assess the effectiveness of OSH programs. These types of data are necessary but may not be sufficient for developing proactive safety, ergonomic and medical management plans. To build a framework for improved OSH benchmarking, it is useful to define the overall goals of an OSH program, which include primary through tertiary prevention (Brewer et al., 2007; Habeck, Hunt, & VanTol, 1998; Hunt, Habeck, VanTol, & Scully, 1993; NIOSH, 1997). OSH metrics can therefore be characterized as measures of the following activities:

- Loss Prevention (Pre-Loss)
  - Activities to protect against the occurrence of injury/illness and disability (also known as *Primary Prevention)*
- Loss Reduction (Post-Loss)
  - Activities to identify and detect injury/illness in the earliest stages when successful treatment is most likely (*Secondary Prevention*)
  - Activities to treat injuries/illnesses early to limit disability through rehabilitation and to promote timely return-to-work (*Tertiary Prevention)*

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Most OSH program metrics can be further differentiated as leading or trailing. Leading metrics typically represent self-assessment ratings of a company's exposure to safety hazards or musculoskeletal disorder (MSD) risk factors and safety, ergonomic, or medical management activities. These metrics can indicate why incidents have occurred in the past and may be predictive of future losses, since they represent potential systematic causes of injury occurrence and severity (Akbar-Khanzadeh & Wagner, 2001; Amick et al., 2000, 2004; Cullen et al., 2005; Fernandez-Muniz, Montes-Peon, & Vazquez-Ordas, 2009; Habeck et al., 1998; Hunt et al., 1993; Iyer, Haight, Del Castillo, Tink, & Hawkins, 2005; Neal & Griffin, 2006; Shannon et al., 1996; Shannon, Mayrc, & Haines, 1997). Addressing leading factors may help develop more proactive OSH programs. These types of metrics may also have several drawbacks such as a potential lack of reliability, vulnerability to respondent bias, and unproven predictive validity.

Trailing metrics are typically measures of the frequency and severity of past injuries/ illnesses, such as injury rates and WC costs. These types of metrics are reflective of what has occurred, but may not necessarily be predictive of future losses. Trailing metrics also are often difficult to track effectively, due to the random variability of injury/illness rates, skewed nature of WC costs, and protracted payout of WC claims (Hashemi, Webster, & Clancy, 1998b; Hashemi, Webster, Clancy, & Courtney, 1998a; Hashemi, Webster, Clancy, & Volinn, 1997; Hauer, 1986). An additional problem with focusing solely on trailing metrics is that all remedial steps are necessarily reactive.

In summary, metrics for OSH program effectiveness can be characterized as one of four main types: leading-prevention, leading-reduction, trailing-prevention, or trailing-reduction. Aspects of this expanded evaluation framework are generalized in Table 1.

## 2. Methods

The specific aims of this pilot study were to compile leading and trailing loss prevention/ loss reduction metrics that could be readily used by OSH personnel to monitor program effectiveness and test the association between the metrics and standard future loss outcomes. The overall hypothesis was that all metric types (leading-prevention, leading-reduction, trailing-prevention, and trailing-reduction) would be shown to be correlated with future WC losses and that the development and use of the metrics in an expanded framework may be justifiably encouraged among OSH personnel.

### 2.1. Explanatory Variables

#### 2.1.1. Survey assessments

The first step in developing leading metrics was to define the key elements of OSH loss prevention/ loss reduction programs. A number of safety and health organizations (including the United States Occupational Safety and Health Administration [OSHA], the National Institute for Occupational Safety and Health [NIOSH], and the American Industrial Hygiene Association [AIHA]), various U.S. state workers compensation bureaus (Ohio and Minnesota), and business management organizations (including the International Organization for Standardization [ISO], 1996 and the British Standards Institute [BSI], 1996) have developed models for OSH program components. Although there are distinct differences between program systems, a literature review indicated that most system components could be grouped into seven main program elements using nomenclature adapted from the OSHA Voluntary Protection Program (VPP; OSHA, 2008) and the NIOSH ergonomics program (NIOSH, 1997). These elements include: (a) Management Leadership, Commitment, and Communication, (b) Employee Participation, (c) Hazard Identification and Assessment, (d) Hazard Prevention and Control, (e) Medical Management, (f) Training, and (g) Program Evaluation. The next step was to find suitable survey instruments that could be used to assess OSH practices, policies, and procedures that captured the above essential loss prevention/ loss reduction elements. Below is a summary review of several contemporary instruments.

Hunt et al. (1993) developed a comprehensive questionnaire to evaluate a company's OSH loss prevention and loss reduction efforts for safety, ergonomics, disability management, and health promotion. The survey was used in a cross sectional study of 220 Michigan companies that found correlations between reported safety/ return-to-work practices and disability outcomes. Unfortunately, this promising survey and study was only published initially as a technical report submitted by the Upjohn Institute to the Michigan Department of Labor and was not considered during the development of the current study. The measures of organizational policies and procedures developed by Hunt et al. (1993) were later reported by Habeck et al. (1998) and Amick et al. (2000). Subsets of the measures have also been used in a number of more recent studies (Amick et al., 2004; Cullen et al., 2005; Cullen, Silverstein, & Foley, 2008; Ossmann et al., 2005; Steenstra et al., 2010; Williams, Westmorland, Shannon, & Amick, 2007).

In 1995, OSHA developed the Program Evaluation Profile (PEP, Form OSHA-195), a scored questionnaire to evaluate an employer's worksite

**Table 1**
Types of Metrics for OSH Programs.

| | ***Loss Prevention*** (Pre-Loss)<br>• *Goal is to reduce injury/illness frequency*<br>• *Focus on injury/illness causes* | ***Loss Reduction*** (Post-Loss)<br>• *Goal is to reduce injury/illness severity*<br>• *Focus on injury/illness disability drivers* |
|---|---|---|
| ***Leading***<br>- *Self-rating measures* | **Leading Prevention**<br>• Measures of a company's present/ future efforts to eliminate or prevent injuries/ illnesses<br>• Semi-quantitative<br>• Ratings of general safety, industrial hygiene and ergonomic management policies, practices, and procedures<br>• Specific measures of hazards, behaviors, and controls (e.g. compliance checklists, behavior-based safety ratings, assessments of control effectiveness) | **Leading Reduction**<br>• Measures of a company's present/ future efforts to minimize impairment and disability due to existing injuries/ illnesses<br>• Semi-quantitative<br>• Ratings of medical management policies, practices, and procedures (designed to ensure early detection, prompt treatment, and timely recovery) |
| ***Trailing***<br>- *Measures of past injuries/ illnesses* | **Trailing Prevention**<br>• Measures of a company's past outcomes in eliminating or preventing injuries/ illnesses<br>• Quantitative<br>• Specific measures of injury incidence (e.g. injury/ illness rates) | **Trailing Reduction**<br>• Measures of a company's past outcomes in minimizing impairment and disability due to injuries/ illnesses<br>• Quantitative<br>• Specific measures of injury disability and cost management (e.g. workers compensation case severity and costs, case progression metrics) |