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Objectives Paper - February 5 and 6, 2020

Chemicals Management Plan Science Committee

Considerations for identifying potential risks from exposure to chemicals in the workplace

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1. Meeting objectives and scope

Health Canada (HC) is exploring ways to reduce the risks to Canadians from exposure to chemicals by considering exposures in the workplace and enhancing the protection of workers by leveraging the information, tools, and/or technical expertise of the Chemicals Management Plan (CMP).

The objective of this meeting is to identify what considerations and sources of information could inform future work related to the protection of workers from exposure to chemicals in Canada.

Although pesticides are within the scope of the CMP, the *Pest Control Products Act* has specific protections in place for pesticides in the workplace; therefore, the focus of these deliberations will be on considerations for identifying potential priorities from exposures to industrial chemicals or products available to consumers that are used in the workplace.

This meeting will consider the key lessons learned from international federal chemicals management agencies to inform potential future activities in Canada, with a particular focus on the scientific considerations for identifying potential priorities (that is, risks) in the workplace.

The CMP Science Committee is requested to consider the charge questions identified in this discussion paper in the context of a modernized chemicals management program in Canada. For ease of reference, the full list of charge questions can be found in Appendix 1, and a list of key reading material can be found in Appendix 2.

2. Context and background

While the CMP is broad in scope, it has not included activities that assess or address risks from chemical exposures in the workplace, with 1 exception, the pesticides program at HC's Pest Management Regulatory Agency (PMRA).[1] This approach is different from the practices of many other international chemicals management agencies, where federal chemical programs provide a scientific role by including occupational exposure in risk assessments, developing occupational exposure limits, and/or developing chemical hazard classifications.

2.1 Canadian context

In Canada, worker protection is a shared responsibility, and federal, provincial, and territorial (FPT) governments have legislation in place to help protect Canadian workers from chemicals of concern. HC administers the *Hazardous Products Act* (HPA), which requires suppliers of hazardous products to communicate the hazards associated with their products via product labels and safety data sheets (SDSs) as a condition of sale and importation for workplace use. The *Hazardous Products Regulations* (HPR) specify the criteria for classifying hazards posed by chemical products and requirements for product labels and SDSs. The Workplace Hazardous Materials Information System (WHMIS) 2015 requirements are laid out in the HPA and

[1] Health Canada also administers the *Pest Control Products Act*, which has specific protections in place for pesticides in the workplace, including supplier hazard communication requirements and pre- and post-market risk assessment.

the HPR, and incorporate the Globally Harmonized System of Classification and Labelling of Chemicals (GHS) for workplace chemicals. WHMIS is Canada's national system for classifying the hazards of workplace chemicals and communicating hazard and safety information to employers and workers. WHMIS is implemented through federal (F) [HC and Employment and Social Development Canada (ESDC)] as well as provincial and territorial (PT) legislation.

ESDC and PT occupational health and safety (OHS) regulators administer the employer requirements, as well as employee training and education. While FPT-level OHS legislation covers workplace labelling, access to SDSs, mitigation of workplace hazards, and worker education programs, specific requirements vary among provinces and territories. All jurisdictions, however, require internal responsibility systems based on employee–employer partnerships to help ensure a safe and healthy workplace.

HC has been working with FPT representatives from the Canadian Association of Administrators of Labour Legislation, Occupational Safety and Health Committee (CAALL-OSH) to identify potential opportunities to enhance the protection of workers using the information, tools, and/or technical expertise of the CMP. In the fall of 2018, as part of this initiative, FPT jurisdictional members of the Committee of WHMIS Coordinators (CWC) were surveyed to identify potential opportunities to leverage the expertise and data accumulated on hazardous substances used in Canadian commerce through the CMP to benefit worker health and safety (Government of Canada 2019a). Through further discussions with the CWC and HC's Workplace Hazardous Materials Program, the current approach of FPT OHS regulators in the following scientific areas have been identified.

2.1.1 Prioritization

FPT OHS regulators across the country each have their own processes to identify priorities for the protection of workers from chemical exposures. However, these processes are often reactive (for example, responding to stakeholder reports) or inspection oriented. OHS regulators do not readily have access to the data collected, generated, or analyzed by the CMP, nor are their priorities currently taken into account when identifying priorities for chemicals management in Canada.

2.1.2 Risk assessment and risk management

Employers in Canada are responsible for knowing which hazardous products are present in their workplace and ensuring the appropriate hazard control measures are in place. This may include the assessment of risk. Only 1 province conducts occupational risk assessments. International experience with risk assessment shows that occupational exposure is often a driver for risk management, and that there are

situations where risks to workers cannot be mitigated using engineering controls, administrative controls, or the use of personal protective equipment (PPE). HC has not considered risks from exposure to chemicals in the workplace in screening assessments under the *Canadian Environmental Protection Act, 1999* (CEPA 1999) within the context of the CMP.

2.1.3 Occupational Exposure Limit Development

The Threshold Limit Values (TLVs®) developed by the American Conference of Governmental Industrial Hygienists (ACGIH®) form the basis for the occupational exposure limits (OELs) established by most Canadian jurisdictions. Many jurisdictions implement the ACGIH TLVs by reference or incorporation into their regulations. The OELs in some of these jurisdictions are based on the current edition of the TLVs, and for some jurisdictions, their OELs are based on older editions of the TLVs booklet. Therefore, the OEL values for specific substances may not be harmonized, even when they are based on the ACGIH TLVs. In addition, 5 jurisdictions have stakeholder and/or technical review processes in place for establishing OELs, which has the potential to increase differences in OELs between jurisdictions.

There is currently no pan-Canadian organization that develops OELs for potential use across the country. ACGIH TLVs represent only a portion of substances currently in commerce in Canada. As such, there are chemicals for which limits have not been derived and may pose a risk in the Canadian workplace. Some Canadian jurisdictions do not have mechanisms in their regulations to incorporate OELs that are not on the ACGIH TLVs list.

2.1.4 Research and monitoring

Most FPT OHS regulators do not routinely conduct workplace exposure monitoring. Seven jurisdictions have research funding programs that are or could be targeted to worker chemical exposure issues. HC has a world-leading research and monitoring program in environmental health. While it does not have a specific program for projects related to exposure or effects of chemicals used in the workplace, several ad hoc projects have focused on occupational exposure. OHS regulators do not have a mechanism to influence HC research and monitoring projects to protect Canadian workers.

2.1.5 Hazard classification

HC has only classified a fraction of the chemicals currently in use in Canadian workplaces, and has done so on an *ad hoc* basis in order to review the hazard communications for hazardous products. Although there are other domestic and international organizations that publish classification information under the Globally Harmonized System, there is no national Canadian repository of WHMIS 2015

classification information for suppliers or employers to utilize when developing hazard communication products (that is, SDSs and product labels). The impact of supplier SDSs and product labels accuracy is critical, as it impacts the level of awareness of the entire supply chain. Improved knowledge may lead to the safer handling of chemicals, leading to improved worker safety.

2.2 A need for further work

International chemicals management agencies, including the United States (U.S.) Environmental Protection Agency (EPA), the Australian National Industrial Chemicals Notification and Assessment Scheme (NICNAS), and the European Chemicals Agency (ECHA), consider occupational exposure in risk assessments and often find it to be the driver for risk management. Many of these assessments are on chemicals that are, or are notified to be in, commerce in Canada and have been assessed under the CMP. Workplace exposures are different than what is experienced in the general population; on 1 hand, chemical exposures could be of increased frequency and duration; on the other hand, control measures used (such as ventilation and PPE) may be more robust. Stakeholders could have information on how hazards are controlled in the workplace that could inform risk assessment.

Canadians spend a significant amount of time at work—some handling large volumes of, or being repeatedly exposed to, hazardous chemicals. Burden of occupational disease estimation contributes to the understanding of both magnitude and relative importance of different occupational hazards and provides essential information for targeting risk reduction (Rushton 2017). However, establishing the burden of disease due to occupational exposure to hazardous chemicals is an exceedingly complex undertaking. It can often take several decades for cancer to develop following exposure, making it difficult to associate cancer with work (Budnik et al. 2018, Labrèche et al. 2013). In addition, burden estimates can only be derived on the basis of existing literature, where only a fraction of environmental and occupational risks are adequately covered (WHO 2006). Workers' compensation board data focus on submitted and approved claims, which:

- underestimates the true degree and character of work-related injuries, disease, and death due to under-reporting of occupational disease
- provides limited information on the causes of chronic diseases
- limits the under-recognition of occupational diseases, including cancer, by many workers' compensation systems (OCRC 2019)

Globally, it is estimated that 5%–7% of fatalities can be attributed to occupational illness or injury, with work-related cancers representing one third, indicating that

occupational hazards continue to remain an important cause of ill health and mortality worldwide (Rushton 2017). In Canada, 9,700–10,400 new cancer cases (3.9%–4.2% of the total) were attributable to work in 2011 (Labrèche et al. 2019). Most exposures selected for study are based on a limited number of agents that have been classified as carcinogenic to humans [for example, International Agency for Research on Cancer (IARC) Group 1]. As the number of known occupational carcinogens will only increase in the future, burden estimates are almost certainly an underestimate of overall cancer burden attributable to occupational exposure (Labrèche et al. 2019). A 2019 report on the Burden of Occupational Cancer in Canada from the Occupational Cancer Research Centre (OCRC) also highlights the need for policy action to be taken to reduce workplace exposure to priority carcinogens (OCRC 2019).

Studies on workplace hazards and international risk assessments have also identified non-cancer health outcomes of concern in the workplace, including, for example, respiratory disease (Lau and Tarlo 2019, NIOSH 2006, Ruston 2007), developmental and reproductive health (ANSES 2014, DeMatteo et al. 2012, U.S. EPA 2015), and neurotoxicity (NIOSH 2013, U.S. EPA 2014), highlighting the need for continued efforts around risk identification and reduction. Appendix 3 presents some examples where risks were identified related to non-cancer outcomes.

In 2019, the United Nations (UN) Special Rapporteur on human rights and hazardous substances and wastes undertook an official country visit to Canada. He expressed concern that workers are currently not considered as a vulnerable class under the CMP, and that risk assessments, to date, have not considered occupational exposures. He urged the government to include workers under the CMP going forward, and to expeditiously re-evaluate the previously assessed substances.

The Government of Canada is exploring approaches to build on its world-leading chemicals management program. HC recognizes that enhancing the protection of Canadians from exposure to chemicals in the workplace is a key area of interest for stakeholders, and is exploring options to expand its role in this area. Since 2018, HC has been working with FPT OHS regulators to identify opportunities for collaboration where HC could help support them in their program delivery.

In July 2019, a proposed integrated strategy was posted online for consultation, outlining potential elements of a new program and roles and responsibilities (Government of Canada 2019b). The proposed strategy described how HC could provide scientific leadership and a coordination role through activities such as prioritization, risk assessment, and OEL development, to support FPT OHS regulators in their program delivery. As one of the first steps in refining this strategy, the CMP Science Committee is asked to provide HC with key lessons learned from international

experience and, more specifically, considerations for identifying priorities (that is, potential risks) in the workplace.

CMP Science Committee input will be considered along with feedback from stakeholder consultations as HC works with FPT OHS regulators to develop its strategy for the next phase of chemicals management in Canada as part of the CMP modernization. Further analysis, including the use of gender-based analysis plus tools, can also be used to help assess how diverse subgroups of the population may experience proposed policies, programs, and initiatives differently.

3. Part I. International lessons learned

Internationally, federal government scientific expertise contributing to the protection of workers from exposures to chemicals is spread across both regulatory and research agencies, and goes back decades. Presentations from international chemicals management agencies describing their OHS programs and key lessons learned will be shared via 2 pre-meeting webinars (U.S. and Europe; and Australia) to inform deliberations on the following charge question:

Charge Question 1: Considering what was presented at the international government science forum at the pre-meeting webinars, what are the key scientific lessons learned from international agencies? What considerations does the CMP Science Committee recommend as HC explores ways to contribute to the protection of workers from exposure to chemicals in Canada?

International government science that contributes to OHS may include activities in risk assessment, occupational exposure limit development, research and monitoring, and development of individual chemical hazard classifications. Presentations from chemicals management agencies that are similar to the CMP will be given to the CMP Science Committee and are identified in Table 1.

Table 1. Presentations from international federal chemicals management agencies with scientific activities that contribute to the protection of workers from exposure to chemicals

Agency	Scientific activity
U.S. EPA, Existing Substances and New Substances	Risk assessment for new and existing substances; develop new chemical exposure limits for new substances
ECHA	Examine proposals for harmonized classification and labelling; coordinate

	substance evaluations (that is, risk assessment) done by member states under the community rolling action plan (CoRAP); develop OELs
NICNAS, Existing Substances Program	Risk assessment; develop hazard classifications

These agencies will be asked to present:

- a high-level description of scientific aspects of the program that contribute to protection of workers from exposure to chemicals
- how priorities have been identified
- key scientific lessons learned (for example, where advances have been made, challenges that have been overcome, and challenges that are not yet overcome)
- a measuring of the impact/effectiveness of the program
- concrete examples where action has been taken that has had a positive impact on the protection of workers
- emerging science priorities that have been identified over the last few years

4. Part II. Identifying potential risks in the workplace

Identifying potential risks from exposure to chemicals in the workplace begins with a robust prioritization framework and relevant data sources. Efficiencies can be achieved by leveraging existing frameworks and data sources, and the CMP Science Committee is asked to deliberate on a series of charge questions that will inform changes that can be made to the CMP prioritization process to support the identification of potential risks in the workplace.

4.1 Current approach for the identification of risk assessment priorities (IRAP) and data sources

The current approach for prioritization in the CMP is IRAP (Government of Canada 2014). IRAP has not been designed to identify potential risks from exposure to chemicals in the workplace. An overview of IRAP and its data sources will provide the baseline information to inform CMP Science Committee deliberations on modifications for expanding the scope of IRAP to identify potential risks in the workplace.

Because risks in the workplace have not been considered in CEPA assessments to date, data sources specific to occupational exposure have not be considered in IRAP. Presentations from *ad hoc* members on surveillance projects underway at Carcinogen Exposure Canada (CAREX) and the Occupational Cancer Research Centre (OCRC), and an overview of some occupational exposure data sources (which is provided below), will inform deliberations on the second charge question.

Charge Question 2a: Given the summary of types of data and sources identified below that could inform a risk-based prioritization exercise like IRAP, is anything missing? Comment on the importance and relevance of the various types of data and sources (for example, relevance of total quantities used in workplaces across Canada, number of workers, and work tasks; relevance of changes to/new hazard classifications).

The ongoing IRAP approach contributes to the identification of risk assessment priorities under the CMP. The approach includes the systematic collection, consolidation, and analysis of new information in order to determine the appropriate action for substances with new information. There are 3 steps involved in the identification of risk assessment priorities:

(1) **acquisition** of information relevant to the potential health and ecological risks of substances
(2) **evaluation** of the information available for each substance
(3) identification of appropriate **action** for each substance

Acquisition refers to the collection and compilation of data for further consideration in the evaluation phase. Data on chemicals, including uses, quantities in commerce, and biomonitoring and toxicological information, is then evaluated to identify priorities for further work. While some data sources may contain information related to occupational exposure (for example, international risk assessment priorities), identifying priorities for risk assessments under CEPA 1999 has focused on preventing risks to the general population (that is, not in the workplace).

Figure 1 illustrates the mechanisms for collecting information currently considered in the IRAP approach. Data are collected on an ongoing basis, and the review process considers all information collected for a given substance as the basis for a recommended action (that is, risk assessment, further data collection/generation, or no further work at this time). The IRAP approach is not prescriptive in the data sources used, and it is anticipated that the data sources considered in future review cycles will be expanded as appropriate. However, due to challenges with staying abreast of new information for large inventories of substances such as the Domestic Substances List (DSL), the data sources currently included in the process are limited to those that are

easily accessible and are typically compilations of international decisions, hazard classifications, or other tabulated data. This approach limits the amount and type of emerging science that can be identified through the current process, as emerging science information is often only available in the open literature and not in a database or Microsoft Excel format [for example, with Chemical Abstracts Service Registry Numbers (CAS RNs) and results tabulated].

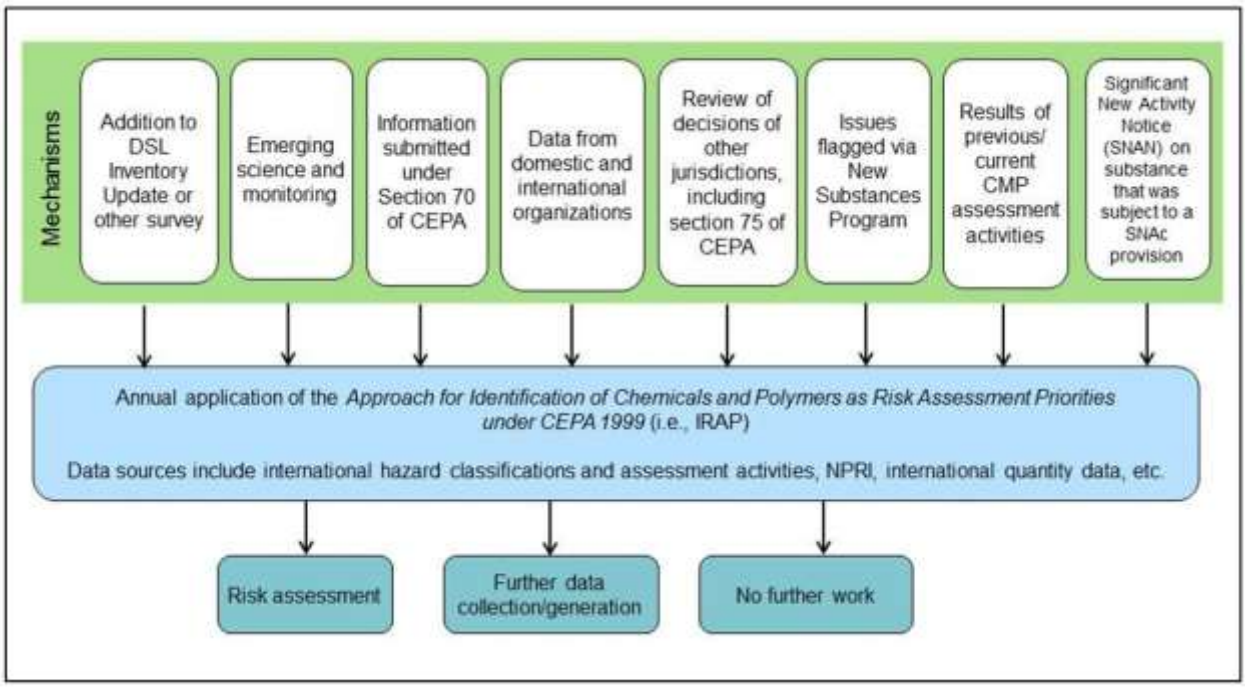

Figure 1: Mechanisms to identify priorities.

Inventory update or other survey: Information-gathering initiatives, such as mandatory and voluntary surveys issued under sections 46 and 71 of CEPA 1999 (where Canadian quantities, uses, facilities, and/or toxicological information are reported) identify substances with high exposure potential or changing commercial status. This information can be compared with hazard flags to identify substances of potential concern.

Emerging science and monitoring: Program scientists identify emerging science that suggests that a substance is of concern. Monitoring conducted under the CMP is a source of Canadian exposure data used to identify substances measured in humans or the environment. Consideration of new approach methodologies (NAMs) data would fit under this mechanism.

Section 70: This section of CEPA 1999 requires stakeholders to provide Environment and Climate Change Canada (ECCC) information in their possession that reasonably supports the conclusion that a substance is toxic or is capable of becoming toxic, thereby identifying potentially hazardous substances.

Data from domestic and international organizations: A number of domestic and international data sources are included in the review to identify hazard and/or exposure flags. For example, substances with increasing releases to the environment can be identified using data from the ECCC's National Pollutant Release Inventory list, including identification of specific industrial sites. International hazard identification activity is also tracked to see which substances are being prioritized for assessment elsewhere and which substances have increased import/manufacture. To date, some specific sources of information used in the IRAP review to identify priorities for human health include:

- carcinogenicity evaluations from international agencies (for example, World Health Organization's IARC)
- GHS hazard classifications (for example, ECHA's harmonized classification and labelling information)
- international lists of restricted and/or prohibited substances, or other international priorities [for example, substances of very high concern (SVHCs) from the ECHA Candidate List]
- notifications to HC concerning substances used in cosmetics
- non-confidential data reported under the U.S. EPA Chemical Data Reporting (CDR) Rule
- biomonitoring, environmental monitoring, and surveillance data

Review of decisions of other jurisdictions, including section 75: Regulatory decisions taken in other jurisdictions are also used to flag substances of potential concern or review under section 75 of CEPA 1999. These regulatory decisions may be based on risks identified in the workplace; however, HC has not identified priorities for further work based on occupational exposure.

Issues flagged via the New Substances Program: The New Substances Program receives studies from New Substances Notifications that may flag concerns for other similar substances that are in commerce in Canada. These data on analogues can also feed into the identification of future risk assessment priorities.

Results of previous CMP assessment activities: Data used in previous or ongoing CMP assessments that show high hazard may be relevant for other substances not currently identified as priorities for assessment (for example, analogues).

Significant New Activity notice: When a Significant New Activity (SNAc) notice is received on a substance with a significant new activity provision, an assessment is triggered.

Due to the labour-intensive nature of this process, the most practical data sources are compilations or databases of international decisions, classifications, or other tabulated data (for example, U.S. CDR or Canadian section 71 quantity data). As a result, it has proven difficult to identify new priorities based on data published in literature. To date, HC has not developed a feasible process for reviewing individual scientific publications. IRAP is largely reliant upon other jurisdictions/organizations to review the literature and add to the compilations or databases that HC is already referencing, or to identify new substances as priorities in their jurisdiction. Delineating a process by which IRAP could identify and use emerging tools and technologies to collect and collate individual pieces of information would be beneficial to Canada in order to include the most recent data in the identification of priorities for assessment.

Emerging science has become available in the form of databases and dashboards (for example, results of *in vitro* high-throughput screening (HTS) and high content testing). However, work is still underway to incorporate these types of data into the IRAP approach and is being informed by input from the 2016 CMP Science Committee meeting (CMP Science Committee 2016) as well as advances made in the area of NAMs since the 2016 meeting. Improvements on the systematic and automated collection, interpretation, and reporting of existing and emerging data sources are being explored through the application of programming languages (that is, R-script) and the development of automated workflows using analytics platforms (that is, KNIME). Improvements to the interoperability of databases are also important to support the integration of tools and information sources to introduce further automation of the IRAP approach.

While hazard data are universal (that is, toxicity is not typically dependent on location), exposure can vary between countries. Therefore, there can be limitations with using international exposure data. Although the IRAP approach attempts to identify exposure flags for substances, it has been difficult to identify useful exposure information without further data gathering in Canada (for example, conducting a survey of use in Canada).

Types of occupational exposure data and potential data sources that could inform a risk-based prioritization approach such as IRAP could include the following details:

Mandatory survey information

Some sections of CEPA 1999, such as sections 46 and 71, allow the Government of Canada to collect information from industry and other individuals regarding their activities with substances, as well as other available toxicological information that informs assessment. CEPA 1999, section 71 includes mandatory information-gathering provisions whereby the Minister of the Environment can require the submission of information, samples, or testing for the purposes of assessing whether to control or the manner in which to control a substance (refer to Appendix 4 for further details). CEPA 1999, section 46 can be used to require the submission of information for the purposes of creating an inventory of data. Information from inventory updates or other surveys conducted under CEPA 1999 are often used as a source of information on the current Canadian commercial status of chemicals (for example, quantities and use) to inform IRAP.

Mandatory survey information as a potential source of Canadian data to inform prioritization

Inventory updates or other surveys conducted under sections 46 and 71 of CEPA 1999 have not specifically requested information on exposure in workplace settings to date. Appendix 5 provides an example of the information requested in the most recent inventory update that was conducted on 1,430 chemicals and polymers. Modifications to survey questions could be helpful in identifying priorities in the workplace. For example, in the U.S. CDR, questions about workplace exposure have included the volume used on site, number of workers at a manufacturing and/or processing site, maximum concentration, and number of commercial workers reasonably likely to be exposed.

Workplace exposure monitoring

Workplace exposure monitoring generally refers to air sampling measurements. Workplace exposure databases provide a benchmark of current and past exposures, and highlight data gaps that may be crucial in future research or policy-making agendas. Workplace exposure databases are used around the world for a variety of important purposes, such as identifying hazardous workplaces and workers at risk, assessing temporal–spatial trends, setting priorities for prevention, and informing epidemiological research (Hall et al. 2014). The U.S. Occupational Safety and Health Administration's (OSHA) Chemical Exposure Health Database can be used as surrogate data to provide an idea of the levels of exposures in workplaces to specific chemicals based on industrial hygiene samples taken by OSHA compliance officers.

Workplace exposure monitoring as a potential source of Canadian data to inform prioritization

There has been a significant decrease in workplace exposure monitoring in Canada since the 1990s and a shift in responsibility from regulators to employers in conducting exposure measurement surveys (OCRC 2019). In all jurisdictions in Canada, workplace exposure monitoring is an employer responsibility (Government of Canada 2019a). In Ontario, for example, there are monitoring requirements for designated substances that are identified in the regulations (Ontario Ministry of Labour 2009). Workplace exposure monitoring conducted by the employers may or may not be systematically collected and analyzed and may or may not be available to OHS regulators. For example, the Ontario Ministry of Labour used to have a database that included workplace exposure measurements collected by Ministry inspectors to determine compliance with OELs between 1981 and 1996. The measurements were analyzed in the Ministry's laboratory until it was closed in 1996 (Demers et al. 1999).

The province of Quebec is the only large jurisdiction in Canada that still collects exposure measurements in workplaces. The Institut de recherche Robert-Sauvé en santé et en sécurité du travail (IRSST) operates a laboratory that analyzes and stores these measurements in a repository named the Laboratory Information Management System (LIMS). The LIMS is an electronic database containing all analytic results for workplace exposure measurements taken by occupational health teams in Quebec since 1985. As of 2011, the LIMS included over 380,000 measurements to various solvents, metals, gases, isocyanates, and acids, as well as crystalline silica. More than 70% of exposure measurements in the LIMS were collected on high-priority industry groups (for example, natural resource extraction; metal and chemical manufacturing) for the Commission des normes, de l'équité, de la santé et de la sécurité du travail (CNESST), the Quebec workers' compensation board (Demers et al. 2019).

The Canadian Workplace Exposure Database (CWED) was originally developed in 2008 by the CAREX Canada project to assist in estimating worker exposure to carcinogens across the country. The CWED has centralized nearly half a million air sampling measurements for approximately 330 substances across 6 jurisdictions (British Columbia, Saskatchewan, Manitoba, Ontario, Yukon, Human Resources and Skills Development Canada) from the 1970s to 2010. Most of the samples come from Ontario and British Columbia, and provide information on exposure concentration, substance, industry [coded to the North American Industry Classification System (NAICS)], occupation (coded to National Occupational Classifications), sampling method, duration, location, and year. Figures 2 and 3 illustrate the number of samples collected for the top ten non-carcinogens and carcinogens sampled, respectively (Davies 2019).

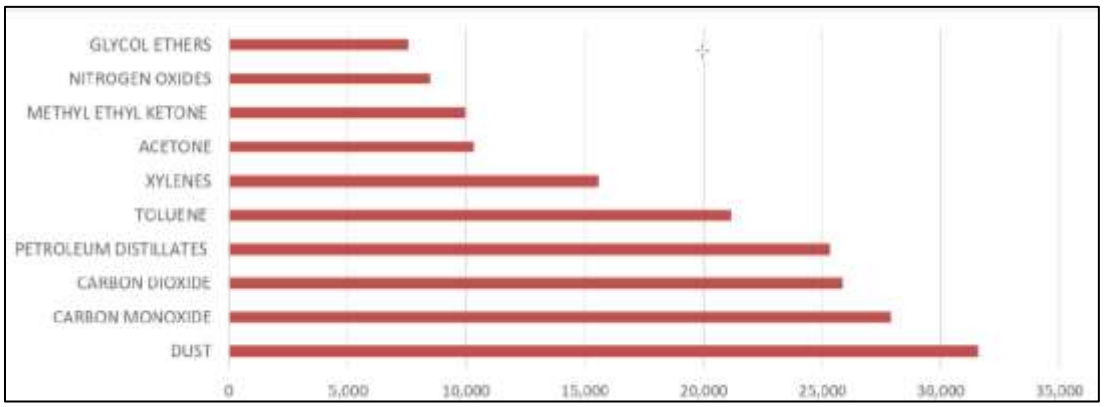

Figure 2. Number of samples: non-carcinogens (top 10).

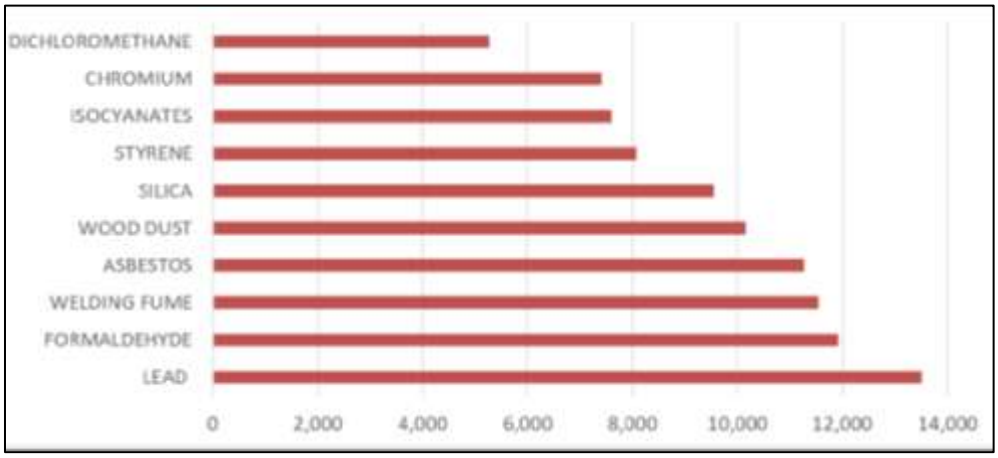

Figure 3. Number of samples: carcinogens (top 10).

CWED's long-term vision includes partnerships with regulatory agencies and other exposure data owners and users to encourage prospective data collection and coordinated efforts to centralize this information (Hall et al. 2014).

Workplace exposure/Incident reporting

Incident reporting is used by chemicals management programs at HC in the areas of pesticides, drugs, and other products available to consumers (for example, cosmetics, children's products).

In the case of pesticides, for example, incidents reported to the PMRA may include exposures of workers, among others (for example, generation population, animals, or the environment) to registered pest control products. Priority for in-depth reviews is given to incidents that are serious in nature, that involve multiple people or animals, or

that indicate a recurring problem. In addition, when the PMRA reviews new active ingredients or conducts re-evaluations of older pesticides, a complete analysis of all incidents involving that pesticide is integrated into the risk assessment. A weight-of-evidence approach is used to evaluate pesticide incident reports. That is, many different sources of information, such as available scientific studies and poisoning data, are considered and integrated into assessments of pesticide incident information. Thus, the evaluation of risk is based on extensive data analysis in order to determine whether improved label language or additional mitigation measures are warranted to further reduce pesticide exposure, with the aim to reduce the occurrence of adverse effects (PMRA 2018). To date, pesticide incident reports have not been used to identify priorities for risk assessment in the context of registrations and re-evaluations; however, surveillance of pesticide incidents for risk identification and trend analysis is undertaken on an ongoing basis, and the PMRA will take action as necessary should a health or environmental concern be identified from incident reports.

Incident reports have not been used in IRAP to inform prioritization of risk assessment in the general population.

Canadian poison control centres are the 24/7 focal point for medical professionals and the public to seek treatment advice on drug, poison, and chemical exposures. Collectively, they manage roughly 184,000 cases annually, including many workplace exposures. The Canadian Surveillance System for Poison Information (CSSPI) is currently in year 2 of a 4-year implementation plan (2018–2022). The CSSPI is a pan-Canadian toxicovigilance system that will aggregate, analyze, and interpret data from the 5 poison centres to provide near real-time surveillance and generate national statistics on poisonings, chemical intoxications, and adverse drug reactions. Information captured includes demographics (for example, age), exposure information (for example, substance), clinical outcomes (for example, outcome), and management (for example, treatments, treatment qualifier, patient flow; managed on site or referred to a healthcare facility). A study in Sweden found that the identification of exposures and symptoms by the Poisons Information Centre allowed recognition of chemicals with problematic occupational uses, and that these records may serve as an important complement to official injury statistics related to incidents with hazardous substances at work (Schenk and Oberg 2018). Information from poison control centres has not been available for use in IRAP to inform prioritization of risk assessment in the general population to date.

Workplace exposure/incident reporting as a potential source of Canadian data to inform prioritization

Reporting systems whereby workers/employers notify OHS regulators of occupational exposures/incidents is not common in Canada. Workers' compensation boards would typically receive notice of workplace injuries or illnesses that can be claimed (CCOHS 2019).

For example, WorkSafeBC has an Employers Incident Reporting System that relates to those situations where an incident has occurred with potential or actual outcome and often leads to a claim. WorkSafeBC also has a voluntary on-line exposure registry that was developed to register a worker's perceived or actual exposure to a harmful substance or agent at work. Sometimes the worker, employer, or another person will provide information on the specific chemical exposure, and sometimes this information will be obtained through a follow-up visit or interview. Investigation or consultant reports may also be forwarded to WorkSafeBC after the submission to clarify no, partial, or over-exposure situations and sampling results. This voluntary on-line exposure registry creates a snapshot of the range of potential exposure hazards workers might face. Information is stored and analyzed, and may allow for an early, proactive response to a potential problem. It allows WorkSafeBC to look at emerging trends and follow up on any increases in the numbers of exposures, repeat incidents, multi-worker exposures, and high-risk outcomes.

Canadian poison control centres also receive calls about chemical exposures that occur in the workplace. The call may be placed by the worker or someone on their behalf, such as a healthcare provider seeking clinical care guidance. Specialists in poison information record the details of the exposure, including location (that is, whether the exposure occurred at work), how they were exposed, the chemicals involved, and symptoms. Poison centre data offer a near-real-time record of chemical exposures and may allow for an early warning of worksite hazards. However, the primary mandate is clinical; therefore, the recorded data may lack details on the specific worksite and conditions.

Biomonitoring data

When considered with other information, biomonitoring data can help identify priority chemicals that warrant further action. Biomonitoring data alone cannot determine the source or route of the exposure; the measurement of a chemical indicates exposure from any or all sources (for example, air, water, soil, food, products), any or all routes (ingestion, inhalation, or skin contact), and at any location/source (for example, at home, outside, or at work). Biomonitoring data have been used in IRAP to inform the prioritization of risk assessment for the general population.

Biomonitoring data as a potential source of Canadian data to inform prioritization

Canadian biomonitoring initiatives that collect information about a person's occupation include the Maternal-Infant Research on Environmental Chemicals (MIREC) study and the national biomonitoring program conducted as part of the Canadian Health Measures Survey (CHMS).

The MIREC study was established to obtain national-level biomonitoring data on pregnant women and their infants and to examine potential adverse health effects of prenatal exposure to environmental chemicals on pregnancy and infant health. MIREC-ENDO (short for endocrine) is currently following MIREC mothers and children through the adolescent years. MIREC also includes a data and biospecimens biobank for future research. Questionnaires completed during pregnancy and after the babies' birth collected information on, among other things, occupation and medical history of the mother and father.

The national biomonitoring program is conducted as part of the CHMS. Launched in 2007, this ongoing survey provides baseline data on indicators of environmental exposures, chronic diseases, infectious diseases, fitness, and nutritional status through personal interviews and the collection of physical measurements from more than 5,000 Canadians every 2-year cycle. The survey also includes a biomonitoring component, measuring the environmental chemical concentration in blood, urine, and hair. Blood, urine, and DNA samples are stored in a biobank for future health research use. To date, the CHMS has measured more than 250 unique chemicals in blood and urine from over 30,000 Canadians at 81 sites across the country. The CHMS collects information through a household interview and direct physical measures at a mobile examination centre. Through household interviews, the CHMS gathers information related to, among other things, medical history, current health status, and occupation (for example, what kind of business, industry, or service did you work in; what was your work or occupation; in this work, what were your main activities; how many hours did you work per week).

Occupational disease surveillance

Occupational disease surveillance is broadly defined as "the systematic investigation of the occurrence of health outcomes in relation to work conditions." The data generated can be used to trigger screening for early signs of occupational illness or disease in groups with high levels of exposure; inform the development of primary prevention activities to reduce or eliminate exposure (that is, by identifying situations where control measures are inadequate); and/or identify new relationships between levels of exposure and disease outcomes (when linked with an effective hazard surveillance system) (Demers et al. 2019). Disease surveillance systems can provide an early

warning system for some health conditions, especially those with short latencies (Occupational Disease Prevention Committee 2010).

Data sources for occupational disease surveillance may include workers' compensation claims, death certificates, administrative health records, record linkages, population-based surveys, and patient registries (that is, physician- and clinic-based approaches). The strengths and limitations of these data sources are described in Demers et al. 2019.

Disease surveillance has not been used in IRAP to inform prioritization of risk assessment in the general population.

Occupational disease surveillance as a potential source of Canadian data to inform prioritization

Information about medical diagnoses in administrative health records is captured in Canada. However, there is no way to determine where these patients worked or whether their health condition might be related to a workplace exposure. The Occupational Disease Surveillance System (ODSS) aims to overcome this challenge (CAREX and OCRC presentation 2019). The ODSS is led by the Occupational Cancer Research Centre (OCRC) and combines different provincial data sources to examine the risk of cancer and non-malignant diseases among workers in Ontario. To identify disease cases, a cohort of 2.2 million workers, identified from Workplace Safety and Insurance Board (WSIB) accepted lost-time compensation claims data, was linked to tumour registry data (Ontario Cancer Registry), hospital records (Canadian Institute for Health Information's Discharge Abstract Database), ambulatory care records (National Ambulatory Care Reporting System), and physician billing records (Ontario Health Insurance Plan eClaims Database). By combining occupation and industry from time-loss compensation claims data with disease information from administrative health databases, the ODSS provides an efficient approach to study work-related diseases. It can identify at-risk groups of workers and potential hazardous exposures. Next steps for the ODSS include expanding beyond Ontario, with a grant to replicate ODSS in British Columbia and, potentially, Manitoba. The ODSS is currently being used to examine the associations between occupation and industry and 28 cancer sites and 9 non-malignant health outcomes (that is, acute myocardial infarction, asbestosis, asthma, carpal tunnel syndrome, contact dermatitis, idiopathic pulmonary fibrosis, Raynaud's syndrome, and silicosis).

Workers' compensation boards exist in each province and territory and provide benefits for work-related injuries, diseases, and deaths. Rules vary considerably between jurisdictions. The only available data source for describing national trends

and characteristics of compensated claims for deaths from occupational cancers is the Association of Workers' Compensation Boards of Canada (AWCBC). Although record keeping and reporting vary by jurisdiction, all workers' compensation boards in Canada provide records to this association, which are then converted to a standardized format such that jurisdictional comparisons can be made (Del Bianco and Demers 2013). While data from workers' compensation boards can provide a source of information on work-related injury, disease, and death, the data only represent the submitted and approved claims, thereby underestimating the true degree and character of these issues. Furthermore, self-employed workers, employees of small businesses, military personnel, and other people who are not covered by provincial workers' compensation boards are not represented in claims data (Del Bianco and Demers 2013).

The Québec *Public Health Act* makes it mandatory to report certain types of chemical exposures: notifiable diseases of chemical origin (Government of Québec 2013). Other *Public Health Act* regulations list those notifiable diseases and provide criteria for including a notifiable disease of chemical origin (Government of Québec 2014a, 2014b). Nine diseases are defined and must be reported by physicians. Also, physicians must report heart, gastrointestinal, hematopoietic, renal, pulmonary, or neurological disorders caused by 12 families of contaminants. Laboratories must report the results of biological indicator measurements for 8 families of contaminants if they exceed recognized public health thresholds. A provincial recording, health surveillance, and monitoring system for notifiable diseases attributable to a chemical or physical agent is used to collect data relating to notifiable diseases of chemical origin. Access to the data and surveillance products is reserved for people who have received permission from their regional public health director (INSPQ 2014).

The Canadian Partnership for Tomorrow Project (CPTP) is Canada's largest group of volunteer research participants (population cohort), built to address key questions about what causes cancer and chronic disease. This program is different than the cross-sectional national biomonitoring survey collected as part of the CHMS in that it collects longitudinal data on participants. More than 330,000 Canadians aged 30–74 years have joined CPTP from 6 regional cohorts—the BC Generations Project, Alberta's Tomorrow Project, Manitoba Tomorrow Project, Ontario Health Study, CARTaGENE, and Atlantic PATH. Each participant completed a baseline questionnaire that included information on socio-demographic characteristics (including occupation), personal and family history of disease, medication use, lifestyle and health behaviours, environmental exposures, physical measures, and several other details about themselves. Questions about occupational history, type of job, and location of employment could help to further examine occupational exposures. The aim is to help researchers better understand what aspects of a person's life history may increase

the risk of developing a disease. Large subsets of participants have provided biological samples, which include venous blood samples (approximately 150,000), urine samples (approximately 101,000), and saliva samples (approximately 19,000); physical measurements were also collected (Dummer et al. 2018). The CPTP presents a unique opportunity to provide data linking exposure to health outcomes by following the same individuals over time. The cohort design could allow for targeted specific exposure scenarios, and consequently, the selection or exclusion of participants on the basis of their potential for low or high exposures to environmental chemicals. In addition, it could be possible to target a subpopulation with specific health outcomes to examine their exposure profile. This platform could also provide nimbleness to react to changes in priorities for risk assessment and risk management, as the biobank could be accessed for the rapid analysis of samples to provide a picture of exposure to that chemical.

4.2 Priorities that have been identified to date

Through consultations with stakeholders on the proposed integrated strategy for the protection of workers and the public comment period on the consultation document, a number of potential priorities have been raised. These priorities identified range from specific substances to sectors. The CMP Science Committee is asked to deliberate on the following charge question:

Charge Question 2b: What guiding principles or factors could help prioritize substances or sectors that have been identified to date? If sectors are identified as priorities, what considerations are important for prioritizing the chemicals for further work within those sectors?

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Appendix 1. List of charge questions

Charge Question 1: Considering what was presented at the international government science forum at the pre-meeting webinars, what are the key scientific lessons learned from international agencies? What considerations does the CMP Science Committee recommend as HC explores ways to contribute to the protection of workers from exposure to chemicals in Canada?

Charge Question 2a: Given the summary of types of data and sources identified below that could inform a risk-based prioritization exercise like IRAP, is anything missing? Comment on the importance and relevance of the various types of data and sources (for example, relevance of total quantities used in workplaces across Canada, number of workers, work tasks; relevance of changes to/new hazard classifications).

Charge Question 2b: What guiding principles or factors could help prioritize substances or sectors that have been identified to date? If sectors are identified as priorities, what considerations are important for prioritizing the chemicals for further work within those sectors?

Appendix 2. Key reading material

CMP background information

Government of Canada. 2014. Approach for identification of chemicals and polymers as risk assessment priorities under Part 5 of the Canadian Environmental Protection Act, 1999 (CEPA 1999).

Government of Canada. 2019. Consulting on an integrated strategy for the protection of Canadian workers from exposure to chemicals.

Canadian occupational disease and exposure data

Demers P., DeBono N., Arrandale V., et al. 2019. Options for tracking occupational disease and exposure in Ontario. [PDF]

Appendix 3. Summary of non-cancer occupational risks identified in international risk assessments

Risk assessment	Effects of concern	Exposure of concern	Risks identified	Reference
Final risk assessment for N-methylpyrrolidone (NMP): paint stripper use	Adverse developmental toxicity; the most sensitive health effects selected for use in the risk assessment affect the fetus	In paint-stripping use scenarios, the predominant route of exposure for NMP were expected to be dermal, including absorption of vapour-through-skin	The use of higher concentration products may result in risks. Specifically: From acute exposures of: ▪ 4 hours per day, when gloves were not used ▪ greater than 4 hours per day, and risks were not mitigated by PPE such as respirators or gloves From chronic (repeated) exposures of: ▪ 4 hours per day, when gloves were not used ▪ greater than 4 hours per day, and risks were not mitigated by PPE such as respirators or gloves	U.S. EPA 2015
Final risk assessment for methylene chloride (DCM): paint stripping use[a]	Neurological and hepatic effects	In paint-stripping uses, the main route of exposure for DCM was believed to be inhalation. While DCM may also be absorbed through the skin, the EPA did not have the data or methodology to	There are non-cancer risks associated with chronic exposure for liver effects for most workers (including bystanders) using DCM-based paint strippers in relevant industries. Non-cancer risks are not reported when workers reduce their exposure to DCM-based strippers by taking **all 3** of the following actions: 1. wearing respiratory protection (that is, respirator with at least an assigned protection factor of 50) 2. limiting exposure to central tendency exposure conditions (that is, 125 days/year for 20 years)	U.S. EPA 2014

		estimate dermal exposure	3. working in facilities with low-end DCM air concentrations There are acute risks for neurological effects for most workers using DCM-based paint strippers. These risks are present in the presence or absence of respiratory protection.	
REACH Annex XV Restriction Report for Bisphenol A in thermal paper	Effects used to assess the adverse risks for pregnant women and the unborn child include effects on the female reproductive system, brain development and the developing mammary gland, and metabolism and obesity	In handling of thermal receipts; exposure via the dermal route	According to the results of the exposure calculations based on a probabilistic approach, the handling of thermal receipts leads to risk situations for the four types of effects considered, both for pregnant women working as cashiers and tellers as well as for pregnant woman consumers handling thermal receipts.	ANSES 2014

[a] There are also cancer risk concerns for workers and occupational bystanders exposed to DCM that are employed at various industries handling DCM-containing paint strippers; however, these are not characterized in this table as the focus is on non-cancer effects.

Appendix 4. Extract of the information gathering provisions under section 71, part 5 of the *Canadian Environmental Protection Act, 1999* (CEPA 1999)

The following is an extract of the information gathering provisions under section 71, part 5 of CEPA 1999

71. (1) The Minister may, for the purpose of assessing whether a substance is toxic or is capable of becoming toxic, or for the purpose of assessing whether to control, or the manner in which to control, a substance, including a substance specified on the List of Toxic Substances in Schedule 1,

> (a) publish in the *Canada Gazette* and in any other manner that the Minister considers appropriate a notice requiring any person who is described in the notice and who is or was within the period specified in the notice engaged in any activity involving the substance to notify the Minister that the person is or was during that period engaged in that activity;
>
> (b) publish in the *Canada Gazette* and in any other manner that the Minister considers appropriate a notice requiring any person who is described in the notice to provide the Minister with any information and samples referred to in subsection (2) that may be in the person's possession or to which the person may reasonably be expected to have access; and
>
> (c) subject to section 72, send a written notice to any person who is described in the notice and who is or was within the period specified in the notice engaged in any activity involving the importation or manufacturing of the substance or any product containing the substance requiring the person to conduct toxicological and other tests that the Minister may specify in the notice and submit the results of the tests to the Minister.

(2) A notice sent under paragraph (1)(b) may require any information and samples, including

> (a) in respect of a substance, available toxicological information, available monitoring information, samples of the substance and information on the quantities, composition, uses and distribution of the substance and products containing the substance; and

(b) in respect of a work, undertaking or activity, plans, specifications, studies and information on procedures.

Appendix 5. Example of questions included in the 2017 inventory update

The following is an example of questions included in the 2017 inventory update

5. For each substance listed in Schedule 1 that a person manufactured, or imported alone, in a mixture, in a product or in a manufactured item, during either the 2014 or 2015 calendar year, for which the criteria set out in Schedule 2 have been met, the person shall provide the following information:

(a) the CAS RN or the Confidential Accession Number of the substance; and

(b) whether the person manufactured a quantity greater than 100 kg of the substance, or imported a quantity greater than 100 kg of the substance whether alone, or in a mixture, a product, or a manufactured item at a concentration equal to or above 0.1% by weight (w/w%), during each of the 2012, 2013, 2014, and 2015 calendar years, by indicating “yes” or “no.”

6. For each of the person’s facilities where substances listed in Part 1, 2 or 3 of Schedule 1 were manufactured, or to which they were imported alone, in a mixture or in a product, for activities other than distribution and warehousing during the calendar year for which the person is responding to this notice, the person to whom this notice applies shall provide

(a) the name and address;

(b) the CAS RN or the Confidential Accession Number of the substance; and

(c) each applicable six-digit North American Industry Classification System (NAICS) code.

7. For each substance listed in Schedule 1 that a person manufactured, or imported alone, in a mixture or in a product, during the calendar year for which the person is responding to this notice, for which the criteria set out in Schedule 2 have been met, the person shall provide the following information:

(a) the CAS RN or the Confidential Accession Number of the substance; and

(b) the total quantity of the substance that the person manufactured, imported and exported, reported in kilograms (rounded to two significant digits).

8. (1) For each substance listed in Schedule 1 that a person manufactured, or imported alone, in a mixture or in a product, during the calendar year for which the person is responding to this notice, for which the criteria set out in Schedule 2 have been met, the person shall provide the following information:

(a) the CAS RN or the Confidential Accession Number of the substance;

(b) the Substance Function Code(s) set out in section 11 that apply to the substance;

(c) for each Substance Function Code provided, the Consumer and Commercial Code(s) set out in section 12 that describe the known or anticipated final goods containing the substance;

(d) for each Consumer and Commercial Code provided, the quantity of the substance, reported in kilograms (rounded to two significant digits);

(e) for each Consumer and Commercial Code provided, whether any known or anticipated final goods containing the substance are intended for use in commercial activities, by indicating “yes” or “no”;

(f) for each Consumer and Commercial Code provided, whether any known or anticipated final goods containing the substance are intended for use in consumer activities, by indicating “yes” or “no”; and

(g) for each Consumer and Commercial Code provided, whether any known or anticipated final goods containing the substance are intended for use by or for children 14 years of age or younger, by indicating “yes” or “no.”

8. (2) Where code U999 is provided for paragraph (1)(b), a written description of the substance function must be provided.

8. (3) Where code C105 (Cleaning and furnishing care), C108 (personal care and cosmetic) or C999 (Other) is provided for paragraph (1)(c), a written description of the known or anticipated final goods containing the substance must be provided.

9. (1) For each substance listed in Part 2 of Schedule 1 that a person manufactured, or imported alone, in a mixture or in a product, during the calendar year for which the person is responding to this notice, for which the criteria set out in Schedule 2 have been met, the person shall provide the following information:

(a) the CAS RN;

(b) the name, city and province of the 10 persons in Canada to whom the largest quantity of the substance above 100 kg was sold; and

(c) the total quantity of the substance sold to each person, reported in kilograms (rounded to two significant digits).

10. (1) For each substance listed in Part 3 or Part 4 of Schedule 1 that a person imported in a manufactured item during the calendar year for which the person is responding to this notice, for which the criteria set out in Schedule 2 have been met, the person shall provide the following information:

a) the CAS RN;

b) for a substance in Part 3, each applicable category of manufactured items listed in subparagraphs 3(c)(i) to (x) of Schedule 2;

c) or a substance in Part 4, whether it is, is contained in, or is intended to be a component in a cosmetic, food, therapeutic product or natural health product subject to the *Food and Drugs Act*;

d) the Consumer and Commercial Code(s) set out in section 12 that describe the manufactured item containing the substance;

e) for each Consumer and Commercial Code provided, whether the manufactured item containing the substance is intended for use in commercial activities, by indicating "yes" or "no";

f) for each Consumer and Commercial Code provided, whether the manufactured item containing the substance is intended for use in consumer activities, by indicating "yes" or "no"; and

g) for each Consumer and Commercial Code provided, whether the manufactured item containing the substance is intended for use by or for children 14 years of age or younger, by indicating "yes" or "no."

10. (2) Where code C105 (Cleaning and furnishing care), C108 (personal care and cosmetic) or C999 (Other) is provided for paragraph (1)(c), a written description of the manufactured item containing the substance must be provided.