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Commentary

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Commentary

Canada Should Move Toward Adopting Harmonized Evidence-Based OELs to Consistently and Adequately Protect Workers

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Abstract

Due to the way occupational exposure limits (OELs) are set in Canada, workers across the country are not equally and adequately protected from harmful workplace exposures. This disparity is illustrated in the case of exposure to diesel engine exhaust (DEE). Based on the findings of a recent pan-Canadian and international scan of OELs for DEE, we recommend that Canada overcome these current disparities by moving towards harmonized, evidence-based OELs. To achieve this, Canada should adopt a centralized framework for setting OELs that considers the most recent scientific evidence as well as feasibility of implementation in the Canadian context. We assert that harmonizing OELs across Canada would allow for expertise and resources to be consolidated and is a crucial step to ensuring that all workers are consistently protected from harmful workplace exposures.

Keywords: diesel engine exhaust; implementation; legislation; occupational exposure limits; workplace exposures

Introduction

Occupational exposure limits (OELs) are an important tool to protect workers from harmful workplace exposures. They provide a quantitative, achievable criterion for prevention and risk assessment, including selecting appropriate controls, evaluating efficacy, and

testing compliance (Deveau *et al.*, 2015). In Canada, provinces and territories are responsible for setting OELs, which results in considerable disparities in how limits are set and used. While most adopt limits based on ACGIH® recommendations, some use them as a starting point to develop their own limits for specific exposures or industry sectors. The lack of consistent OELs across and within jurisdictions in Canada means that not all workers are adequately and equally protected. The objectives of this commentary are to summarize the regulatory landscape in Canada and to argue, based on our recent research on diesel engine exhaust (DEE), that harmonized evidence-based OELs are needed in all Canadian jurisdictions.

How OELs are set in Canada

Under Canada's federated governance model, responsibility for occupational health and safety (OHS), including setting and enforcing OELs, falls under provincial/territorial authority. In each jurisdiction, this responsibility is held by a single branch of government (typically the Ministry of Labour) or by the agency responsible for delivering the workers' compensation system. Within some jurisdictions, OELs are set by multiple agencies. For example, in British Columbia (BC), OELs are set and enforced by the BC Ministry of Energy, Mines & Petroleum Resources, which has jurisdiction over mines in the province (Government of British Columbia and Ministry of Energy and Mines, 2017); the federal Labour Program, which has jurisdiction over federal workplaces (Employment and Social Development Canada, 2020); and WorkSafeBC, which has jurisdiction over all other worksites covered by its legislation (WorkSafeBC, 2020).

Depending on the jurisdiction, OELs are found in either the enabling statute (i.e. the *Occupational Health and Safety Act* or the *Workers' Compensation Act*) or in the subordinate regulations. The specific industries and workers to which the relevant legislation applies vary across the country. For example, the *Canada Labour Code* applies to workers in the federal government, federal corporations, and federally regulated industries (e.g. aviation, some grain elevators, banks, inter-provincial trucking, shipping, railway, and bus companies) (Canadian Centre for Occupational Health and Safety, 2019). Provincial or territorial OHS legislation applies to most other workplaces (Canadian Centre for Occupational Health and Safety, 2019), with the exception of certain sectors, like agriculture and mining. In jurisdictions that exclude mining, OELs are enacted under mining-specific OHS regulations and/or codes of practice.

All jurisdictions in Canada use the ACGIH® *Threshold Limit Values* (*TLVs*) and *Biological Exposure Indices* (*BEIs*) as the starting point for their OELs. The ACGIH® is among several professional organizations around the world that develop and publish health-based exposure limits. Independent scientific committees review and evaluate the peer-reviewed literature across a range of disciplines (including toxicology, occupational hygiene, occupational medicine, and occupational epidemiology) and make recommendations on the basis of health-related factors only (Howard, 2005). Technical or analytic feasibility as well as economic impacts of implementation are considered by lawmakers at the jurisdictional level. Recommended limits become legally enforceable once they are promulgated into law by agencies with the legislative authority to do so.

All regulatory instruments in Canada make explicit reference to the ACGIH® *TLVs* and *BEIs*, but there are differences in the edition cited. For example, some jurisdictions state that OELs are based on the most recent edition [e.g. the federal *Maritime Occupational Health and Safety Regulations* (Government of Canada, 2019)]; some reference older editions [e.g. Alberta, the 2006 edition (Government of Alberta, 2018)]; and others reference a specific edition, but include language that allows the OELs to be updated without going to the legislature for a regulatory amendment. For certain substances, some provinces (e.g. BC and Ontario) have developed and adopted province- and/or industry-specific limits instead of the TLVs. In these situations, the jurisdictions generally started with a review of the TLVs, but ultimately adopted limits based on whether industry could meet them and/or a validated sampling method existed.

DEE: an example of pan-Canadian disparities in OELs

DEE is one of the most prevalent workplace exposures in Canada. Approximately 897 000 Canadian workers are exposed to DEE, with truck drivers and heavy equipment operators being the largest exposed groups, followed by underground mine workers (CAREX Canada, 2019a). Non-road diesel engine-related exposures can also occur among railroad workers, loggers, and those in the marine industry (International Agency for Research on Cancer, 2014; National Toxicology Program, 2016). It has been suspected of causing cancer in humans since the 1980s and was upgraded to a known human carcinogen by the International Agency for Research on Cancer in 2012 (International Agency for Research on Cancer, 2014).

Table 1. Adopted and recommended OELs for DEE particulate in other jurisdictions.

Jurisdiction	OEL	Marker of exposure	Notes
Adopted (and legally enforceable) OELs			
US Mine Safety and Health Administration (MSHA)	8-h TWA (Time-Weighted Average): 160 μg m^{-3}	TC; respirable dust	Since 2006. Applies to underground metal and non-metal mines.
EU	8-h TWA: 50 μg m^{-3}	EC	Adopted December 2018. Becomes effective in 2026 in underground mining and construction tunnels and in 2023 in other industries.
Switzerland	8-h TWA: 100 μg m^{-3}	EC	Since 2012.
Germany	8-h TWA: 50 μg m^{-3}	EC	Set in 2017. Does not apply to underground mines until 2022.
Austria	8-h TWA: 300 μg m^{-3} 8-h TWA: 100 μg m^{-3}	EC/respirable aerosol	Underground mines (since 2011). All other industries (since 2011).
Australia	8-h TWA: 100 μg m^{-3}	EC	Adopted by Queensland, Western Australia, New South Wales.
New Zealand	8-h TWA: 100 μg m^{-3}	EC	Enacted 2016.
Recommended OELs (Note 1)			
California Department of Public Health (California, USA)	8-h TWA: 20 μg m^{-3}	Diesel particulates	
Finnish Institute of Occupational Health (Finland)	8-h TWA: 5 μg m^{-3} 8-h TWA: 20 μg m^{-3}	EC	Applies to general workplaces. Applies to mines, underground construction.
Health Council of the Netherlands (Netherlands)	8-h TWA: 0.011 μg m^{-3} 8-h TWA: 1.03 μg m^{-3}	Respirable EC	Target risk level (Note 2). Prohibition risk level (Note 3).
Australian Institute of Occupational Hygienists (Australia)	8-h TWA: 100 μg m^{-3}	EC	

Notes:
1.Limits recommended by professional organization. Not legally enforceable until enacted into law.
2.Target risk level: predetermined risk level for death from lung cancer based on 40 years of occupational exposure, corresponding to 4 extra deaths per 100 000.
3.Prohibition risk level: predetermined risk level for death from lung cancer based on 40 years of occupational exposure, corresponding to 4 extra deaths per 1000.

In recent scientific reviews, elemental carbon (EC) has emerged as the best surrogate of exposure to DEE particulate (International Agency for Research on Cancer, 2014; Taxell and Santonen, 2017; Health Council of the Netherlands, 2019). Four professional organizations have recommended an OEL for DEE; all but one are based on EC (Table 1). Internationally, several jurisdictions have adopted or are in the process of adopting a legally binding OEL for DEE based on EC (Table 1).

Our environmental scan found that while OELs exist in Canada for various gaseous components of DEE (e.g. carbon monoxide), exposure to the carcinogenic fraction [mainly found in the particulate matter (Health Council of the Netherlands, 2019)] is inconsistently regulated. Of 11 Canadian jurisdictions with an OEL for the particulate constituents of DEE (Table 2), seven are based on respirable combustible dust (1.5 mg m^{-3}) and four are based on total carbon (TC). In jurisdictions with a TC-based OEL, three set it at 0.4 mg m^{-3} and one at 0.16 mg m^{-3} (CAREX Canada, 2019b). Notably, these OELs apply only in the mining industry. No agency with responsibility for protecting workers in other sectors has yet adopted an OEL for DEE.

Key informants interviewed about our environmental scan findings identified several key barriers to adopting an OEL for DEE in Canada: regulatory agency reliance on the ACGIH® TLVs, a lack of consensus on the substance(s) that should be measured to accurately assess exposure, a lengthy and often slow regulatory process, and a perceived lack of leadership on the part of the regulators. Although the ACGIH® added DEE to its list of agents under study in 2016, it has yet to issue a TLV recommendation (Gordon, 2017; ACGIH, 2019). The ACGIH® first proposed a TLV of 0.15 mg m^{-3} for DEE [as diesel particulate matter (DPM)] in its 1995–1996 Notice of Intended Changes (NIC). At that time, it assigned a designation of A2 (suspected

Table 2. Adopted or recommended OELs for DEE particulate in Canada.

Jurisdiction	OEL	Marker of exposure	Scientific basis	Notes/policy instrument reference
CAN	8-h TWA (Time-Weighted Average): 1.5 mg m^{-3}	Respirable combustible dust	ACGIH® 'Threshold Limit Values and Biological Exposure Indices', as amended from time to time.	
BC	8-h TWA: 1.5 mg m^{-3}	Respirable combustible dust	ACGIH® 'Threshold Limit Values and Biological Exposure Indices', 1994–1995 edition.	Applies to mines and to any underground working which is not a mine within the meaning of the *Mines Act*.
SK	8-h TWA: 0.16 mg m^{-3}	TC (Note 1)	n/a	Applies to mines, as defined by the Mines Regulations, 2018.
ON	8-h TWA: 0.4 mg m^{-3}	TC	US Mine Safety and Health Administration 'Diesel Particulate Matter Exposure of Underground Metal and Nonmetal Miners', 2001 edition.	Current OEL; applies to all mines, mining plants, and mining development in Ontario. Method: NIOSH 5040 (National Institute for Occupational Safety and Health, 2003).
	8-h TWA: 0.16 mg m^{-3}	TC; respirable dust	US Mine Safety and Health Administration 'Diesel Particulate Matter Exposure of Underground Metal and Nonmetal Miners', 2008 edition.	Proposed OEL. Would apply to workplaces in which Regulation 833 applies. Method: NIOSH 5040.
QC	8-h TWA: 0.4 mg m^{-3}	TC	n/a	Applies to a mine, as defined by the mining OHS regulations. Method: NIOSH 5040.
NL	8-h TWA: 0.4 mg m^{-3}	TC	n/a	Applies to underground mines. Measured as per NIOSH Method 5040.
NB	8-h TWA: 1.5 mg m^{-3}	Respirable combustible dust	ACGIH® 'Threshold Limit Values and Biological Exposure Indices', 1992–1993 edition.	Applies to underground mines.
NS	8-h TWA: 1.5 mg m^{-3}	Respirable combustible dust	ACGIH® 'Threshold Limit Values and Biological Exposure Indices', latest edition.	Applies to non-coal mines.
YK	8-h TWA: 1.5 mg m^{-3}	Respirable combustible dust	n/a	Applies to mines, as defined under the OHS regulations.
NWT	8-h TWA: 1.5 mg m^{-3}	Respirable combustible dust	ACGIH® 'Threshold Limit Values and Biological Exposure Indices', 1994–1995 edition.	Applies to mines.
NU	8-h TWA: 1.5 mg m^{-3}	Respirable combustible dust	ACGIH® 'Threshold Limit Values and Biological Exposure Indices', 1994–1995 edition.	Applies to mines.

Note:
1.Documentation indicating the particle size fraction (i.e. inhalable, thoracic, or respirable) for the marker of exposure was not available.

human carcinogen). That proposed limit was later lowered to 0.05 mg m^{-3} (as total DPM) and was replaced in 2002 with a proposed TLV of 0.02 mg m^{-3} (as EC). The proposed designation remained as A2. In 2003, the ACGIH® withdrew DPM from the NIC. The following year, the ACGIH® was named as a defendant in lawsuits filed in the US District Court in Macon, Georgia that sought to enjoin the ACGIH® from taking action on publishing or revising TLVs on several substances, including DPM (ACGIH, 2004). In November 2004, the court upheld the ACGIH®'s right to publish TLVs under the First Amendment of the US Constitution (ACGIH, 2004).

Provincial reliance on the TLVs likely means that many jurisdictions in Canada will wait until the ACGIH® issues a recommendation for DEE before adopting an OEL. The variability *between* jurisdictions in the edition of the TLVs on which the OELs are based, coupled with the siloing of who has responsibility for OHS (e.g. mining versus federal workplaces versus all other industries) *within* individual provinces, means that it is unlikely a consistent OEL will be adopted across the country once a TLV recommendation is issued. The consequence of this is that some provinces will have more protective OELs than others and within individual provinces, some industries will have more protective OELs than others. In either case, there will be uneven protection across the country for workers exposed to DEE.

An argument for harmonized OELs in Canada

The research we conducted on the status of DEE OELs is just one example of how workers in Canada are not adequately and consistently protected from harmful exposures. Harmonizing OELs across Canada is essential to ensuring that all workers are treated equally. The harmonization approach that we propose for Canada is modelled after the European Union, where the Committee for Risk Assessment (RAC) conducts scientific reviews for priority substances and provides OEL recommendations to the European Commission which then considers socio-economic and technical feasibility factors and issues proposed OELs (European Chemicals Agency, 2020). A harmonized Canadian framework could centralize review and implementation activities through two committees in a similar fashion. The first would consist of scientific experts responsible for reviewing scientific evidence to make health-based OEL recommendations. Since most jurisdictions in Canada directly adopt or adapt ACGIH® TLVs, these recommendations would be a reasonable starting point for the scientific review. In cases where no published TLVs exist, values recommended by other professional organizations could be used. A second committee, focussed on implementation, would then take these health-based recommendations and consider factors such as technical, analytical, and economic feasibility of meeting the health-based recommendations in the Canadian context. Ideally, the implementation committee would consist of regulators, researchers, industry, labour, and advocacy groups.

In the case of DEE, the Health Council of the Netherlands' recent review would be an ideal scientific starting point for setting a health-based OEL. The implementation committee would ensure that appropriate measurement technologies are available, that controls exist to meet the recommended OEL across industries, and that both are economically feasible. This committee could also recommend that the OEL be introduced in a structured, phased approach (similar to the transitional arrangements of the European Commission) to allow industries time to address any technological challenges and associated costs, as well as implement appropriate control technology and collect baseline exposure data. The input we received from Canadian key informants suggests that there is an appetite to create a national committee and to engage stakeholders early. Such an approach would not only foster support for the adoption and implementation of an OEL, but also build momentum towards a harmonized OEL across Canada (CAREX Canada, 2019b).

Ultimately, our proposed framework would result in one set of recommendations made to all Canadian jurisdictions, with the intent that jurisdictions would voluntarily adopt the OELs. While the European model requires member states to adopt the recommended OELs, we believe that aiming for voluntary uptake is more practical in Canada because legally mandating their uptake would require a major restructuring of the current legislative framework. However, the model of bringing together jurisdictional representatives to make policy recommendations for all is showing promising early success in, for example, the Human Biological Monitoring for the European Union (HBM4EU) program (Santonen *et al.*, 2019). Although not all jurisdictions would necessarily take up committee recommendations, this process would still be an important first step to consolidating resources and expertise across Canada and allowing for a more simplified OEL development process. More importantly, it would lay the foundation for achieving consistent and equitable protection of Canadian workers.

Summary

Canada needs consistent evidence-based OELs to equally and adequately protect all workers from harmful workplace exposures. As we have illustrated with DEE, disparities currently exist in OELs across and often within jurisdictions in Canada. By adopting a centralized framework for setting OELs, Canada would ensure that limits are based on the most recent scientific evidence as well as feasibility of their implementation in a Canadian setting. Additionally, centralizing these activities would enable consolidation of expertise and resources. The use of harmonized evidence-based OELs is essential to ensuring that all workers in Canada are equally protected.

Conflict of interest

The authors have no conflicts of interest to declare.

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