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## Original Article

# Establishing a Policy Framework for the Primary Prevention of Occupational Cancer: A Proposal Based on a Prospective Health Policy Analysis



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## ABSTRACT

**Background:** Despite our knowledge of the causes of cancer, millions of workers are involuntarily exposed to a wide range of known and suspected carcinogens in the workplace. To address this issue from a policy perspective, we developed a policy framework based on a prospective health policy analysis. Use of the framework was demonstrated for developing policies to prevent cancers associated with diesel engine exhaust (DEE), asbestos, and shift work, three occupational carcinogens with global reach and large cancer impact.

**Methods:** An environmental scan of existing prospective health policy analyses was conducted to select and describe our framework parameters. These parameters were augmented by considerations unique to occupational cancer. Policy-related resources, predominantly from Canada, were used to demonstrate how the framework can be applied to cancers associated with DEE, asbestos, and shift work.

**Results:** The parameters of the framework were: problem statement, context, jurisdictional evidence, primary prevention policy options, and key policy players and their attributes. Applying the framework to the three selected carcinogens illustrated multiple avenues for primary prevention, including establishing an occupational exposure limit for DEE, banning asbestos, and improving shift schedules. The framework emphasized the need for leadership by employers and government.

**Conclusion:** To our knowledge, this is the first proposal for a comprehensive policy framework dedicated to the primary prevention of occupational cancer. The framework can be adapted and applied by key policy players in Canada and other countries as a guide of what parameters to consider when developing policies to protect workers' health.

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## 1. Introduction

Millions of workers are involuntarily exposed to a wide range of known and suspected carcinogens in the workplace. It has been estimated that approximately 2 million deaths occur globally every year due to occupational diseases, with 32% attributable to occupational cancer [1]. A study is currently in progress in Canada that will quantify the proportion of cancers attributed to occupational exposures and the economic costs associated with these cancers. This Canadian study, which includes 44 known or suspected carcinogens and 27 different cancer sites, addresses an important

research gap and its results will be used to inform primary cancer prevention policies [2].

In general, primary prevention policies aim to prevent the incidence of disease or injury before it occurs. A policy framework, broadly defined as a tool to help guide decision-making and set future directions, is integral to policy development [3,4]. Some frameworks (i.e., conceptual frameworks) theorize the policy process. For example, the advocacy coalition framework examines how opposing communities advance their distinct policy goals through advocacy [5]. There are also frameworks based on policy analyses, which organize parameters in a systematic way to influence

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decision-making. A policy analysis can be retrospective and applied to help describe, critically interpret, and evaluate a particular policy that is already in place. Alternatively, it can be prospective and used to plan for future policy by identifying key issues, policy options, and players [6,7]. Prospective policy analyses are especially valuable for establishing evidence-informed policies, but there is a need for greater applied research in this area [7], especially pertaining to occupational cancer.

In Canada, as in some other countries, there are policies related to the primary prevention of occupational cancer. However, these have not necessarily been the result of a concerted or deliberate effort to reduce the incidence of occupational cancer. Moreover, there are complexities regarding jurisdiction over occupational health and safety (OHS). For example, in the USA and Canada, OHS is both a federal and state/provincial responsibility. These layers of jurisdiction for OHS make it challenging to develop and implement policies for the protection of workers and can result in inequalities and gaps in coverage of hazards, industries, and occupations. Primary prevention policies and investment in OHS in general are less apparent in many countries primarily due to competing social, economic, and political challenges [8].

There is a lack of comprehensive policy frameworks that can be used to guide the prevention of occupational cancer in Canada or other countries. A framework based on a prospective health policy analysis could support a systematic, robust examination of how various factors affect occupational carcinogen exposures and what can be done to reduce or prevent occupational cancer. The purpose of this study was to provide an applied analysis of how to develop occupational cancer primary prevention policies. To do this, key parameters from the literature were identified, described, and organized into a framework. The use of the framework for developing policies to prevent occupational cancer was demonstrated using three occupational carcinogens of global importance: diesel engine exhaust (DEE), asbestos, and shift work.

## 2. Materials and methods

An environmental scan of existing prospective health policy analyses was conducted to identify potential parameters for a framework that can be used to develop occupational cancer primary prevention policies. An environmental scan was chosen given its usefulness in examining social, economic, technological, and political contexts and its importance in supporting the development of evidence-based policies [9].

The environmental scan consisted of a targeted search for prospective health policy analyses. Given the deficiency of literature in this area, searches were not limited by year, health issue, or country of study. Only opinion pieces were excluded. In order to account for any existing occupational cancer prevention policy frameworks in the literature that were based on a prospective health policy analysis, a search using the terms “occupational cancer” and “policy framework” was also conducted. All searches were conducted using PubMed, Canadian Research Index, Muniscope, and PolicyFile, as well as online search engines (Google and Google Scholar). The reference lists of selected studies were also reviewed to identify any relevant studies that may have been missed.

Cancer sites associated with occupational exposure to DEE, asbestos, and shift work were chosen as examples of how primary prevention policy options may be devised and implemented in real-world contexts because of the high number of workers exposed to each of these carcinogens in Canada and other countries, the strength of evidence of their known or suspected associations with these carcinogens, and the feasibility to eliminate or reduce exposure. Additional targeted searches were conducted in order to

collect data on some of the parameters for these carcinogens. Resources included websites of Canadian federal and provincial government agencies, advocacy organizations, academic research organizations, and OHS groups. For illustrative purposes, this framework included predominantly Canadian policy examples, but it was intended to be robust and applicable to other settings.

## 3. Results

### 3.1. Framework development

A few prospective health policy analyses were found through the environmental scan [6,7,10–18]. There were several elements that appeared repeatedly throughout this literature. These were: problem statement, context, evidence, and actors. However, these elements were not systematically organized across all analyses and only one analysis developed policy options based on an applied consideration of these elements [17]. Furthermore, only one policy framework for the prevention of occupational cancer was found [19]. Although consideration was given to the proposed prevention policies in this latter study, it was not a prospective health policy analysis and lacked a systematic and comprehensive consideration of parameters in order to develop its prevention policies. It is also important to note that some of these analyses discussed the policy process, referred to as the process of policy change from agenda setting to policy evaluation [6,7,10,11]. The current study focused on policy formulation rather than the entire policy process and found that the commonly appearing elements were appropriate.

The *problem statement* helped define the key issues to consider [12,14,16,17]. In this case, the problem statement focused on the individual cancers and associated occupational carcinogens of study. *Context* was an important part of many of these analyses and was generally considered as systemic factors of the policy setting that may have an effect on policy change [6,7,10–13,16–18]. These systemic factors were commonly categorized as situational, structural, cultural, and external [6,7,10–13]. Collecting evidence on how policy problems have been mitigated or solved in other jurisdictions (*jurisdictional evidence*) was also an important part of these analyses [12,14,15]. These parameters were considered to develop *primary prevention policy options* for cancers associated with exposures to DEE, asbestos, and shift work.

Given that policy options help determine who would be involved, it was also important to consider the actors (*key policy players*), who were defined as the individuals, institutions, or organizations interested in or directly involved in implementing a particular policy [6,7,10,11]. We also chose to consider *key policy players' attributes*, such as their positions, resources, and perceptions of policy options [7,11].

The elements that routinely appeared in the literature and that were most applicable to occupational cancer primary prevention were ultimately chosen for inclusion. Therefore, the final framework incorporated the following parameters: problem statement, context, jurisdictional evidence, primary prevention policy options, and key policy players and their attributes.

### 3.2. Parameters of the framework and application to selected carcinogens and associated cancer sites

#### 3.2.1. Problem statement

As the starting point of the framework, the problem statement situates evidence so that it appeals to key policy players and the context [6]. The problem statement can include a quantitative component, such as the problem's magnitude or scope [14]. For example, it can include facts about the prevalence of exposure to

occupational carcinogens, estimates of occupational cancer burden, and cancer risk information.

Occupational exposures to DEE, asbestos, and shift work are prevalent worldwide and can contribute to common cancers including mesothelioma and neoplasms of the lung and breast. Occupational exposures to DEE occur mostly in the transportation industry; asbestos exposures occur mostly in construction; and shift workers are most frequently found in the accommodation and food services, manufacturing, and healthcare sectors [20–22]. Approximately 897,000 Canadian workers are exposed to DEE, equal to 5% of the working population [20]. While 152,000 workers are currently exposed to asbestos in Canada, exposures in the past were much greater when workers were exposed to asbestos fibers during mining and milling, as well as from the primary use of asbestos in manufacturing and construction [21]. Globally, there are more than 2.5 billion shift workers [23].

Asbestos has been classified by the International Agency for Research on Cancer (IARC) as a known carcinogen for the lung. Asbestos is also known to be associated with mesothelioma and cancers of the larynx and ovary and suspected to be associated with cancers of the colorectum, pharynx, and stomach [24]. DEE has also been classified by IARC as a known carcinogen for the lung [25]. There is limited evidence that DEE is a bladder carcinogen [25]. Shift work, especially long-term rotating night shift work, has been classified by IARC as a probable carcinogen for breast cancer [26].

### 3.2.2. Context

**3.2.2.1. Structural factors.** Structural factors describe the setting for policy processes to occur and tend to be unchanging elements of society [27]. Such factors may include the type of economy or political structure, or a country's level of economic development or wealth [6]. Labor trends and regulations, such as occupational exposure limits (OELs), can also be considered.

Structural factors and their relation to OHS differ across countries and influence policy development in various ways. High income nations, such as the USA, Canada, and the UK, are recognized for their advanced economic development and democratic political systems that engage citizens in the policy process. In many countries, there are organized labor groups and some governments support research on work and health. In most countries, it is up to governments to enforce OHS regulations and develop evidence-informed policies [28]. Nevertheless, OHS and cancer prevention often compete with other political, economic, and social factors that may take precedence, thus contributing to the lack of policies to protect workers' health [8]. For example, India is the world's largest importer of asbestos yet OHS legislation is poor, there is a lack of worker education on workplace hazards, and personal protective equipment is inadequate [28]. Furthermore, OELs, which are legal restrictions on the amount and length of time that a worker can be exposed to airborne concentrations of hazardous biological or chemical agents [29], differ globally and are an important component of OHS.

In Canada, most workers are covered by provincial or territorial OHS legislation. A small proportion of workers (6% of the Canadian population) are covered by federal OHS laws [30]. While OELs exist for asbestos, there are variations in OELs overall and by fiber type between provinces and territories [31]. There are currently no OELs for DEE as a whole or shift work, and a lack of recognition of shift work as an occupational hazard. Protection from DEE has historically focused on underground miners, with little effort to address exposures in workers in other industries and occupations [31]. Moreover, in the past several years there have been cuts to federal workplace OHS inspections, thereby limiting funding and the number of health and safety officers available to monitor exposures and enforce OHS laws [32].

**3.2.2.2. Situational factors.** In contrast to structural factors, situational factors change over time and are often termed focusing events [27]. The death or injury of a worker and changes in government, regulations, or resources for enforcement, can influence occupational cancer policy development. In addition, changes in the recognition of health effects might prompt policies to safeguard workers' health and safety.

There is a long latency period between exposure and cancer onset, which can make it challenging to attract media attention and public awareness. A high-profile event may catalyze policy development. For instance, the death of Howard Willems, an advocate for asbestos awareness, and the resulting public and media attention, prompted the province of Saskatchewan to legislate a public registry of asbestos-containing buildings [33]. The connection between occupational and environmental carcinogen exposures can also encourage or hinder policy change. Declines in environmental air quality are more likely to result in immediate policy change for DEE than occupational cancer given the very large urban populations affected by air pollution and the prevalence of adverse acute health outcomes such as asthma. For shift work, if additional evidence promotes its classification from a suspected to a known carcinogen, this may put additional pressure on policy makers to adopt protective policies regarding work time and scheduling.

**3.2.2.3. Cultural/social factors.** Cultural or social factors are values and norms that can affect policy development [27]. A common perception is that occupation is not an important cause of cancer, but rather that lifestyle factors (e.g., smoking, exercise, and diet) mainly account for cancer risk [34]. For example, the association between lung cancer and DEE and asbestos is well established, but often overshadowed by the emphasis on smoking as a cause of lung cancer. Asbestos has been called the "miracle mineral" in construction, auto, retail, and other industries. In large part, pressure from the asbestos industry has led to asbestos' prolonged use in Canada despite the strong evidence of carcinogenicity and other harmful health effects such as asbestosis. Greater awareness of mesothelioma and the impact on asbestos victims has placed pressure on policy makers to legislate a ban in many European countries [35]. Shift work, viewed as an essential part of globalization and economic competition, is seldom acknowledged for its negative effects on health. Much work remains to be done to change this paradigm and implement preventive measures for the growing proportion of shift workers worldwide.

**3.2.2.4. External factors.** There may be external factors aside from the aforementioned elements that influence policies. For example, the import and export of known and suspected occupational carcinogens, their economic importance, trade relations with other countries, and costs of safer alternative products can affect policy development. This is relevant for many countries, including Canada, that have had a long history of mining asbestos and continue to import asbestos-containing materials such as brake pads and linings, cement sheets, and pipe fittings [36]. Despite the closing of all asbestos mines in Canada, workers are at risk of exposure through asbestos-containing materials and pre-existing asbestos in schools, homes, and offices. Similarly, industries that use diesel, such as mining, are important parts of the economy of Canada and many other countries. As sectors expand, such as transportation, there may also be a greater number of workers exposed to DEE [37].

### 3.2.3. Jurisdictional evidence

Evidence from other jurisdictions can be used to understand how a particular policy problem has been addressed elsewhere [14]. In this analysis, relevant primary prevention policies were examined from governments outside of Canada in order to inform possibilities within Canada.

Hazard control programs are commonly used in workplaces to protect workers from exposure to hazards and to enforce OELs. The main ways to control exposure are outlined in the hierarchy of hazard controls, which consists of elimination (most protective), substitution, engineering controls, administrative controls, and personal protective equipment (least protective) [38]. Effective hazard controls can manifest as workplace-based policies and greatly reduce workers' exposure to carcinogens and their risk of cancer.

Elimination has been used in many jurisdictions to prevent the adverse health effects associated with asbestos exposure. For example, more than 55 countries have banned all forms of asbestos [39]. Safer substitutes exist for most asbestos applications [40], which could be incentivized in Canada. Although there is no safe level of exposure to asbestos, rigorous OELs are needed to protect workers (e.g., construction workers) who may be exposed to pre-existing asbestos. Australia has a National Strategic Plan for Asbestos Management and Awareness and a national asbestos registry where people can report potential asbestos exposures at work, home, or in the community [41]. Surveillance of asbestos-exposed workers was offered in several countries, including Germany, the USA, Norway, Finland, and the UK [42], but characterized secondary prevention.

Environmental concerns about DEE have increased over the past 20 years, resulting in stricter environmental emissions regulations for diesel engines in North America and Europe [25]. There was sparse evidence of policies that have been implemented for the prevention of cancers associated with occupational exposure to DEE. Recommendations for protecting workers included eliminating the engine type altogether or a combination of hazard controls to help limit emissions [43]. For truck and ground transportation workers, recommendations were predominantly administrative and engineering controls, such as turning off engines when not in use and using diesel particulate filters, respectively [43]. A few countries have OELs based on elemental or total carbon, but these vary widely with the lowest (i.e., most protective) recommended in Finland (5 µg/m<sup>3</sup> elemental carbon for general workplaces) [44] and the highest (i.e., least protective) reported by the United States Mine Safety and Health Administration (160 µg/m<sup>3</sup> total carbon) [45]. Strict diesel engine emission regulations and worker education regarding the hazards of DEE exposures have been advised [46]. Cleaner alternative fuels containing fewer carcinogenic agents, such as compressed natural gas, are also gaining support in some countries [47].

There is evidence that administrative controls such as fast-forward shift scheduling can reduce the adverse health effects of shift work. Less evidence exists for controlled light exposure, pharmaceutical agents, and behavioral changes [48]. In most countries, shift work is not a well-recognized potential cause of cancer and this has partly hindered policy development [49]. While not an example of primary prevention, Denmark is the only country to date to recognize night shift work as a cause of occupational breast cancer and provide compensation for eligible claimants [49]. Much work needs to be done to raise the profile of shift work as a potential cause of breast cancer in order to influence policy change through workplace-based preventive measures.

### 3.2.4. Primary prevention policy options

Putting forth several policy options is an important catalyst for action by policy makers. Policy options should reflect the problem statement and jurisdictional evidence. Context also helps determine the feasibility of policy options. This policy analysis illustrated several policy options for preventing cancers associated with carcinogenic occupational exposures in Canada. For instance, while the development of workplace education or training programs is a

common policy option, there are many policy options that are specific to the carcinogenic exposures and associated cancer sites.

While the large number of Canadian workers exposed to DEE and its known carcinogenicity are important considerations, the lack of implemented DEE elimination policies in other jurisdictions, as well as contextual factors such as the importance of diesel in many Canadian industries, makes complete elimination of diesel engines a less feasible policy option at the present time. In this regard, policy options that focused on using low-emission engines, incentivizing alternative fuels, strengthening enforcement of emission regulations, and developing stricter emission regulations and an OEL for DEE as a whole, were more appropriate for Canada.

The policy analysis for asbestos demonstrated that an asbestos ban was the most appropriate policy option given the strong scientific evidence of mesothelioma and lung cancer and the precedent of successful bans in other countries. Developing a national public building registry, substituting asbestos with safer alternatives, and adopting and enforcing more rigorous OELs have also been used in other jurisdictions and are feasible policy options for Canada.

Many Canadian workers are exposed to shift work, which is an essential part of globalization and economic competition. However, there is comparably less strong and consistent scientific evidence on the association between shift work and breast cancer, as well as fewer examples of implemented primary prevention policies from other jurisdictions. More research and evaluation of preventive measures are needed and as a result, this research gap translated to fewer policy options relative to DEE and asbestos.

A detailed list of policy options for the primary prevention of occupational cancers associated with exposure to DEE, asbestos, and shift work are presented in Table 1. Similar connections between the framework parameters (problem statement, jurisdictional evidence, and context) were made in order to devise these policy options.

### 3.2.5. Key policy players and their attributes

Key policy players are the individuals, institutions, or organizations that have an interest in or who are instrumental in implementing a particular policy [6,7,10,11]. Each player has distinct resources, interests, and positions regarding policy problems and options to address them [6,7,50]. Resources can include expertise, funding, and staff support. For most key policy players, interests and positions can be determined by direct consultation, but if this is not possible then these can be estimated via assessments of organizational mandates and activities, as was done here.

The Labour Program of Employment and Social Development Canada applies to DEE, asbestos, and shift work by regulating hours of work, workplace training, and OELs. However, the Labour Program has no specific articulated positions on these carcinogens [30]. Health Canada acknowledged that all forms of asbestos are carcinogenic, but did not have any position about shift work or DEE [51]. Environment Canada recognized the health hazards of DEE from an environmental standpoint [52]. This Ministry also has the authoritative power and expertise to influence policies that affect the health of workers. Industry Canada and manufacturers may also influence policy development as they control the import and production of substances, respectively.

Employers also play an important role in developing workplace-based policies and have many interests. For example, they are also legally required to enforce OHS standards, such as the development of workplace OHS policies and identification of workplace hazards. However, primary prevention policies may not be a priority, possibly due to perceived or real challenges and the lack of legislation. As an example, the primary prevention of health effects associated with shift work could be a complex issue for employers if

**Table 1**  
Key Canadian policy players and prospective policy options for preventing occupational cancers associated with exposure to diesel engine exhaust, asbestos, and shift work

	Diesel engine exhaust*						Asbestos†					Shift work‡		
	Primary prevention policy options											1	2	
	1	2	3	4	5	6	1	2	3	4	5			
Key policy players														
Federal government & agencies														
Employment & Social Development Canada (e.g., Canada Labour Program)	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓		✓
Industry Canada								✓	✓					
Environment Canada	✓			✓	✓			✓						
Health Canada								✓	✓					
Provincial government & agencies														
Ministries of Labour	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Ministries of Environment				✓	✓			✓						
Ministries of Health								✓						
Ministries of Education								✓						
Occupational Health & Safety Associations			✓									✓		✓
Federal and provincial organizations														
Labor Unions (e.g., Canadian Union of Public Employees)			✓									✓	✓	✓
Employers	✓	✓	✓					✓		✓	✓	✓	✓	✓
Industry (e.g., transportation, mining, construction)	✓	✓						✓			✓			

\* Diesel engine exhaust: 1 = Initiate incentives for industries and employers to substitute diesel with safer alternative fuels; 2 = Use low-emission diesel engines; 3 = Develop and enforce workplace education/training programs for all supervisors, employers, and workers who are potentially or knowingly exposed to diesel engine exhaust; 4 = Strengthen enforcement of current diesel engine exhaust emission regulations; 5 = Develop stricter diesel engine exhaust emission regulations; 6 = Develop and enforce occupational exposure limits for diesel engine exhaust as a whole.

† Asbestos: 1 = Ban all forms of asbestos; 2 = Develop a national registry of asbestos-containing buildings; 3 = Adopt and enforce more rigorous occupational exposure limits; 4 = Initiate incentives for industries and employers to substitute asbestos with safer alternative fibers; 5 = Develop and enforce workplace education/training programs for all supervisors, employers, and workers who are potentially or knowingly exposed to asbestos.

‡ Shift work: 1 = Improve shift schedules; 2 = Develop and enforce workplace education/training programs for all supervisors, employers, and workers involved in shift work.

they do not have the resources or staff to support personal shift choices or if there is a lack of support from regulations and guidelines.

**4. Discussion**

Occupational cancer is largely preventable. Primary prevention policies in the form of legislation or regulations, economic incentives, and worker education [53] can help promote healthier workplaces and substantially reduce cancers associated with exposure to occupational carcinogens. Core elements of a primary prevention policy framework were identified in this study, which were robust as demonstrated by applying the framework to DEE, asbestos, and shift work. This framework can be readily applied or adapted for other occupational carcinogens. A similar analysis can be done for secondary or tertiary prevention policies. For example, organized lung cancer screening policies could be used as secondary prevention among workers in high-risk industries and occupations involving exposure to lung carcinogens such as metals and crystalline silica. Policies related to the surveillance of workers' exposures and improved workplace compensation policies could also be discussed with respect to secondary and tertiary prevention.

The parameters in this framework were chosen based on their prevalence of use in the prospective health policy analysis literature and their relevance to the primary prevention of occupational cancer. The different results obtained for each carcinogen suggest that developing policies to prevent occupational cancer is a complex and targeted undertaking. Nevertheless, this analysis illustrated how various parameters can be integrated to develop a set of feasible primary prevention policy options and help determine the most urgent or appropriate one(s). For example, a range of policy options for preventing lung cancers associated with occupational exposures to DEE ranged from the development of an OEL to

educating workers and imposing stricter emission regulations and enforcement. Policy options for preventing cancers associated with occupational exposures to asbestos included complete elimination, development of a national asbestos building registry, and economic incentives for using alternative fibers. Options for preventing breast cancer associated with occupational exposures to shift work were primarily focused on improving shift schedules. Altogether, these policy options were based on consideration of the problem statements, Canadian context, and jurisdictional evidence for each of the occupational carcinogens.

The policy options and methodology from this study may support existing efforts to prevent occupational cancer or stimulate novel opportunities that can be considered by policy makers, public health professionals, researchers, activists, and other stakeholders. Carcinogens found in Canadian workplaces are also relevant in other countries with similar industrial make-ups. However, an analysis of individual parameters should be tailored according to local conditions.

There are several limitations to this study. Policy formulation is not always a step-by-step process as this framework suggested. Moreover, it is up to key players to develop and implement policies based on processes available in their particular setting. Engaging with key policy players to understand fully their resources, interests, perceptions, positions, and acceptability of a policy is an important part of a health policy analysis [7,54] that was not covered here. Future work can include consultation with key policy players in order to improve the usefulness of the framework in interdisciplinary policy settings. This framework also does not include all possible parameters of a prospective health policy analysis. For example, the feasibility of policy options based on context, as well as problem statements and jurisdictional evidence were taken into account. However, this framework does not include an evaluation of policy options, including unintended positive or

negative effects, outcomes, equity considerations, or the effectiveness and financial costs of these policy options [54]. While these elements are undoubtedly important considerations for policy makers, they are not widely apparent in the prospective health policy analysis literature and were outside the scope of this study. Nevertheless, this framework provides a useful starting point for key policy players to consider the development of primary prevention policies. An analysis of other parameters and policy options in consultation with key policy players would help strengthen the framework.

Applying the framework to a few selected carcinogens illustrates the value of integrating scientific evidence and considering multiple avenues for policy development that address gaps and inequalities in legislation and leadership. Examples of policy options could have been made based simply on what other jurisdictions have done. This rapid, evidence-based approach to decision-making is often preferred in public health given time constraints [54]. However, the comprehensive approach presented in this paper shows how other parameters can be easily considered in conjunction when conducting a prospective health policy analysis and planning for future policy change.

This framework is unique in that it provides an example of how a prospective health policy analysis can be applied specifically for occupational health. Most of the prospective health policy analyses currently in the literature identify parameters, but do not provide detailed examples of their application. Furthermore, many policy analyses focus on identifying parameters that are key to understanding or analyzing a particular policy already in place (i.e., a retrospective analysis). This framework addresses a gap in the literature by providing an example of how to prospectively develop future policies, specifically for occupational cancer prevention. It shows how prospective health policy analyses can be systematically organized into a framework and applied to public health policy problems, such as OHS, an issue of interest to policy makers and stakeholders worldwide. In order to address the lack of published work in this area, future research can expand upon this framework and apply a prospective health policy analysis to other occupational health issues of importance in Canada and other jurisdictions.

In summary, this was the first comprehensive policy framework dedicated to the primary prevention of occupational cancer. This study helped address an important gap in occupational disease prevention using a systematic policy approach that was evidence-based, practical, and pertinent to a variety of users and contexts. Occupational cancers associated with exposure to carcinogens such as DEE, asbestos, and shift work represent an important public health concern and the global burden of disease will continue to rise without appropriate primary prevention policies. While policy development is a complex task, this proposed framework provides a useful starting point for key policy players of what parameters to consider when developing policies to protect workers' health.

### Conflicts of interest

The authors of this manuscript have no conflicts of interest to declare.

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