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No. 94525-0

IN THE SUPREME COURT  
OF THE STATE OF WASHINGTON

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BRANDON APELA AFOA,

Respondent,

v.

PORT OF SEATTLE,

Petitioner.

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**AMICUS BRIEF OF WASHINGTON STATE LABOR COUNCIL**

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## **I. IDENTITY AND INTEREST OF AMICUS CURIAE**

The Washington State Labor Council (“WSLC” or “Labor Council”) is the largest and most prominent advocate for the interests of working people in Washington State. It represents approximately 600 local and state-wide unions associated with the AFL-CIO, as well as the 450,000 individuals who belong to those unions. Member unions operating at Seattle-Tacoma International Airport (“Sea-Tac Airport”) include the Air Line Pilots Association, the American Federation of Government Employees, Professional Aviation Safety Specialists, AFSCME, International Brotherhood of Electric Workers, International Association of Fire Fighters, the Association of Flight Attendants-CWA, United Food & Commercial Workers, International Association of Machinists and Aerospace Workers, and the International Brotherhood of Teamsters.

The Labor Council’s goals include providing assistance to organizing campaigns, communications and media relations, and legislative advocacy on behalf of its affiliates. The Labor Council pursues these goals in a variety of ways, including legislative lobbying, educational programs, financial and strategic support to local unions, initiative campaigns, and legal action, including the filing of amicus briefs.

## II. INTRODUCTION AND STATEMENT OF THE CASE

It is a matter of public record that ground safety problems persist at Sea-Tac Airport. In March 2016, the Washington State Department of Labor and Industries (“DLI”) fined Menzies Aviation, the largest ground service provider at Sea-Tac Airport, \$62,000 for 16 violations of WISHA rules pertaining to poor maintenance of ground service equipment, including malfunctioning or deficient engines, brakes, gears, steering, electrical systems and tires, and other safety violations. *See, e.g.*, Steve Wihelm, “Alaska Airlines, baggage-handler Menzies fined by labor regulators,” PUGET SOUND BUSINESS JOURNAL (March 8, 2016) (<https://www.bizjournals.com/seattle/news/2016/03/08/alaska-airlines-baggage-handler-menzies-fined-by.html>); Sydney Brownstone, “State Fines Alaska Airlines for Failing to Keep Baggage Handlers Safe,” THE STRANGER (March 8, 2016) (<https://www.thestranger.com/slog/2016/03/08/23680676/state-fines-alaska-airlines-for-failing-to-keep-baggage-handlers-safe>); “Alaska Airlines Cited For Unsafe Working Conditions,” KIRO 7 NEWS (March 7, 2016) (<http://www.kiro7.com/news/li-cites-alaska-airlines-for-unsafe-working-conditions/149315730A>). DLI found that these ground service employees working at the airport have *four times* the likelihood of injury as compared to other workers in their risk class. *Id.* In the record from

this trial, Mark Coates, the senior Port manager in charge of safety at the airport, admitted that the airport is an “inherently dangerous environment.” Ex. 112 p.1.

The hard-working men and women we represent deserve protection by this Court from the Port’s efforts to avoid its obligation to provide the safest possible working environment.

Unfortunately, the record in this case shows that the Port has long been acting as a “law unto itself” in defiance of clear holdings of this Court as to the meaning of the WISHA Specific Duty Clause, RCW 49.17.060(2). Since 1985 and 1990, this Court has made it clear that statutory WISHA employers owe a nondelegable duty to comply with WISHA regulations under RCW 49.17.060(2) *that runs to any employee of any employer on the jobsite. Stute v. PBMC*, 114 Wn.2d 454, 460, 788 P.2d 545 (1990); *Goucher v. JR Simplot Co.*, 104 Wn.2d 662, 671, 709 P.2d 774 (1985). A sophisticated party such as the Port should have clearly understood that it falls within the definition of “employer” under WISHA. RCW 49.17.020(4) (“any person ... which engages in any business, industry, profession, or activity in this state and employs one or more employees or who contracts with one or more persons, the essence of which is the personal labor of such person or persons and includes the state, counties, cities, and all municipal corporations, public corporations,

political subdivisions of the state ...”). Nonetheless, during the appeal that led to this Courts decision in *Afoa v. Port of Seattle*, 176 Wn.2d 460, 470, 296 P.3d 800 (2013) (“Afoa I”), the Port claimed this did not apply to it. That position was totally and clearly rejected by *Afoa I*, which held that “[w]e reject the Port’s argument, which is inconsistent with our holdings in *Goucher* and *Stute*,” and “[w]e reaffirm *Goucher* and *Stute* and hold that WISHA’s specific duty does not require a direct employment relationship.” 176 Wn.2d at 473. Yet despite all this, at the 2015 trial the Port testified that it *was still* only staffing and directing its Sea-Tac Airport WISHA compliance office to ensure that WISHA is followed for *its own direct employees*, RP 1086/3-6, RP 3071/11-13, and it admitted this in its Appellate Briefing below. *See, Brief of Appellant Port* at 22 (“the Port department responsible for WISHA compliance and health and safety had a three-member staff whose job was to ensure the **Port** and its employees, not other employers and their employees, were in compliance”) (emphasis in original); *accord, id.* at 25-26.

This is a serious concern to WSLC and its members. There are 16-18,000 workers at Sea-Tac Airport who are *not* employed directly by the Port, but who are supposed to be protected by the Port’s WISHA Specific Duty, yet the Port has only allocated *three* employees to do this crucial job. Of course, by its contracts the Port retains complete authority

to monitor safety at the airport, and it does staff a ramp control tower, the Port Ramp Patrol, the Port Police, and the Port Fire Department, all of whom combine to in fact control all aspects of job performance by everybody on the ramp portion of the airfield. But at the same time, the Port is blatantly shirking its legal duty to ensure that *all employees* at Sea-Tac Airport have a WISHA-compliant safe workplace. The Port refuses to face the fact (now found by the jury) that it is the party best able to ensure worker safety at the airport, and that therefore the law requires it to do so across the board, for all airport workers, direct and indirect.

WSLC urges this Court to make it absolutely clear that the Port cannot evade its responsibility any longer. Allowing the Port to pass off to another party even one dollar of the verdict in this case sends the message that a nondelegable duty is delegable and that the WISHA Specific Duty doesn't mean what this Court has repeatedly held that it does mean.

### **III. ISSUE PRESENTED**

Was the nondelegable WISHA specific duty under RCW 49.17.060(2), and the nondelegable common-law duty of a control party to provide a safe workplace, abrogated by RCW 4.22.070(1)?

#### IV. ARGUMENT

##### A. Traditional *Respondeat Superior* Vicarious Liability Survives Tort Reform

The Port argues that the plain language of RCW 4.22.070(1) means that the trial court had to allocate fault to all entities that may have caused plaintiff's damages. But in making this argument, the Port glosses over the very important exception written directly into RCW 4.22.070(1) by the Legislature for the protection of the working men and women of Washington: "The liability of each defendant shall be several only and shall not be joint except: (a) A party shall be responsible for the fault of another person or for payment of the proportionate share of another party ... where a person was acting as an agent or servant of the party." RCW 4.22.070(1)(a). This language clearly recognizes that the longstanding rule of *respondeat superior* applicable to a "master" for the conduct of its "servants" was not intended to be abrogated by Tort Reform. The vicarious liability of the master was expressly maintained as an exception to the usual rule of several liability, and therefore as an instance of joint and several liability that survived Tort Reform. RCW 4.22.030 ("Except as otherwise provided in RCW 4.22.070, if more than one person is liable to a claimant on an indivisible claim for the same injury, death or harm, the liability of such persons shall be joint and several.").

Applied to the context of WISHA, the Port is the statutory employer. *Afoa I*, 176 Wn.2d at 473. Applied to the context of both common-law and WISHA control liability, the Port is in the position of the “master” because it is the party best able to control safety at the multiemployer job site. *Id.* at 473, 477, 478, 479, 481. The fact that it works both through direct employee agents and other kinds of agents – airlines, ground service contractors, and their employees – does not change the reality of the relationship. *Id.* at 477-78. Under the nondelegable duty doctrine, the Port has vicarious liability for the actions of its agents and servants that is identical to the vicarious liability that the Legislature expressly excluded from the general rule of several liability in RCW 4.22.070(1)(a).

**B. The “Buck” For Safety Has To Stop With The Party Best Able To Protect Worker Safety At The Multiemployer Job Site**

A recent study by Dr. Emile Tompa, published in June 2016 in the *American Journal of Industrial Medicine*, concludes that “specific deterrence from inspections with penalties” results in a decrease in subsequent workplace injuries, whereas general deterrence (i.e., the impact on actors from knowing that others have been penalized for workplace violations) is not effective. Emile Tompa, et. al., *A Systematic Literature Review of the Effectiveness of Occupational Health and Safety*

*Regulatory Enforcement*, American Journal of Industrial Medicine (Oct. 28, 2015), pp.10-11, 12 (appended to this brief for the Court's convenience. This means that safety will not improve at Sea-Tac Airport unless and until the Port of Seattle is made to understand that the "buck" for safety at Sea-Tac Airport stops with it.

The evidence in this case clearly shows that the Port is the "super-authoritative" body with power over all other actors at the airport, and this accords with the experience of our members, who analogized the Port in this case to "the Eye of Sauron" from *The Lord of the Rings*. RP 526/3-21. With respect to the nonparty airline empty chair defendants, they all operate under signed agreements in which the Port granted them a nonexclusive right to use the airfield area "subject at all times to the *exclusive control and management by the Port.*" Ex. 675 at Port 277 (China); Ex. 676 at Port 3465 (British), Ex. 677 at Port 3648 (Eva); Ex. 678 at Port 190 (Hawaiian), RP 1510/8-19. At the trial in this case, Michael Ehl, the Port's Director of Aviation Operations, admitted that the Port was the one entity best able to keep Sea-Tac Airport safe. RP 3021/1-7. Menzies itself has asserted that many of the citations it was issued by DLI, discussed earlier, related to matters with the control of the

Port, not it alone.<sup>1</sup> The Tompa study referenced above means that Sea-Tac Airport will become more dangerous if the Port is allowed to pass off its responsibility for ensuring a safe workplace at the airport to others. Likewise, other airports and the many multiemployer jobsites (virtually every construction site) across the state will become more dangerous as responsibility for safety becomes more diffuse. As this case demonstrates, that would have a real human cost to WSLC members and their families.

This is not to say that, in the appropriate case, an injured Sea-Tac Airport worker could not seek and recover third-party liability from an airline or other employer operating at the airport. It is clearly the law that more than one controlling party can be responsible for workplace injuries at a multiemployer job site. *E.g.*, *Weinert v. Bronco Nat'l Co.*, 58 Wn. App. 692, 795 P.2d 1167 (1990); *George Sollitt Corp. v. Howard Chapman Plumbing & Heating, Inc.*, 67 Wn. App. 468, 836 P.2d 851 (1992). But concurrent liability is not inconsistent with nondelegable liability. All it means is that, for the initial liability to the injured worker, each controlling party is fully charged with a nondelegable duty to

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<sup>1</sup> On March 7, 2016, after receiving notice of the citations referenced above, Menzies Aviation sent a statement that said, in part, "Many of the citations relate to airport infrastructure issues. Fully mitigating these issues would require a massive reconfiguration of the airport itself, and changes to baggage systems and ground

provide a safe workplace. Then, if appropriate under the contracts between those controlling parties, they can sue to allocate fault among themselves. *See, Gilbert H. Moen Co. v. Island Steel Erectors, Inc.*, 128 Wn.2d 745, 758, 912 P.2d 472 (1996).

**C. Injured Workers Should Be Spared The Burden Of Suing Everybody**

The injured worker should not be forced to sue everyone at the multiemployer job site in order to ensure that he or she receives proper compensation. That would be a terrible waste of judicial resources, and tends to overwhelm the practical ability of the injured worker to assert his or her third-party claim for full and fair compensation. The nondelegable duty to provide a safe workplace means that an injured worker can pick one or two prominent defendants at a multiemployer job site such as the airport, and be assured of recovering full and fair compensation.

The evidence in this case is that there are some 200 independent contractors operating at Sea-Tac Airport, including about 34 air carriers. *Brief of Appellant Port* at 5. A seriously injured employee should not be saddled with the burden and high cost of investigating exactly which of these many entities might arguably have had some control over the manner of work involved in his or her injury. The folly of the Port's

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handling equipment used not just at Sea-Tac, but throughout the U.S. aviation industry.” “Alaska Airlines Cited For Unsafe Working Conditions,” KIRO 7 NEWS, *supra*.

position is demonstrated in this case, in which the airlines and Port witnesses steadfastly denied in sworn statements that the airlines had any involvement, and the airlines were so convincing that they persuaded Judge Coughenour to grant them summary judgment in Federal Court. How then can injured workers ever determine who to sue, if they do not simply sue every single entity out of an abundance of caution? If the Port's position succeeds, WSLC and its union affiliates will be forced to advise any employee injured at the airport to sue every airline and every other employer operating on the airfield. The costs, both to injured workers and to the judicial system itself, would be catastrophic.

**D. The Port's Arguments Fit Within A Discredited Historical Pattern Of Employers Seeking To Pass Off Responsibility For Industrial Accidents To Others**

WSLC also wishes to remind the Court that the current dispute fits within a historical context in which employers have, since the 19th century, attempted to place blame for industrial accidents onto others. Long ago, in *Farwell v. Boston & Worcester Rail Road*, 45 Mass. 49 (1842), Chief Justice Lemuel Shaw of the Massachusetts Supreme Court laid down the seminal American case for the notorious "fellow-servant" rule, which shielded employers from liability for workplace injury "caused" by the carelessness of other employees, and was thus an

exception to the usual rule of *respondeat superior*. This rule led to untold suffering and the creation of workers compensation statutes.

The long line of Washington cases from 1896 to 2013 cited by Mr. Afoa in favor of a “nondelegable duty” to provide a safe workplace, *see, Supplemental Brief of Afoa*, pp.4-5, fns. 10-12, constitute this Court’s renunciation of this outdated rule. These cases show this Court’s consistent view: (1) that sound public policy requires that the party best able to control safety at the workplace should bear *full* liability for failure to do so, and (2) that it will read all statutes consistent with the Washington Constitutional mandate that the legislature ““pass necessary laws for the protection of persons working in mines, factories and other employments dangerous to life or deleterious to health.”” WA Const. Art. II §35 (*quoted in Afoa I*, 176 Wn.2d at 470).

The Port’s argument that RCW 4.22.070(1) allows it to pass liability for injury to Sea-Tac Airport workers onto other entities who have only partial or limited control over worker safety is no different from the old arguments in favor of passing liability to fellow servants. We have come too far to go back now to the Gilded Age when workers were just disposable cogs in the machinery of industry.

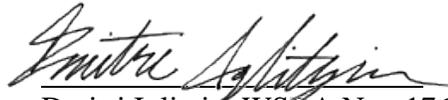
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## V. CONCLUSION

On behalf of hundreds of thousands of working men and women in Washington State, the WSLC urges this Court to affirm the decision of the Court of Appeals in this case, and to find that Tort Reform does not abrogate the Port's nondelegable duty and vicarious liability for ensuring a safe workplace for all employees at Sea-Tac Airport.

Respectfully submitted this 4<sup>th</sup> day of December, 2017.



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## DECLARATION OF SERVICE

I, Jennifer Woodward, declare under penalty of perjury under the laws of the state of Washington, that on December 4, 2017, I caused the foregoing Amicus Brief of Washington State Labor Council to be filed electronically with the court using the appellate court portal, and a true and correct copy of the same to be sent via email service to:

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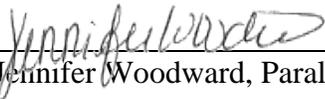
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\_\_\_\_\_  
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# Appendix

# A Systematic Literature Review of the Effectiveness of Occupational Health and Safety Regulatory Enforcement

Emile Tompa, PhD,<sup>1,2,3\*</sup> Christina Kalcevich, MA,<sup>1</sup> Michael Foley, MA,<sup>4</sup> Chris McLeod, PhD,<sup>1,5</sup> Sheilah Hogg-Johnson, PhD,<sup>1,3</sup> Kim Cullen, PhD,<sup>1</sup> Ellen MacEachen, PhD,<sup>3,6</sup> Quenby Mahood, MA,<sup>1</sup> and Emma Irvin, BA<sup>1</sup>

**Background** We aimed to determine the strength of evidence on the effectiveness of legislative and regulatory policy levers in creating incentives for organizations to improve occupational health and safety processes and outcomes.

**Methods** A systematic review was undertaken to assess the strength of evidence on the effectiveness of specific policy levers using a “best-evidence” synthesis approach.

**Results** A structured literature search identified 11,947 citations from 13 peer-reviewed literature databases. Forty-three studies were retained for synthesis. Strong evidence was identified for three out of nine clusters.

**Conclusions** There is strong evidence that several OHS policy levers are effective in terms of reducing injuries and/or increasing compliance with legislation. This study adds to the evidence on OHS regulatory effectiveness from an earlier review. In addition to new evidence supporting previous study findings, it included new categories of evidence—compliance as an outcome, nature of enforcement, awareness campaigns, and smoke-free workplace legislation. Am. J. Ind. Med. © 2016 Wiley Periodicals, Inc.

**KEY WORDS:** regulation; legislation; occupational health and safety; OHS; regulatory effectiveness

## INTRODUCTION

Occupational health and safety (OHS) regulation takes different forms across jurisdictions and over time. Responding to involved stakeholders, government

authorities strive to devise ways to protect the health and safety of workers that will be effective in the context of competitive business environments, contemporary labor market structures, available resources, labor-management power issues, perspectives of health and safety professionals, and political will. OHS policy levers (i.e., the specific means used to promote compliance)<sup>1</sup> used by regulatory authorities include a variety of approaches such as administrative monetary penalties, prosecutions, orders to comply, injunctions, inspections and audits, and consultations. For regulations to be effective, it is critical that they address key health and safety risks that are amendable by workplace parties, are clearly communicated to organizations, are enforceable by regulators, and create

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Accepted 23 April 2016

DOI 10.1002/ajim.22605. Published online in Wiley Online Library (wileyonlinelibrary.com).

<sup>1</sup> We use the term “policy lever” to refer to the specific means by which a regulator attempts to encourage action in a particular direction, as opposed to the broader notion of “policy” as the operationalization of legislation.

incentives for compliance [Mendeloff, 1979; Scholz and Gray, 1997; Shapiro and Rabinowitz, 1997; Baggs et al., 2003; Wright and Genna, 2005; Bluff, 2011; Safe Work Australia, 2013].

The literature on OHS regulatory policy levers is large and diverse, uses different statistical methods and levels of data aggregation, and considers experiences from various time periods and jurisdictions. As a result, it is difficult to compare and contrast findings from different studies, discern the quality of evidence, and identify the overarching strength of evidence on particular levers. Nonetheless, collating and synthesizing the evidence on the effectiveness of OHS regulatory policy levers is critical, given the substantial resources invested by the public sectors in regulatory enforcement and by organizations seeking to be compliant.

While earlier studies reviewed parts of this diverse literature [e.g., Kralj, 2001; Mendeloff, 2001], Tompa et al. [2007] was the first to use a structured approach to identifying, evaluating, and synthesizing the evidence base. More recent reviews have complemented these evidence syntheses by considering the literature on the socio-psychological factors of stakeholders that bear on their ability to address OHS issues [Bluff, 2011], and others have focused on why some regulatory efforts are successful while others are not [Safe Work Australia, 2013].

The Tompa et al. [2007] review found strong evidence that the first hand experience of citations and penalties (known as specific deterrence) reduces injuries. In contrast, the first hand experience of inspections had only limited to mixed evidence. Similarly, there was limited to mixed evidence that the probability of inspections, citations, and penalties (known as general deterrence) reduces injuries. The review considered evidence up until 2004, but the literature has grown substantially since then, with investigations of new legislation and more detailed inquiries into existing practices. The current systematic review follows from the earlier review, expanding the scope to include studies that consider intermediate outcomes, specifically compliance, as well as other OHS policy levers such as consultations and awareness campaigns. Also included is the introduction of smoke-free workplace legislation.

The overarching question guiding this review is “what is the strength of evidence on the effectiveness of OHS policy levers in creating incentives for organizations to improve occupational health and safety processes and outcomes.” We follow with a detailed description of the systematic search strategy, study inclusion criteria, quality assessment, and evidence synthesis approach. The results provide evidence synthesis profiles across nine clusters of studies that were retained in the final review. Our discussion section elaborates on the policy implications of our findings, expounds on the importance of context, details the strength and limitations of our review, and provides suggestions for the way forward for

research. We end with a brief summary of findings and implications in our conclusion.

In addition to the research question noted above, the review had the following objectives:

- To identify peer-reviewed literature on the effectiveness of OHS policy levers;
- To evaluate the quality of identified studies and synthesize the evidence;
- To engage a stakeholder committee throughout the process to assist with identifying the research questions, scope of the study as well as interpretation of findings; and
- To disseminate the review findings locally, nationally, and internationally.

## METHODS

### Stakeholder Engagement

Consistent with stakeholder engagement recommendations [Keown et al., 2008], an advisory committee was formed to provide feedback on the key question guiding the review, the scope of the literature search, the interpretation of the findings, and the formulation of policy implications. The committee consisted of three senior policy makers with extensive regulatory enforcement experience from the Ontario Ministry of Labour (Canada), three senior academics with a specialty in OHS issues (from the United States, United Kingdom, and Australia), two senior industry OHS service providers and an injured workers’ advocate (all three from Canada). The first advisory committee meeting was held in the early stages of the study after some preliminary groundwork on searches had been completed. A second one was held near the end of the study after preliminary synthesis profiles had been formulated.

### Systematic Literature Search

This review, which focused on quantitative studies, was undertaken in conjunction with a qualitative review on the same topic. The quantitative review considered evidence on effectiveness, while the qualitative review considered planning and implementation of regulations. The two reviews had a common search process, but once full studies were identified as meeting preliminary inclusion criteria, the two reviews were completed independently.

The review was based on a systematic search of several peer-reviewed journal databases, specifically MEDLINE, EMBASE, PsychINFO, ABI Inform, Health and Safety Science Abstracts, ASSIA, EconLit, Sociological Abstracts, Wilson Social Science Abstracts, and Index to Legal

Periodicals. Databases were chosen to capture all disciplinary areas that might have studies meeting the inclusion criteria. The search methodology followed a modified PICO (population, intervention, comparison, and outcome) format, in which studies had to contain at least one term in each of four categories (regulatory focus, setting, policy lever, and context) in order to be retrieved. The search strategy combined sets of keywords using an “AND” term between categories, and an “OR” term within categories so that citations would have to include at least one term from each of the categories in order to be pulled from the database. Wild-card characters were used extensively to ensure different spelling and forms of words were captured. Table SI in the supplemental materials provides details on the final keywords used.

A hand search was also done on the journal “Policy and Practice in Health and Safety” and on the website SafeWork Australia/RegNet because of their focus on research related to OHS regulatory mechanisms. As well, the research team compiled a list of 19 content experts from seven countries and solicited their suggestions of studies for consideration that were already published in peer-reviewed journals, in press, or accepted for review.

Searching for additional studies was an iterative process. For example, all references of studies selected for inclusion in the review were scanned to identify incremental relevant studies. Other literature review studies on the topic of OHS regulation were also scanned. This latter category included a review by Bluff [2011] and a Cochrane collaboration review by Mischke et al. [2013].

## Selection of Studies for Inclusion

To be eligible for inclusion in the review, studies had to be in English, published between January 1990 and June 2013 in a peer-reviewed journal, and be longer than two pages. The latter was to filter out short discussion pieces.

At the title and abstract screening stage there were two criteria for study inclusion. First, studies had to consider directives related to OHS legislation and/or regulation made by a government authority. Second, studies had to evaluate OHS legislation and/or regulations using quantitative and/or qualitative methods. Studies that met the two criteria were then classified as quantitative, qualitative, or mixed methods.

The title and abstract screening stage began with a pilot test in which the entire research team reviewed the same set of 120 studies based on the above noted criteria. After all reviewers tested the criteria, the team met to discuss discrepancies and fine tune the technical guidelines document accordingly. A second meeting was held with the research team after alternating pairs of two reviewers assessed another 1,500 titles and abstracts to further discuss any outstanding issues. Following this piloting, each

reviewer was assigned a separate batch of titles and abstracts. A second reviewer audited 20% of citations across the entire frame of studies pulled by the electronic searches to ensure accuracy of the selection process. Agreement for passing citations onto the next stage was 99.5%. In cases where only a title was available for review, the entire paper was retrieved and reviewed before deciding on its eligibility for inclusion.

The full study screening stage used the same criteria for inclusion as the title and abstract stage. The difference here was that the full article was reviewed to ensure it met the criteria. At this stage, studies were assigned to a single reviewer. Again, 20% of the full article screenings were subjected to a second review. Agreement was 96% at this stage for inclusion. All studies selected for inclusion were again screened by both the project coordinator and the principle investigator as part of a quality check.

Studies included in the quantitative and mixed methods categories were reviewed by multiple quantitative team members to identify those that met the following incremental inclusion criteria: (i) the study had a temporal element (i.e., study must either use data from multiple points in time, or ask respondents about past experiences); (ii) the study design was rigorous (i.e., study could not be just descriptive, it had to use multiple regression modeling methods or had to have a quasi-experimental design, including before/after or a concurrent control group); and (iii) the study considered final outcomes, such as injuries and illnesses, or intermediate outcomes, such as compliance or reduced exposures (studies examining only monetary outcomes were not included).<sup>2</sup> Compliance and reduced exposures are seen as intermediate outcomes since the ultimate goal of OHS regulatory enforcement is to reduce work injuries and illnesses. Essentially, compliance and reduced exposures are simply a means to that goal.

Relevant regulatory policy levers included regulation enacted and enforced at any level of government: country, state/province, sector, workplace, and/or individual level; and regulatory levers that focused on enforcement (e.g., stop work orders, injunctions, prosecutions, monetary penalties, warnings, orders, tickets, inspections), voluntary activities (e.g., voluntary guidelines, consultations, certifications, health, and safety group membership) and/or mandated activities (e.g. right to refuse unsafe work, requirement for a joint health, and safety committee). Table I provides an overview of the policy levers and outcomes considered in the review.

<sup>2</sup> Monetary outcomes are used in studies focusing on insurance costs. We excluded these, as we were interested in studies focusing on occupational health and safety performance rather than insurance costs. We note that there were only a few such studies.

**TABLE I.** Summary Table of Policy Levers and Outcomes

Policy levers	Outcomes
Introduction of OHS legislation	Compliance
Introduction of smoke-free workplace legislation	Exposures
Inspection sequence	Awareness (of campaign)
Inspection activity: general deterrence of inspections and penalties	Health (respiratory and sensory symptoms)
Inspection activity: specific deterrence of inspections and penalties	Health behaviours (cigarette smoking)
Nature of enforcement: consultative activities	Injuries and fatalities
Nature of enforcement: autonomy supportive inspector style	Truck crashes
Nature of enforcement: state- versus federal-level enforcement	
Awareness campaigns	

## Quality Assessment and Data Extraction

Quality assessment and data extraction were performed concurrently by two reviewers. The two reviewers independently scored each assigned study and then met to discuss it. A consensus rating was not required. Rather, the discussion was meant to ensure that both reviewers considered the full range of issues relevant to each study. Studies were evaluated based on a quality appraisal protocol developed by Tompa et al. [2007] that consisted of 10 items in two parts (study quality and policy lever relevance). Each item was ranked on a Likert scale from one to five. See Table II for details of the 10 items. Ratings from the two reviewers were averaged for part one and part two separately. The lower of the two scores was used for the overall quality rating score. The final quality rating for a study was grouped into one of three categories: high (70% or greater), medium (50–70%), or low (50% or less). Only high and medium quality studies were retained for evidence synthesis.

## Evidence Synthesis

The evidence-ranking algorithm used to synthesize evidence across studies was based on a qualitative methods approach known as “best evidence synthesis” developed by Slavin [1986, 1995] and used in other published reviews [e.g., Tompa et al., 2007; Rivilis et al., 2008; Tullar et al., 2010]. Best-evidence synthesis identifies the strength of a relationship based on the quantity, quality, and consistency of the evidence available to support a relationship between variables. Part and parcel to the approach is the notion of precedence. If a certain quality standard was required in the past, then current requirements should be the same or higher.

Thus, as the literature grows and advances, the bar for each quality level may be set higher. The best evidence synthesis approach is well suited for the subject matter and literature of this review because of the broad range of study designs and analytic approaches. Quantitative methods such as meta-analysis cannot be employed when statistical methods used by different studies are too varied. Best evidence synthesis aims to provide the same methodological rigor to evidence synthesis as meta analysis by clearly and concisely articulating the synthesis criteria.

For each policy lever and outcome category, we ranked the evidence supporting the hypothesized relationship on a five-level scale consisting of strong evidence, moderate evidence, limited evidence, no evidence, and mixed evidence.<sup>3</sup> Evidence on a policy lever was tested against the criteria for the highest level (strong evidence), and, if it was not met, the criteria for the next highest level (moderate evidence) was considered. If it was not met, the subsequent level (limited evidence) was considered. If the evidence did not meet the criteria for any of these three levels, it defaulted to one of the two categories, no evidence or mixed evidence. The former arose if there were no studies or only low-quality studies. The latter arose if there was more than one high- or medium-quality study and the studies provided conflicting evidence. Table III below provides details on the evidence synthesis algorithm.

## RESULTS

### Literature Search Results

The literature search, which included electronic databases, hand searches, and references from content experts, identified 11,947 unique titles and abstracts across 13 sources. Table IV below provides details by source. The cell counts are prior to the removal of duplicates from across the different sources.

Of the 11,947 titles and abstracts, 2,360 passed to full study review. Of these studies, 282 were retained in the quantitative or mixed method categories. At this stage the incremental quantitative rigor criteria were invoked to screen the 282 studies, 61 of which passed the screening and moved onto the quality assessment stage. Three additional articles were identified in the reference lists of these studies, increasing the count to 64 that were assessed for quality. Of these studies, 43 were rated high or medium quality and were retained for evidence synthesis. Figure 1 below provides a flow chart of the number of studies retained at each stage.

<sup>3</sup> A significance level of 5% was used as the cutoff for evidence of a relationship between a policy lever and an outcome. Though some studies included considered 10% as significant, we treated these as not significant.

**TABLE II.** Quality Assessment Tool

<b>Overall study quality</b>
1. Does the study specify a theoretically correct relationship between the policy feature (explanatory variable), and the outcome variable (dependent variable)?
2. Are the characteristics of the study population properly well-defined, measured and described?
3. Was the statistical methodology appropriate for the research question and study design?
4. Does the study establish an empirically correct relationship between the outcome and independent variables?
5. Was there adjustment made for important covariates?
6. Are the results interpreted correctly?
<b>Policy lever relevance</b>
7. How strongly would you rate the measurement validity of this study?
8. How strongly would you rate the statistical validity of this study?
9. How strongly would you rate the internal validity of this study?
10. How strongly would you rate the external validity of this study?

The Tompa et al. [2007] review had identified 24 studies on the effectiveness of regulatory policy levers published from 1970 to 2004. Sixteen of those studies were published from 1990 onward, though four were not from peer reviewed journal publications and one study was not in English. The remaining 11 studies from that review were identified in our search and had passed through the same quality appraisal protocol as the newly identified studies. Of the 11 studies, seven dropped in quality ranking from high to medium or from medium to low quality, due to a higher standard imposed by the team in response to a noted higher level of quality identified in the overall literature. This is consistent with the best-evidence synthesis approach, which takes into consideration precedence and the state of the literature. Ultimately, seven of the original studies received a ranking of medium or high quality and were included in this review.

Included studies were grouped into nine thematic clusters, defined by the policy lever being evaluated. The clusters were: (i) introduction of OHS legislation; (ii) introduction of smoke-free workplace legislation; (iii) inspection sequence (defined below); (iv) inspection activity: general deterrence of inspections and penalties, (v) inspection activity: specific deterrence of inspections with/without penalties; (vi) nature of enforcement: consultative activity; (vii) nature of enforcement: autonomy supportive inspection style, (viii) nature of enforcement: state- versus federal-level enforcement; and (ix) awareness campaigns. See Table SII in the supplemental material for details. Table V provides a high level summary of the studies by cluster and the synthesis statements related to each.

## **Evidence Synthesis Results**

### ***Introduction of OHS legislation***

There are nine studies in this cluster (one of high quality and eight of medium quality). Studies considered the

introduction of a mix of different legislation, some enabling legislation to promote good practices and empower workplace parties, and others regulations as mechanisms for creating compliance obligations. Specifically, the legislation includes a hearing conservation program, chemical exposure mitigation, universal precautions for blood borne pathogens, ergonomics regulation, lockout/tagout requirements, internal responsibility systems, and training requirements. Some studies in this cluster considered final outcomes of injury, illness, and fatality rates, while others considered intermediate outcomes of exposure and compliance rates. For the former, there is “moderate evidence” that the introduction of OHS legislation has an effect on final outcomes (based on one high quality study and five medium quality studies). For the latter, there is “limited evidence” that the introduction of legislation improves intermediate outcomes, that is, reduces exposure rates and/or increases compliance rates (based on three medium quality studies). Four of the studies in this cluster were in manufacturing, two in health care, one in forestry, and one in multiple sectors. Six of the studies were undertaken in the United States, two in Canada, and one in Spain.

### ***Introduction of smoke-free workplace legislation***

There are six studies in this cluster (five of high quality and one of medium quality). Studies all considered the introduction of different forms of smoke-free workplace legislation in North America and Europe. Here too some studies considered final outcomes, specifically respiratory and sensory symptoms. Others considered intermediate outcomes, specifically reductions in smoke exposure, and reductions in cigarette consumption. For final outcomes, there is “moderate evidence” that smoke-free workplace legislation reduces respiratory and/or sensory symptoms (based on two high quality and two medium quality studies).

**TABLE III.** Evidence Synthesis Algorithm

<b>Strong evidence</b>
Minimum study quality: high. Minimum number of studies: three. Consistency criteria: if there are only three high-quality studies, all of them must report consistent findings. If there are four or more high-quality findings, all of them must report consistent results unless there is a specific methodological reason that could explain a divergent result. The majority (>50%) of medium-quality studies must concur with the findings from the high-quality studies. If the above criteria are not met, then the criteria for establishing moderate evidence are applied.
<b>Moderate evidence</b>
Minimum study quality: medium or less than three high-quality studies. Minimum number of studies: three; they can be a mixture of medium- or high-quality studies. Consistency criteria: at least three studies must report consistent findings, and the majority (>2/3) of all the studies must report consistent findings. If the above criteria are not met, then the criteria for establishing limited evidence are applied.
<b>Limited evidence</b>
Minimum study quality: medium. Minimum number of studies: one. Consistency criteria: fewer than three studies report consistent findings, with the majority (>50%) of the studies reporting consistent findings. If the above criteria are not met, then there is no evidence or mixed evidence.
<b>No evidence</b>
No high- or medium-quality studies are available from which to draw conclusions.
<b>Mixed evidence</b>
The findings from medium- and high-quality studies are contradictory.

Four studies considered respiratory symptoms as an outcome and three sensory symptoms. For intermediate outcomes, there is “strong evidence” that smoke-free workplace legislation reduces smoke exposure and/or cigarette consumption (based on four high quality and one medium quality studies).

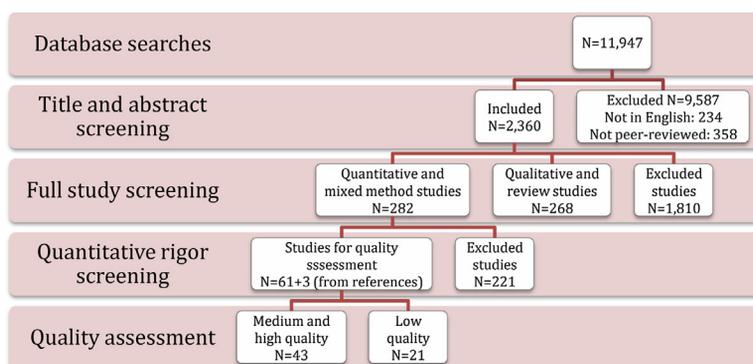
Four of the included studies on smoke-free workplace legislation examined the impact of national laws in Europe. Ayres et al. [2009] examined the health changes before and

after smoke-free workplace legislation was passed in Scotland in 2006. Allwright et al. [2005] examined the health changes in bar workers resulting from smoke-free workplace legislation in the Republic of Ireland in 2004 and compared them to changes in workers in Northern Ireland (which at the time did not have smoke-free workplace legislation). Larsson et al. [2008] examined the health effects of a smoke-free workplace legislation, enacted in 2005, on bar, restaurant and gaming workers in Sweden. The fourth European study examined the impact of a Spanish federal smoke-free workplace legislation that exempted hospitality venues from following the ban. Firms were given the choice to choose a smoke-free policy, a partial smoking restriction, or have no restrictions at all. The authors compared exposure and health effects following the ban with those in hospitality workers in Portugal and Andorra, which had no smoke-free workplace legislation.

Three of the studies in this cluster were undertaken in North America. One study, that of Bondy et al. [2009], examined the impact on bar workers of a municipal smoke-free workplace bylaw in Toronto, Canada in 2004. The authors compared secondhand smoke exposure of bar workers in Toronto to the exposure of workers in Windsor, Canada, a nearby city without smoke-free workplace

**TABLE IV.** Titles and Abstracts Identified by Source

<b>Source</b>	<b>N</b>	<b>Source</b>	<b>N</b>
Medline	3,450	Sociological Abstracts	195
EMBASE	4,190	Wilson Social Science Abstracts	184
PsycINFO	733	Index to Legal Periodicals	149
ABI Inform	4,000	Hand-search: Policy and Practice in Health and Safety	19
Health and Safety Science Abstracts	1,181	Hand-search: SafeWork Australia/RegNet	35
ASSIA	85	Content experts	19
EconLit	279		



**FIGURE 1.** Flow chart of studies retained at each stage.

legislation. The final smoke-free workplace legislation study, that of Moskowitz et al. [2000], considered legislative changes in California. It differs from the other studies in that it looked at the impact of local ordinances on smoking cessation rates and workplace smoking policies.

### ***Inspection sequence***

There were four studies in this cluster, all of which were undertaken in US jurisdictions. The studies considered how inspection sequence influences compliance rates based on changes in compliance violations cited. For this cluster, there is “moderate evidence” that the first inspection has the largest impact on compliance rates for all violations, with subsequent inspections having a declining impact (based on two high quality and two medium quality studies). All four studies had similar findings for all and for serious compliance violations. Ko et al. [2010] also considered four different time periods within 1972–2006 range and found similar results across the periods. As all studies used micro level data on the plant/site, this relationship would be considered specific deterrence.

### ***Inspection activity: General deterrence of inspections and penalties***

This cluster considers the impact of the probability of inspections through aggregate/industry levels inspection activity. There are three studies in this cluster, all of medium quality. Studies considered the final outcomes of lost-time injury rate, lost workdays, and the fatality rate. Based on this cluster, there is “limited evidence” of no general deterrence effect on lost-time injuries at the aggregate level (based on three studies—two studies found no effect and one study found an effect). There is “limited evidence” of a general deterrence on fatalities and lost workdays (based on one study for each outcome). The three studies were from North American jurisdictions; two from the US [Scholz and Gray,

1990; Ruser and Smith, 1991], and one from Alberta, Canada [Auld et al., 2001]. One study used aggregated data [Auld et al., 2001], and two used micro data at the firm level [Scholz and Gray, 1990; Ruser and Smith, 1991].

### ***Inspection activity: Specific deterrence of inspections with/without penalties***

This cluster has the largest number of studies, with 13 studies. Most considered specific deterrence in the form of inspections with/without penalties, while some also considered other types of specific enforcement activities such as consultations or details of the inspection activity such as programmed versus complaint inspections and the value of fines imposed. One study focused on early versus late inspections [Ruser and Smith, 1991], and another focused on compliance reviews in the transportation sector [Chen, 2008]. All considered the effects of the policy lever on final outcomes.

This cluster provides “strong evidence” that specific deterrence from inspections with penalties reduces final outcomes (based on nine studies, six of which were high quality, and three of medium quality). Outcomes considered in the studies include all injuries, health care only injuries, lost-time injuries, workdays lost, musculoskeletal disorders (MSD) and non-MSD injuries, and restricted activity days. All studies found a deterrence effect on most final outcomes.

The cluster provides “moderate to limited evidence” of no effect from specific deterrence of inspections without penalties on final outcomes (based on nine studies, six of which were high quality, and three of medium quality). A range of outcomes was considered in these studies, including all injuries, health care only injuries, lost-time injuries, workdays lost, MSD and non-MSD injuries, and restricted activity days. Some studies found deterrence effects [Foley et al., 2012; Levine et al., 2012], while others found effects only under specific conditions such as in fixed-site industries

**TABLE V.** Summary of Studies by Cluster With Synthesis Statements

<b>Cluster</b>	<b>No. of studies by outcome</b>	<b>Study, jurisdiction, sector</b>	<b>Evidence synthesis</b>
Introduction of OHS legislation	Final outcomes (six studies): injuries and fatality	<ul style="list-style-type: none"> <li>● Davies et al. [2008]: British Columbia, Canada; forestry</li> <li>● Arocena and Nunez [2009]: Spain; manufacturing</li> <li>● Bulzacchelli et al. [2007]: United States; manufacturing</li> <li>● Finger and Gamper-Rabindran [2013]: United States; chemical manufacturing</li> <li>● Lewchuk et al. [1996]: Ontario, Canada, manufacturing</li> <li>● Monforton and Windsor [2010]: United States; mining</li> </ul>	Moderate evidence that the introduction of OHS legislation has an effect on final outcomes
	Intermediate outcomes (three studies): exposure and compliance	<ul style="list-style-type: none"> <li>● Foley et al. [2009]: Washington State, United States; multiple sectors</li> <li>● LaMontagne et al. [2004]: United States; health care</li> <li>● Ramsey and Glenn [1996]: Tennessee; United States, health care</li> </ul>	Limited evidence that the introduction of legislation improves intermediate outcomes
Introduction of smoke-free workplace legislation	Final outcomes (one study): respiratory and sensory symptoms	<ul style="list-style-type: none"> <li>● Ayres et al. [2009]: Scotland; bar/restaurant</li> <li>● Allwright et al. [2005]: Republic of Ireland; bar/restaurant</li> <li>● Fernandez et al. [2009]: Spain; hospitality</li> <li>● Larsson et al. [2008]: Sweden; bar/restaurant</li> </ul>	Moderate evidence that smoke-free workplace legislation improves final outcomes
	Intermediate outcomes (two studies): smoke exposure, cigarette consumption	<ul style="list-style-type: none"> <li>● Allwright et al. [2005]: Republic of Ireland; bar/restaurant</li> <li>● Bondy et al. [2009]: Ontario, Canada; bar/restaurant</li> <li>● Fernandez et al. [2009]: Spain; hospitality</li> <li>● Larsson et al. [2008]: Sweden; bar/restaurant</li> <li>● Moskowitz et al. [2000]: California, United States; multiple</li> </ul>	Strong evidence that smoke-free workplace legislation improves intermediate outcomes
Inspection sequence	Intermediate outcomes (four studies): compliance	<ul style="list-style-type: none"> <li>● Gray and Jones [1991b]: United States; manufacturing</li> <li>● Weil [2001]: United States; manufacturing</li> <li>● Gray and Jones [1991b]: United States; manufacturing</li> <li>● Ko et al. [2010]: United States, manufacturing</li> </ul>	Moderate evidence that the first inspection results in the largest improvement in compliance
Inspection activity: general deterrence of inspections and penalties	Final outcomes (three studies): lost-time injuries	<ul style="list-style-type: none"> <li>● Auld et al. [2001]: Alberta, Canada, construction</li> <li>● Ruser and Smith [1991]: United States, manufacturing</li> <li>● Scholz and Gray [1990]: United States, manufacturing</li> </ul>	<p>Limited evidence (three studies) of no general deterrence effect on lost-time injuries</p> <p>Limited evidence of a general deterrence effect on fatalities (one study) and lost workdays (one study)</p>

*(Continued)*

TABLE V. (Continued)

Cluster	No. of studies by outcome	Study, jurisdiction, sector	Evidence synthesis
Inspection activity: specific deterrence of inspections with/ without penalties	Final outcomes (13 studies): injuries and truck crashes	<ul style="list-style-type: none"> <li>● Foley et al. [2012]: Washington State, United States; multiple sectors</li> <li>● Gray and Scholz [1991]: United States; manufacturing</li> <li>● Gray and Scholz [1993]: United States; manufacturing</li> <li>● Gray and Mendeloff [2005]: United States; manufacturing</li> <li>● Haviland et al. [2010]: Pennsylvania, United States; manufacturing</li> <li>● Haviland et al. [2012]: Pennsylvania, United States; manufacturing</li> <li>● Levine et al. [2012]: California, United States; high risk industries</li> <li>● Mendeloff and Wayne [2005]: United States, manufacturing</li> <li>● Nelson et al. [1997]: Washington State, United States; construction</li> <li>● Ruser and Smith [1991]: United States; manufacturing</li> <li>● Scholz and Gray [1990]: United States; manufacturing</li> <li>● Scholz and Gray [1997]: United States; manufacturing</li> <li>● Chen [2008]: United States; trucking</li> </ul>	<p>Strong evidence (nine studies) that specific deterrence from inspections with penalties reduces final outcomes</p> <p>Moderate to limited evidence (nine studies) of no effect from specific deterrence of inspections without penalties on final outcomes</p> <p>Limited evidence (one study) that specific deterrence in a compliance review of motor safety performance reduces truck crashes</p>
Nature of enforcement: Consultative activities	Final outcomes (three studies): injuries	<ul style="list-style-type: none"> <li>● Baggs et al. [2003]: Washington State, United States; multiple sectors</li> <li>● Foley et al. [2012]: Washington State, United States; multiple sectors</li> <li>● Hogg-Johnson et al. [2012]: Ontario, Canada; manufacturing</li> </ul>	Strong evidence/limited evidence that consultative activity has no effect on final outcomes
Nature of enforcement: Autonomy supportive inspection style	Intermediate outcomes (one study): compliance	<ul style="list-style-type: none"> <li>● Burstyn et al. [2010]: Alberta, Canada; multiple sectors</li> </ul>	Limited evidence that an autonomy-supportive inspector style reduces visits to achieve compliance
Nature of enforcement: State- versus federal-level enforcement	Final outcomes (two studies): injuries and fatalities	<ul style="list-style-type: none"> <li>● Bradbury [2006]: United States, multiple sectors</li> <li>● Morantz [2009]: United States, construction</li> </ul>	Limited evidence that state (versus federal) enforcement results in lower fatalities and higher injuries
Awareness campaigns	<p>Final outcomes (one study): injuries</p> <p>Intermediate outcomes (two studies): awareness and compliance</p>	<ul style="list-style-type: none"> <li>● Mancini et al. [2005]: Italy, metal workers</li> <li>● Gadomski et al. [2006]: New York State, United States; agriculture (children)</li> <li>● Gadomski et al. [2006]: New York State, United States; agriculture (children)</li> <li>● Bjorkdahl et al. [2008]: Sweden; multiple sectors</li> <li>● Stokols et al. [2001]: California, United States, multiple sectors</li> </ul>	<p>Limited evidence that awareness campaigns improve final outcomes</p> <p>Moderate evidence that awareness campaigns improve intermediate outcomes</p>

[Scholz and Gray, 1990], inspections initiated by a worker [Scholz and Gray, 1997], and inspections that were not superficial record checks [Gray and Scholz, 1991], or found a smaller effect than with citations [Nelson et al., 1997]. This inconsistency is the reason for the dual level of evidence. Some studies in this cluster considered inspections without identifying whether there were citations or penalties [Ruser and Smith, 1991; Nelson et al., 1997; Levine et al., 2012].

One study is treated separately in that it focused on truck crashes as an outcome in the transportation sector. This study alone provides “limited evidence” of specific deterrence from a compliance review of motor safety performance with regard to reduced truck crashes.

### ***Nature of enforcement: Consultative activity***

Three studies are in this cluster, all of which are rated high quality. The three considered final outcomes. For this cluster there is either “strong evidence or limited evidence” that consultative activity has no effect on injury rates (based on three high quality studies). The reason for the two-sided synthesis profile is that one study in this group, that of Foley et al. [2012], found mixed results in which one outcome was significant and negative for fixed site locations (lost workday for non-MSD claims) and several other outcomes were significant and negative for non-fixed site locations. The three high quality studies in this cluster included two based on data from Washington State [Baggs et al., 2003; Foley et al., 2012], and one Canadian study from Ontario [Hogg-Johnson et al., 2012].

### ***Nature of enforcement: Autonomy supportive inspection style***

The one study in this cluster considered the intermediate outcome of compliance. For this cluster there is “limited evidence” that an autonomy-supportive style (e.g., one in which an inspector provides a rationale and choices versus deadlines and pressure) reduces the number of visits to achieve compliance (based on one high quality study). The one study in this cluster is based on data from Alberta [Burstyn et al., 2010].

### ***Nature of enforcement: State- versus federal-level enforcement***

Two US studies examined whether state enforcement was more or less effective than federal level enforcement. The premise of these studies was that different styles of enforcement may be provided by different levels of government. The two studies in this cluster are both of

medium quality and both considered final outcomes. For this cluster there is “limited evidence” that state enforcement results in lower fatality rates compared to federal enforcement (based on two medium quality studies). One of the studies also considered injury rates and found a positive and significant result, suggesting that state enforcement is associated with higher injury rates compared to federal enforcement.

### ***Awareness campaigns***

The studies included in this cluster are in different sectors and focused on different OHS risks. There are four studies in this cluster, two of which considered final outcome and three which considered intermediate outcomes. For the former group, there is “limited evidence” that awareness campaigns reduce injuries (based on two medium quality studies). For the latter group, there is “moderate evidence” that awareness campaigns improve compliance (based on three medium quality studies). Among the four studies, one evaluated an eye injury campaign for metal workers in Italy [Mancini et al., 2005], a second evaluated a noise awareness campaign in Sweden [Bjorkdahl et al., 2008], a third evaluated a child labor in agriculture campaign in New York [Gadomski et al., 2006], and a fourth evaluated a train-the-trainer program in California [Stokols et al., 2001].

## **DISCUSSION**

Our findings have important implications for both policy and research. On the policy side, the finding that several legislative and regulatory policy levers are effective in reducing injuries and/or increasing compliance provides evidence for supporting such activities. Specifically, among nine clusters (some with sub-categories) we found strong evidence in three clusters and moderate evidence in five. In terms of generalizability, the introduction of OHS legislation cluster spanned several sectors in the United States, Canada and Spain, and so may be broadly applicable to other developed countries in North America, Europe, and Australasia. The introduction of smoke-free workplace legislation cluster also spanned several countries, and therefore may be broadly applicable to developed countries, particularly in the hospitality sector. Two clusters have studies exclusively from the United States, and largely in manufacturing—that of inspection sequence and specific deterrence of inspections—and thus may be less generalizable to other sectors and countries. The consultative activity cluster and the awareness campaign one have two countries in each and with studies undertaken in multiple sectors, suggesting they may be generalizable to other developed countries.

The strong evidence of an effect from actual inspections with penalties and moderate to limited evidence of no effect

from inspections without penalties reinforces the importance of regulators being out in the field identifying and citing/penalizing non-compliance. The limited evidence for a general deterrence effect found in our review is consistent with this interpretation. The literature review by Tompa et al. [2007] had similar findings with regards to general and specific deterrence and their impact on injury outcomes. Our update with more recent studies [e.g., Gray and Mendeloff, 2005; Mendeloff and Wayne, 2005; Haviland et al., 2010; Foley et al., 2012] adds to this evidence, and the addition of studies with compliance as an outcome [Gray and Jones 1991a,b; Weil, 2001; Ko et al., 2010] provides incremental support for this finding. Essentially, firms may not have the capacity to digest information about inspection activities in the field; they may only react when the adverse experience of an inspection with citations/penalties is first hand.

Bluff [2011] refers to competing theory of firm behavior to explain why general deterrence may not be effective. For it to be effective, firms would need to be rational, long-run optimizers, and knowledgeable about the probability and the financial implications of being inspected, whereas in reality, firms may have bounded rationality and have limited capacity to process information. If this is the case, regulators may need to heighten awareness in the field by actively communicating the consequences of non-compliance, and possibly make information about non-compliers easily available to the general public. Focused awareness campaigns and inspection blitzes might also be a way to provide acute awareness on a particular hazard.

Studies that considered compliance as an outcome offer important insights. The moderate evidence that the first inspection has the largest impact on compliance is corroborated across all four studies included in the review [Gray and Jones, 1991a,b; Weil, 2001; Ko et al., 2010] and has important implications for the efficient use of inspectorate resources. If subsequent inspections to a site have substantially lesser impacts, as the literature suggests, then an intensive regime of multiple inspections to a site may not be the best use of resources. Some jurisdictions have attempted such intensive enforcement strategies.

In another cluster in this review, moderate evidence was found that awareness campaigns increase compliance, reinforcing the importance of communicating regulatory obligations to stakeholders. What is not clear is the relationship between compliance and final outcomes. The limited evidence that awareness campaigns reduce injuries would suggest that the relationship is not definitive. That finding is based on only two medium quality studies. Clearly, more research is needed on the relationship between intermediate and final outcomes. In fact, Bluff [2011] emphasizes the importance of better understanding of motivations, attitude, perceptions, and skills in order to determine how particular strategies, mechanisms, and approaches can best be used to achieve compliance and

ultimately better final outcomes. A recent review by Safe Work Australia [2013] also attempts to address issue of how and why interventions work.

The findings for consultative activity (strong or limited evidence depending on context) provide some preliminary insights relevant to the move towards voluntary guidelines in some jurisdictions. Of three studies considering final outcomes, all of which were high quality, only one study by Foley et al. [2012] found significant effects in some contexts. The study by Hogg-Johnson et al. [2012] did not find an effect, but noted that not all firms received consultative services as was originally planned in the program, and many only received a “light touch.” The findings in this cluster are quite consistent with the findings that specific deterrence is much more effective than general deterrence, and suggest that consultation in the absence of specific deterrence might be interpreted by organizations as that there are no consequence for non-compliance. Clearly, more research is needed in this area to better understand whether consultations, if implemented in a comprehensive and extensive fashion, have an impact on outcomes. Even more pressing is the need for studies on the effectiveness of voluntary guidelines, since no studies were identified on this topic. Another avenue of research could investigate the mix of policy levers that are most effective when used together.

The moderate evidence of an effect on final outcome from the introduction of OHS legislation suggests, at face value, that legislation may not always be the best approach to addressing new and emerging health and safety issues. The limited evidence for an impact on intermediate outcomes further reinforces this interpretation. But the studies in this cluster were quite heterogeneous in the type of legislation being introduced, and this may be the reason for the limited impact. They were also incremental to an existing broad legislative framework and related regulatory enforcement, and were designed to increase protection related to a specific hazard. This is different from the introduction of broad OHS legislative frameworks in the 1970s and 1980s in many developed countries that were the subject of effectiveness studies thereafter. Another issue is that such studies need to consider a longer measurement time period following the introduction of legislation in order to capture the long-run impact. Essentially awareness, compliance and ultimately injury outcomes may take more time to improve than might have been expected by researchers and regulators.

Clearly, given the right context, the introduction of legislation can be effective, as was the case with smoke-free workplace legislation. Looking at this particular example, some lessons might be learned that can be generalized to other areas. Possibly timing, public sentiment, and a broad awareness of the serious health implications may be some of the important ingredients. Also noteworthy were the

concerns on the part of the restaurant and entertainment industries with regards to the implication of such legislation on business, concerns which were not vindicated. Also important was the “across the board” nature of the legislation in most jurisdictions. In fact, in the one study in Spain where a choice was available between total, partial, or no restriction [Fernandez et al., 2009], exposure reductions to second hand smoke varied from substantial for total ban establishments, modest for partial ban establishments, to inconsequential for no ban ones.

The number of studies on the effectiveness of OHS regulation has increased notably since the review by Tompa et al. [2007] as has the quality. More studies are using micro-level data and robust statistical methods to address industry- and organizational-level behavioral responses to regulation and its enforcement. Earlier, less structured reviews that drew on an older evidence base noted quality concerns and concluded that, overall, the evidence suggests OSHA has resulted in only a modest improvement in workplace health and safety in the United States [Kralj, 2001; Mendeloff, 2001; Thomason, 2001].

In our review, the criteria of publication since 1990 onward eliminated some of the weaker (and older) studies. Our expansion of the inclusion criteria to intermediate outcomes has allowed us to explore a broader and richer literature, such as the nature of enforcement and policy levers such as awareness campaigns. The inclusion of studies evaluating smoke-free workplace legislation provided an example of successful introduction that might provide lessons for regulation in other OHS areas.

Regarding the way forward for research, we would encourage policymakers and researchers to work together to build in policy evaluation, particularly with the introduction of new legislation, changes in enforcement strategies, and the roll out of awareness campaigns. This would lend itself to better planned study designs, in some cases the possibility of randomization or staggered introduction. Also, longer measurement time periods may be needed with new legislation in order to ensure there is time for stakeholders to become aware of changes and respond accordingly. The effectiveness of voluntary guidelines is a relatively uncharted area that urgently needs exploration.

More exploration is also needed of the context and conditions for successful legislation and policy. Related to this latter issue, the construct of how OHS policy levers create incentives for organizations to improve OHS processes and outcomes has direct implications for how programs to address OHS within organizations are arranged and implemented. It is noteworthy that such programs themselves have been the subject of systematic reviews [e.g., Robson et al., 2007]. Consideration of the effectiveness of such programs and how they are affected by policy levers and other environmental factors is an area warranting investigation.

## CONCLUSIONS

There is a substantial body of evidence on the effectiveness of legislative and regulatory policy levers at improving intermediate and final outcomes. We identified strong evidence of the following: (i) specific deterrence from inspections with penalties results in a decrease in injuries; (ii) consultative activity has no effect on injury outcomes with some exceptions; and (iii) the introduction of smoke-free workplace legislation reduces exposure to second hand smoke. We identified moderate evidence of the following: (i) a first inspection has the largest impact on compliance rates; (ii) specific deterrence from inspections without penalties has no effect on injuries except in particular contexts; (iii) awareness campaigns improve compliance; (iv) the introduction of OHS legislation as no effect on injury outcomes; and (v) the introduction of smoke-free workplace legislation reduces respiratory and/or sensory symptoms.

This study adds substantially to the evidence base identified in an earlier review. In addition to new evidence supporting previous study findings, it included new categories of evidence—compliance as an outcome, nature of enforcement, awareness campaigns, and workplace smoking legislation. The evidence is of value for informing policy decision making in the OHS field, and provides insights into areas warranting further exploration in future research.

## AUTHORS' CONTRIBUTIONS

Emile Tompa, Principal Investigator: Provided oversight of the review, participated in the design of the study and all phases of the systematic review process, and was the lead pen of the manuscript. Christina Kalcevich, Project Co-ordinator: Coordinated all aspects of the review, participated in the design of the study and all phases of the systematic review process, prepared materials for meetings and presentations, drafted the methods section of the manuscript, and reviewed drafts of the manuscript. Michael Foley, Co-investigator: Participated in the design of the study and all phases of the systematic review process, and reviewed drafts of the manuscript. Chris McLeod, Co-investigator: Participated in the design of the study and all phases of the systematic review process, and reviewed drafts of the manuscript. Sheilah Hogg-Johnson, Co-investigator: Participated in the design of the study and all phases of the systematic review process, and reviewed drafts of the manuscript. Kim Cullen, Co-investigator: Participated in the design of the study and all phases of the systematic review process, and reviewed drafts of the manuscript. Ellen MacEachen, Co-investigator: Participated in the design of the study, the title and abstract and article inclusion selection process, and reviewed drafts of the manuscript. Quenby Mahood, Co-investigator: Participated in the design of the study, provided library search and

systematic review guidance, and reviewed drafts of the manuscript. Emma Irvin, Co-investigator: Participated in the design of the study and all phases of the systematic review process, provided library search and systematic review guidance, and reviewed drafts of the manuscript.

## ACKNOWLEDGMENTS

We thank our advisory committee members—Wayne De L’Orme, Anne Duffy, Anne-Marie Feyer, Steve Mantis, Carol Sackville-Duyvelshoff, Barbara Silverstein, Carmine Tiano, David Walters, and Michael Zacks—for their valuable guidance at key junctures during the process of completing this review.

## FUNDING

Funding for this review was provided by the Institute for Work and Health, which is an independent, not-for-profit research institute. The Institute receives funding from the Prevention Office of the Ministry of Labour in Ontario, Canada.

## ETHICS APPROVAL AND INFORMED CONSENT

Ethics review and approval was not sought for this systematic literature review study, as it does not involve human subjects or animals.

## DISCLOSURE (AUTHORS)

The authors declare that there are no conflicts of interest.

## DISCLOSURE BY AJIM EDITOR OF RECORD

Rodney Ehrlich declares that he has no competing or conflicts of interest in the review and publication decision regarding this article.

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