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Application of a framework for the selection of an appropriate occupational exposure limit for manganese

Michelle Deveau[a,*], Andrew Maier[b], Daniel Krewski[a]

[a] McLaughlin Centre for Population Health Risk Assessment, University of Ottawa, Ottawa, K1N 6N5, Canada
[b] Department of Environmental Health, College of Medicine, University of Cincinnati, Cincinnati, OH, 45267-0056, United States

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ABSTRACT

Occupational exposure limits (OELs) serve as benchmarks for the interpretation of workplace exposures within a health risk context. Different organizations derive OELs for many chemicals, including manganese. OELs recommended by different organizations can vary quantitatively, which can present a challenge to occupational hygienists or other risk managers that need to select a value for decision-making purposes. In this article, we illustrate the application of a previously-developed OEL selection framework to demonstrate the decisions that would be required to select the most appropriate OEL for various manganese exposure scenarios. The framework helped to identify the need to focus an evaluation on three quantitatively similar values—the ACGIH TLV, SCOEL IOELV, and DFG MAK. These values were compared with regulatory standards and considered for their relevance and reliability. The OEL selection framework was a useful tool in guiding the selection process for manganese OELs.

1. Introduction

Occupational exposure limits (OELs) serve as benchmarks for the interpretation of workplace exposures within a health risk context. These values are derived by many different organizations, including those at the state or provincial and federal levels in the United States and Canada, and at national and regional levels elsewhere around the world. For various reasons, including limited harmonization efforts among organizations, large differences in these OELs can arise (Deveau et al., 2015; Schenk et al., 2008; Schenk, 2010). Many of these differences are related to risk science and risk policy decisions that are made throughout the OEL-derivation process. Although these decisions can vary among OEL-setting organizations, they may be equally acceptable and robust, and selected due to differences in problem formulation or organizational policies on risk assessment (Deveau et al., 2015). Occupational hygienists should explore the basis for differences in OELs prior to deciding which value is most appropriate for a particular workplace scenario.

Deveau et al. (2015) previously developed a framework designed to provide guidance to occupational hygienists who might need to select the most appropriate OEL for their workplaces. This framework guides occupational hygienists through the systematic evaluation of availability, relevance, and reliability of OELs. Steps in the selection process include defining the exposure scenario, gathering existing OELs, assessing the relevance of values to the defined exposure scenario, comparing mandatory standards to non-regulatory values, and analyzing the risk science and risk policy basis of each value. The framework has previously been applied for both OEL-rich scenarios (as for *n*-hexane, which has many different OELs) and OEL-poor scenarios (as for methamphetamine, which has exposure guidelines for the general population but not for occupational scenarios) (Deveau et al., 2014).

Occupational exposure to manganese can occur in individuals involved in mining and smelting, welding and fabrication, production and use of agricultural products, and production of manganese-containing metals, alloys, steel, chemicals, fireworks, matches, porcelain, pigments, paints, glass, and dry-cell batteries (ACGIH, 2013; SCOEL, 2011). Many different organizations have derived OELs for manganese, which can present difficulties for occupational hygienists or other risk managers who interpret the results of workplace exposure sampling. The objective of this manuscript is to illustrate the use of the framework developed by Deveau et al. (2015) as a tool for systematically examining the various factors that should be considered when identifying the most appropriate manganese OEL to be applied in a particular occupational exposure scenario.

* Corresponding author.
E-mail address: michelle.deveau@uottawa.ca (M. Deveau).

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2. Materials and methods

A flowchart for the framework used to guide the OEL selection process is given in Fig. 1. This framework will be used to demonstrate the types of questions and decisions that will need to be addressed by risk managers in specific exposure circumstances. As no specific exposure scenario is contemplated in this article, no specific recommendation on the most appropriate OEL for manganese is made. The approach outlined for this purpose will nonetheless be useful to other individuals or organizations seeking to identify the most appropriate OEL for manganese under specific exposure circumstances.

The GESTIS International Limit Values database (http://limit-value.ifa.dguv.de/) and the SER OEL database (https://www.ser.nl/en/oel_database.aspx)—databases developed in Germany and the Netherlands, respectively—were used to facilitate the gathering of OELs from many different organizations. As a follow-up, websites of the health and safety programs for each of the countries identified in the databases were visited, in an attempt to validate the values. The American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values® (TLVs®)—OELs that are widely used and are derived by an expert committee of volunteers—were also obtained directly from the organization's publications (ACGIH, 2013, 2016), as these values are not typically found in either of the aforementioned databases. Attempts were made to gather details underlying the derivation of values in the database, wherever this documentation was made readily available by each of these organizations. Although many other countries around the world are likely to have OELs for manganese beyond those listed in the GESTIS and SER databases, the goal was not to identify an exhaustive list of manganese OELs; therefore, no further attempt was made to identify values from other countries.

3. Results

Factors that should be considered in an OEL selection process for manganese are presented in the following subsections that align with the steps of the OEL selection framework. A flowchart providing highlights of the OEL selection process can be found in Fig. 2.

3.1. Define exposure scenario

To properly define the exposure scenario, occupational hygienists should consider two key factors—*how* exposures are occurring, and *who* is being exposed. Aspects such as duration and patterns of exposure, particulate size, and target population characteristics should be identified.

To define the nature of manganese exposure in a workplace, information on task schedules should be gathered. As many different work tasks might exist in a workplace, with variability in the nature of the exposure, exposure scenarios should be defined for as many groups of workers as necessary. Information on a task schedule is important because the exposures typically considered in the derivation of traditional OELs (8 h per day, 5 days per week, over a working lifetime) might not be relevant for all manganese-exposed workers.

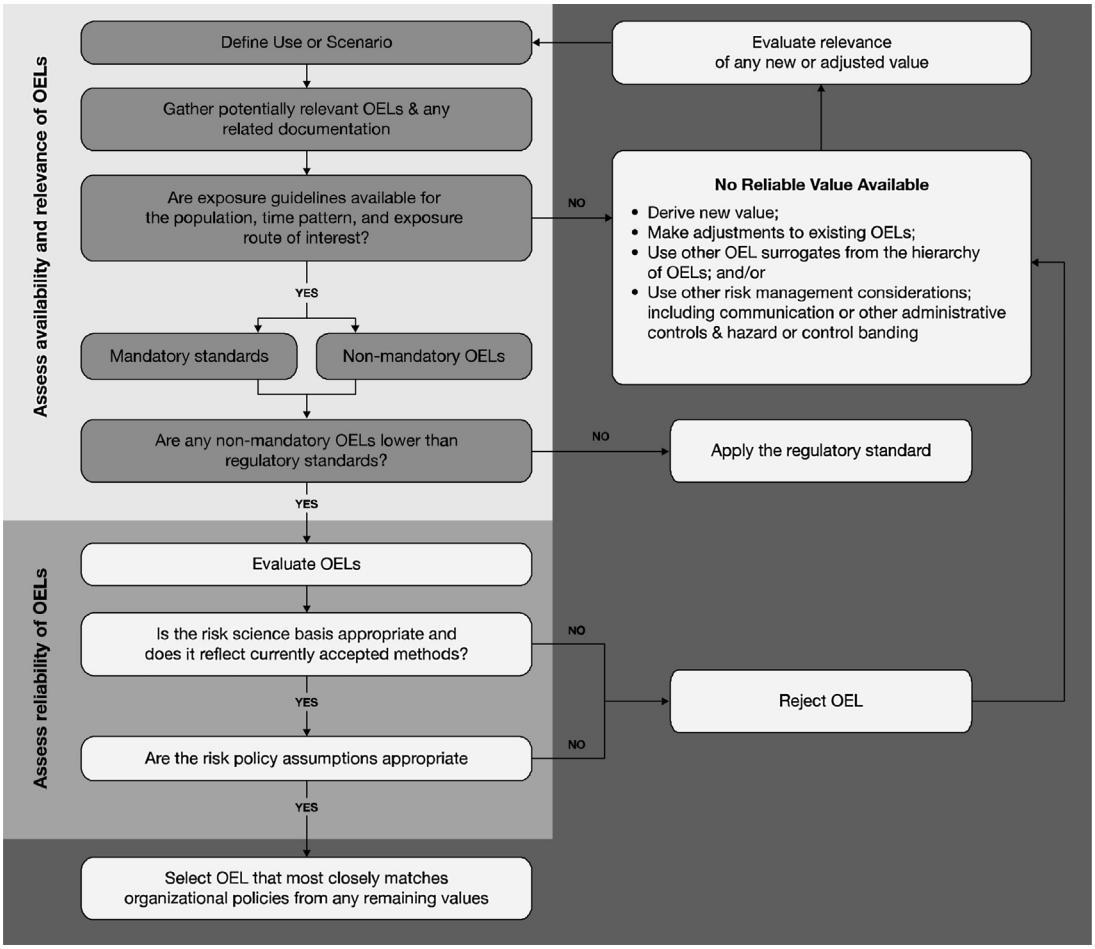

Fig. 1. OEL selection framework. Originally published in Deveau et al. (2015).