

Priority Environmental Carcinogens for Surveillance in Canada: Preliminary Priority List

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Table of Contents

| | |
|---|----|
| Executive Summary..... | 1 |
| Introduction..... | 3 |
| Methods | 4 |
| Results..... | 8 |
| Discussion | 10 |
| Acknowledgements | 10 |
| Figure 1: General schematic of the prioritization process | 5 |
| Figure 2: Results of the preliminary prioritization process | 9 |
| Table 1: Substances excluded from the preliminary prioritization | 11 |
| Table 2: Surveillance priority groups for the environmental carcinogens | 12 |
| Table 3: Group D: Carcinogens not prioritized..... | 13 |
| Appendix A: IARC Carcinogens and Suspected Carcinogens | 14 |
| Appendix B: Detailed Description of Resources Consulted | 23 |
| Appendix C: Summary Table of Key Information Used in Prioritization Process..... | 27 |
| ♣ Industrial chemicals..... | 27 |
| ♣ Metals | 38 |
| ♣ Pesticides | 41 |
| ♣ Fibres & Dusts..... | 44 |
| ♣ Radiation..... | 45 |
| ♣ Others | 45 |
| Appendix D: Environmental Carcinogens needing further investigation (Group C) | 47 |

Executive Summary

What is the purpose of this report?

The main objectives of CAREX Canada are to identify the number of Canadians exposed to environmental carcinogens, to determine at what levels potential exposure may occur, and to ascertain the extent of any geographic variations. This is an enormous task. Many of the substances in the International Agency for Research on Cancer's (IARC's) classifications are either principally environmental or the highest levels of exposure occur under these circumstances. In order to organize this task, a prioritization process is necessary.

How did we prioritize the carcinogens?

The prioritization exercise was undertaken in four steps:

1. Carcinogens were first broadly categorized according to their potential for human exposure *in the environment*. If exposure were unlikely to occur in the environment, substances were excluded from further consideration. The remaining substances were selected for critical review.
2. For substances selected for critical review, CAREX Canada staff collected key information on characteristics and overall toxicity, potential exposure circumstances, and evidence for exposure in the Canadian environment.
3. Tables summarizing key information for each substance were then generated. Each substance was considered in light of three criteria:
 - i. carcinogenicity and other toxic properties
 - ii. prevalence of exposure in Canada, and
 - iii. feasibility of assessing exposure
4. On the basis of these criteria, substances were then placed into one of four groups:
 - A. Immediate high priority substances
 - B. Possible high priority substances
 - C. Moderate priority - further substantial investigation warranted
 - D. Low priority - no evidence of use in Canada

Some examples of the types of data sources consulted are the U.S. National Toxicology Program (NTP) Report on Carcinogens, the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles, Health Canada's categorization of the Domestic Substances List, and the Canadian Environmental Protection Act (CEPA) priority substances lists and risk assessment information. Many other specialized searches targeted at assessing the potential for use and exposure in Canada were also undertaken for each reviewed substance.

What did we find?

A total of 417 IARC known or suspected carcinogens were initially considered for inclusion. After the relevant exclusions, a total of 198 substances remained for critical review. Of the 198 substances chosen for critical review, 25 were IARC Group 1 carcinogens, 33 were IARC Group 2A carcinogens, 135 were IARC Group 2B carcinogens, and 5 were mixed categories of carcinogens. When grouped on the bases of use, the 198 substances fell into the following categories: industrial chemicals (141), pesticides (27), metals (13), fibres and dusts (8), radiation (3), and others (6).

After prioritization, 30 substances were placed in Group A (Immediate high priority), 54 in Group B, 29 in Group C, and 85 in Group D.

What are the next steps?

First, we will send out the results of this prioritization to previously identified experts to ensure transparency of the process as well as to obtain advice on current Canadian usage for substances where information was lacking. At this stage, the priorities we have set are open to adjustment, and we will consider adding or removing substances based on new information or expert advice.

The majority of our work over the next year will focus on the Group A high priority substances and mixtures. We have begun to establish contact with relevant experts and organizations that may hold environmental exposure data that would be pertinent for CAREX Canada's environmental exposure database. For the other priority groups, we will collect more information on current usage in Canada from experts in various industries and academic specialties. Group B includes many substances that are used in Canada, but for which robust estimates of exposure may be difficult to develop. Group C substances require further substantial research into current use in Canada. For many of these substances, we found evidence of use in industries that exist in Canada, but no specific reference to the particular chemical. Group D includes substances that are not expected to be used in Canada (and also not persistent), and therefore unlikely to be found in the Canadian environment. Our intent is to move substances from Groups B and C either up or down in priority (i.e. into high priority or low priority categories) based on advice gathered during expert review of the prioritization.

This prioritization gives us an important starting point to begin accessing environmental exposure data in the Canadian context. Our ultimate goals are to produce robust estimates of the number of Canadians exposed to carcinogens in the environment, determine at what levels exposure occurs, and if exposure levels vary geographically or within population sub-groups. These exposure surveillance results will be important for many purposes, including targeting population groups at high risk of developing cancer for preventative interventions, and identifying research priorities, knowledge gaps and future needs for carcinogen surveillance in Canada.

Introduction

The identification and classification of carcinogens plays a key role in cancer prevention, from labeling to prohibition of exposure. Canada does not have an independent program for classifying substances as to their carcinogenicity. Instead, it relies on agencies outside of Canada, most commonly the International Agency for Research on Cancer (IARC). IARC is a specialized United Nations agency attached to the World Health Organization which is funded directly by the industrialized countries, including Canada. Its program to evaluate carcinogens was initiated in 1971 and uses expert groups to classify potential carcinogens or exposure circumstances¹ into five categories:

| | |
|----------|--|
| Group 1 | Carcinogenic to Humans |
| Group 2A | Probably Carcinogenic to Humans |
| Group 2B | Possibly Carcinogenic to Humans |
| Group 3 | Not classifiable as to its Carcinogenicity to Humans |
| Group 4 | Probably Not Carcinogenic to Humans |

Group 1 includes substances with either strong epidemiologic evidence or extremely strong experimental evidence. At the time this report was prepared there were 102 Group 1 carcinogens². Group 2A primarily consists of substances with good experimental evidence and limited or inconsistent epidemiologic evidence. There are currently 69 Group 2A carcinogens³. Group 2B primarily consists of animal carcinogens with little human evidence of carcinogenicity. There are currently 246 Group 2B carcinogens⁴. A complete list of all IARC Group 1, 2A, and 2B carcinogens see Appendix A. Group 3 is considered the neutral category in IARC evaluations. It currently consists of 516 substances or exposure circumstances for which there was inadequate data to classify as either an animal or human carcinogen. Group 4 has only been used once (for caprolactam) because there must be clear evidence of a negative association (lack of information is not acceptable and would lead to a classification of Group 3) and only substances with some evidence of carcinogenicity are nominated for IARC evaluation.

The main objectives of CAREX Canada (CARcinogen EXposure) are to identify the number of Canadians exposed to environmental carcinogens, to determine at what levels potential exposure may occur, and to ascertain the extent of any geographic variations. This is an enormous task. Roughly half of the substances in IARC Groups 1, 2A, and 2B are principally environmental (or the highest levels of exposure occur under these circumstances), in terms of the number of people exposed, and a small number are almost exclusively environmental. In order to organize this task a prioritization process is necessary. This paper presents the preliminary results of a prioritization exercise carried out by CAREX Canada staff to identify known and suspected carcinogens for immediate surveillance efforts, as well as others that may

¹ Exposure circumstances are reviewed by IARC when excesses among well-defined populations have been observed, but the potential carcinogen has not been identified. Such an evaluation usually prompts further research and subsequent evaluations generally focus on specific substances

² Includes many well known occupational carcinogens, such as asbestos, radon, and environmental tobacco smoke.

³ Includes substances such as tetrachloroethylene, diesel engine exhaust, and specific forms of UV radiation.

⁴ Includes substances such as DDT, styrene, and refractory ceramic fibres, an asbestos substitute.

be added in the future. In this report we describe the methods that were used to prioritize the substances and the data sources that were consulted.

Methods

The prioritization exercise was undertaken in four steps:

1. Carcinogens were first broadly categorized according to their potential for human exposure *in the environment*. If exposure were unlikely to occur in the environment, substances were excluded from further consideration. The remaining substances were selected for critical review.
2. For substances selected for critical review, CAREX CANADA staff collected key information on characteristics and overall toxicity, potential exposure circumstances⁵, and evidence for exposure in the Canadian environment.
3. Tables summarizing key information for each substance were then generated. Each substance was considered in light of three criteria:
 - a. carcinogenicity and other toxic properties
 - b. prevalence of exposure in Canada, and
 - c. feasibility of assessing exposure
4. On the basis of these three criteria, substances were then placed into one of four groups:
 - a. Immediate high priority substances
 - b. Possible high priority substances
 - c. Moderate priority - further substantial investigation warranted
 - d. Low priority - no evidence of use in Canada

The general prioritization process is illustrated schematically in Figure 1.

Initial Categorization of Carcinogens and Exclusions

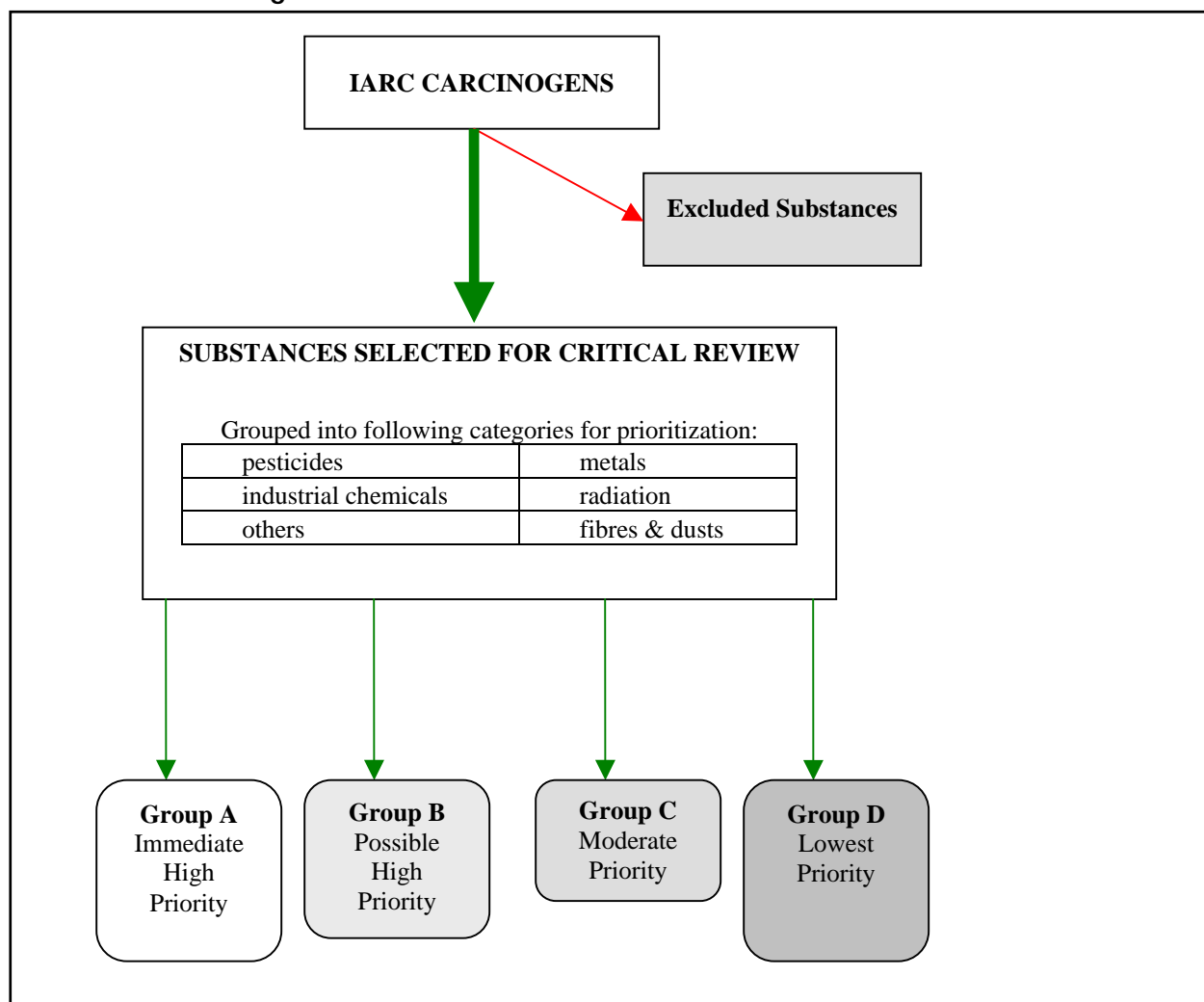
A review of the IARC monographs was undertaken and substances were first placed into broad categories based on their potential for human exposure. The following substances or exposure circumstances were excluded because exposures were either primarily non-environmental, primarily medicinal, or not easily regulated. Although environmental exposures to some of these substances may occur, exposure would predominantly occur in another realm and presumably surveillance and prevention efforts would focus there:

- Naturally occurring dietary exposures (i.e. not contamination)
- Microbiological agents
- Hormones
- Pharmacologic agents
- Exposure circumstances⁶

⁵ Environmental exposure refers to human contact with carcinogens via the air, water, soil, dusts, food, and consumer products.

⁶ These are workplace exposures among well-defined populations where excess cancers have been observed, but the potential carcinogen had not yet been identified. Not of environmental concern.

Figure 1: General Schematic of the Prioritization Process



IARC monographs may address either individual substances or general groups of substances. Therefore, some adjustments have been made to the original IARC lists for the purposes of preliminary prioritization. In some cases, substances reviewed individually by IARC have been grouped for prioritization; while in others, substances considered as a group by IARC have been treated as individual substances for prioritization. The polycyclic aromatic hydrocarbons (PAH) are an example of individual IARC substances that we considered as a group for prioritization. While it is possible in a laboratory setting to examine the carcinogenicity of a singular PAH, in reality humans are exposed to a complex mixture and estimating exposure for any one compound would be impossible and not useful for prevention purposes. Some PAHs have been evaluated separately though (i.e. coal-tars, naphthalene) because they have commercial applications as well as being combustion products. The chlorophenoxy herbicides are an example of an IARC group that we broke down into individual substances for the purposes of prioritization. IARC grouped 6 pesticides (2,4-D, 2,4-DP, 2,4,5-T, MCPA, MCPP, and Silvex), into one monograph because they are chemically similar, but the pesticides vary widely in their

usage (from being banned to being one of the most commonly used in Canada). It therefore makes more sense to examine each one individually.

For the purposes of this prioritization we also included particulate air pollution, although it does not appear on the IARC lists. We have also included chlorination byproducts as an exposure of interest (chlorinated water has been classified as a Group 3 carcinogen).

Data used for Prioritization

For preliminary prioritization, we collected information on the characteristics and overall toxicity of the substance, potential exposure circumstances, and evidence for exposure in Canadian communities. To aid in data collection, synonyms and Chemical Abstract (CAS) numbers were identified when appropriate.

Toxicity information was primarily abstracted from the large systematic reviews conducted by IARC, the U.S. National Toxicology Program (NTP) Report on Carcinogens, and the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles. In addition, Health Canada's Domestic Substances List and the Canadian Environmental Protection Act (CEPA) priority lists and supporting documents were also consulted to assess federal priorities, as well as previous efforts to assess exposure among Canadians.

The large systematic reviews conducted by IARC, NTP, and ATSDR were also reviewed to identify potential environmental exposure circumstances. We define exposure circumstances as settings or activities where human exposure may occur. For environmental exposures these are typically associated pathways to exposure through contaminated air, water, soil, food, or consumer products. These exposure circumstances may have been identified in Canada or in another country, most typically the United States, where current and historical use or production would be similar to Canada.

For the selected substances, a number of search strategies were employed to gather information regarding specific use and evidence for exposure in Canadian communities. Examples of our search strategies are set out below.

- Whenever possible, production (or mining in the case of metals or minerals), sales, import, or export were documented using government sources.
- The material safety data sheet database maintained by the Canadian Centre for Occupational Health and Safety was searched to identify commercial products. The U.S. Household Products database was consulted (on the assumption that consumer products are similar in Canada).
- The database of allowed pesticides maintained by the Canadian Pesticide Management Regulatory Agency was also searched. The National Pollution Release Inventory was also searched.

The goal was to cast a broad net in collecting information for each chemical, and then to produce simplified tables with the most important information sources included.

Additional details regarding the resources used can be found in Appendix B. During the information gathering process, a Wiki with a structured page was created for each carcinogen or suspected carcinogen under review. This allowed multiple researchers to post information in a place accessible to all regarding environmental (as well as occupational) exposures identified

and notes for future searches. To aid in the review, some of this data has been summarized on to one to two page “fact sheets” for each substance.

Preliminary Prioritization

Tables were then created in which some of the key information for each substance was summarized under the following subheadings: ‘Carcinogenicity and Toxicity’, ‘Potential exposure circumstances’, and ‘Evidence of use/exposure in Canada’. A summary table of key information used in the prioritization process (by category and in alphabetical order) is included as Appendix C.

For the prioritization, three criteria were considered:

1. The carcinogenicity and other toxic properties of the substance
2. Prevalence of exposure in Canada
3. Feasibility of assessing exposure

These three criteria were used to place each substance into one of four groups: Immediate high priority, possible high priority, moderate priority and low priority.

Group A - Immediate High Priority

This group consists of substances that ranked high based on all three criteria. It consists primarily of IARC 1 or 2A carcinogens or groups that would logically fall there⁷. Also included in this group are 2B Carcinogens with other, well-established toxic effects, as well as common pesticides. All substances in this group have clear evidence for common exposure in the Canadian environment. Substances in this category are all considered feasible for assessment at the provincial level and potentially at a finer level within provinces. For most there is a substantial amount of measurement data available or exposure is known to occur among well-defined groups that are identifiable using Census data or other sources. For some substances, feasibility may be limited to one or more, but not necessarily all, pathways.

Group B - Possible High Priority

This group consists of substances that are in need of further assessment regarding the prevalence of exposure in Canada or the feasibility of assessment. Although exposure to these substances is known to occur in Canada, it was either difficult to assess whether these exposures are common or unclear whether it would be feasible to assess exposure. This group also includes some substances that are no longer used in Canada; however, these substances are still under consideration because there is at least some evidence of or reason to expect exposure may occur due to environmental persistence (i.e DDT). Many IARC 2B substances are considered in this category.

Group C - Moderate Priority

This group consists of substances that are in need of substantial further investigation. Many may be used in industries that are known to exist in Canada, but specific reference to their use was not found.

⁷ For example, Polycyclic Aromatic Hydrocarbons (PAHs).

Group D - Lowest Priority

This group consists of substances that are not currently under consideration by the project because we can find no evidence for current use in Canada and they are not persistent in the environment. It includes some substances that are banned or heavily restricted in use and others that may be very rare or impossible to meaningfully assess exposures.

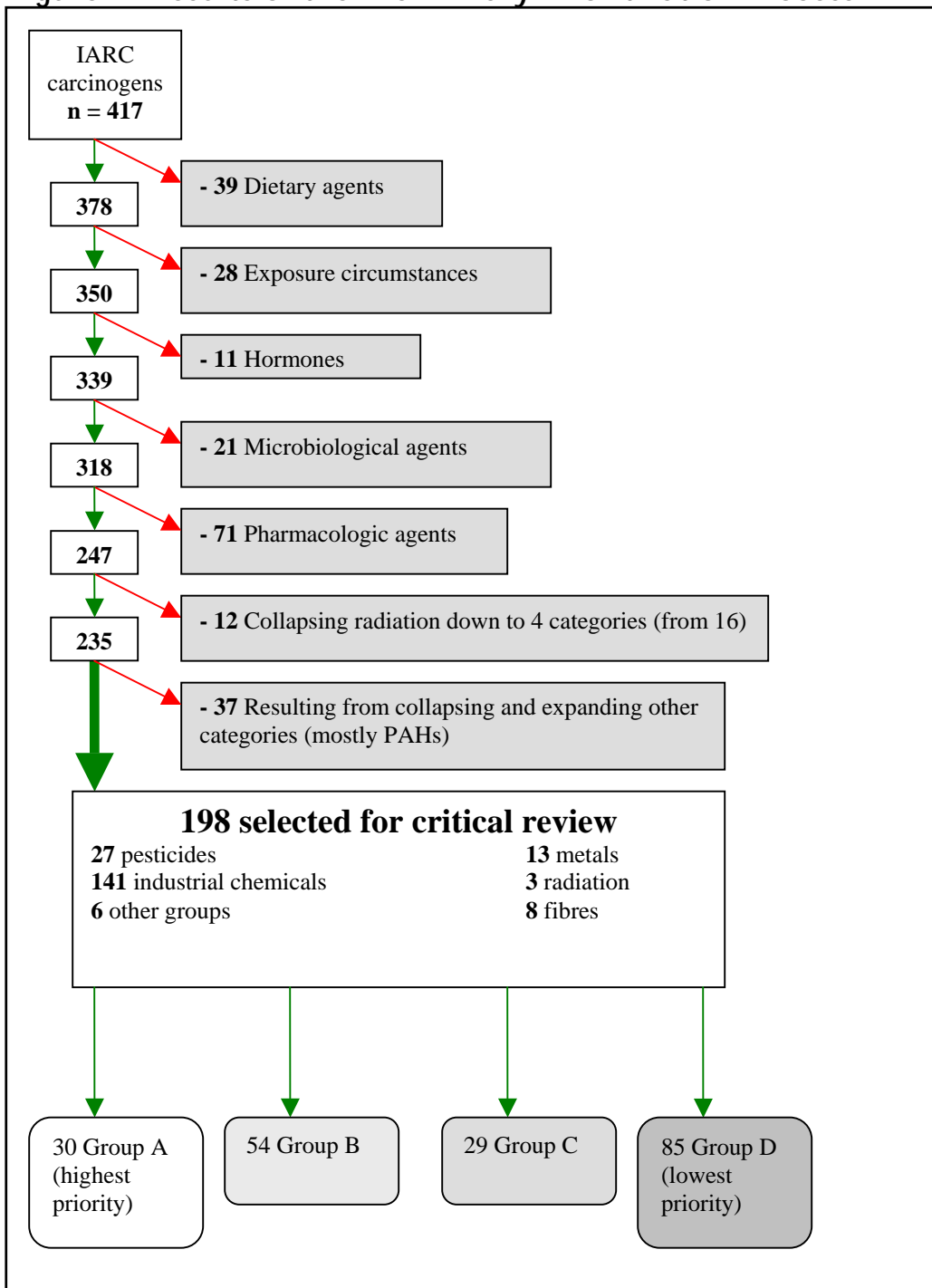
Results

Figure 2 shows a schematic of the overall prioritization process. As shown, a total of 417 IARC known or suspected carcinogens were initially considered for inclusion. After the relevant exclusions, a total of 198 remained for critical review. Excluded substances are listed in Table 1 and are grouped into the following categories: dietary agents, exposure circumstances, hormones, microbiological agents and pharmaceuticals.

Of the 198 substances chosen for critical review, 25 were IARC Group 1 carcinogens, 33 were IARC Group 2A carcinogens, 135 were IARC Group 2B, and 5 were mixed categories of carcinogens. When grouped on the bases of use, the 198 substances fell into the following categories: industrial chemicals (141), pesticides (27), metals (13), fibres and dusts (8), radiation (3), and others (6). Figure 2 shows a schematic of how substances were excluded and eventually categorized. Tables with summary information on each of the carcinogens and suspected carcinogens considered are presented in Appendix C (for Group A and B) and Appendix D (for Group C).

In general, each chemical was considered on a case-by-case basis for inclusion in priority groups. However, despite the fact there are still feasibility issues to address, some common pesticides were moved into Group A. After prioritization, 30 substances were placed in Group A, 54 in Group B, 29 in Group C, and 85 in Group D. Table 2 lists all substances falling into Groups A, B, and C, while Table 3 lists all those falling into Group D.

Figure 2: Results of the Preliminary Prioritization Process



Discussion

This paper presents a preliminary prioritization of known and suspected carcinogens. Substances falling into Group A will dominate the work of the group for the next year. For substances falling into Groups B, C, and D, efforts will continue to identify evidence for exposure in Canada, as well as to locate data that could be used to assess the number of Canadians exposed and their level of exposure. During the next year, input will also be sought from experts in environmental exposure across Canada to further refine this preliminary prioritization. Based on external input and additional data collected, a final prioritization will be produced in December 2008.

Because this project was initiated due to concerns regarding cancer prevention, the identification of potential sources of data focused on current exposure. Although historical exposures that are persistent in the environment were also considered, these substances were placed in the medium category. However, all available exposure data, including historical, will be collected or identified as part of this project and will be made available for disease surveillance, research, and other purposes.

It is important to recognize the limitations of the IARC evaluations in regards to environmental carcinogens. Monographs are only updated periodically and the current evidence may be stronger or weaker than the original evaluation. This is particularly important for rapidly developing areas, such as environmental cancer epidemiology.

The major limitation of this prioritization exercise is the lack of consistent evaluation data for all substances considered. As a result, it was not possible to use simple, objective criteria to identify priorities. While the review identified some substances that were clearly of high priority and others that were clearly of low priority, many will require further investigation over the next year. Outside input will also be essential to refine this prioritization.

Acknowledgements

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Table 1: Substances excluded from the preliminary prioritization

| Dietary agents (n=39) | Exposure circumstances (n=28) | Hormones (n=11) | Pharmaceuticals (n=71) | |
|--|---|---|--|---|
| 3-(<i>N</i> -Nitrosomethylamino)propionitrile A-alpha-C AF-2 Alcoholic beverages Areca nut Betel quid with tobacco Betel quid without tobacco Azaserine Bracken fern Butylated hydroxyanisole (BHA) Caffeic acid Cycasin Daunomycin Dihydrosafrole Ethanol in alcoholic beverages Glu-P-1 Glu-P-2 Hot mate IQ Iron-dextran complex Lasiocarpine MeA-alpha-C MeIQ MeIQx Methylazoxymethanol acetate Mitomycin C Monocrotaline Nitrate or nitrite (ingested) NNN & NNK PhIP Safrole Salted fish (Chinese-style) Sterigmatocystin Trp-P-1 Trp-P-2 Carrageenan, degraded Coffee Pickled vegetables Tobacco, smokeless | Carpentry and joinery Cobalt Metals without tungsten carbide Dry cleaning (occupational exposures) Firefighter (occupational exposures) Printing processes (occupational exposures) Textile manufacturing industry (work in) Aluminium production Auramine, manufacture of Boot and shoe manufacture and repair Chimney sweeping Coal gasification Coal-tar distillation Coke production Furniture and cabinet making Haematite mining (underground) with exposure to radon Iron and steel founding Isopropyl alcohol manufacture Magenta, manufacture of Painter (occupational exposure as a) Paving and roofing with coal-tar pitch Rubber industry Strong-inorganic-acid mists containing sulfuric acid Art glass, glass containers and pressed ware (manufacture of) Carbon electrode manufacture Hairdresser or barber (occupational exposure as a) Petroleum refining (occupational exposures in) Shiftwork that involves circadian disruption Sunlamps and sunbeds (use of) | Androgenic (anabolic) steroids Diethylstilboestrol Estrogen-progestogen menopausal therapy (combined) Estrogen-progestogen oral contraceptives (combined) Estrogens, nonsteroidal Estrogens, steroidal Estrogen therapy, postmenopausal Medroxyprogesterone acetate Oral contraceptives, sequential Progestins Progestogen-only contraceptives Microbiological agents (n=21) Aflatoxin M1 Aflatoxins (naturally occurring mixtures of) <i>Clonorchis sinensis</i> Epstein-Barr virus Fumonisin B1 <i>Helicobacter pylori</i> Hepatitis B virus Hepatitis C virus HIV type 1 (infection with) HIV type 2 (infection with) HPV (several types) HPV types 6 and 11 HPV genus beta (some types) Human T-cell lymphotropic virus type I Kaposi's sarcoma herpesvirus/human herpesvirus 8 Microcystin-LR Ochratoxin A Opisthorchis viverrini <i>Schistosoma haematobium</i> Schistosoma japonicum infection Toxins derived from Fusarium moniliforme | 1,4-Butanediol dimethanesulfonate 2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole 5-Methoxypsoralen 8-Methoxypsoralen (Methoxsalen) plus ultraviolet A radiation Adriamycin Amsacrine Aristolochic acids Azacitidine Azathioprine Bischloroethyl nitrosourea (BCNU) Bleomycins CCNU Chlorambucil Chloramphenicol Chlorozotocin Ciclosporin Cisplatin Cyclophosphamide Dacarbazine Dantron (Chryszazin; 1,8-Dihydroxyanthraquinone) trans-2-[(Dimethylamino)methylimino]-5-[2-(5-nitro-2-furyl)-vinyl]-1,3,4-oxadiazole Ethyl methanesulfonate Etoposide 2-(2-Formylhydrazino)-4-(5-nitro-2-furyl)thiazole Griseofulvin Herbal remedies containing plant species of the genus Aristolochia 1-Hydroxyanthraquinone Melphalan Merphalan 2-Methylaziridine (Propyleneimine) Methyl-CCNU Methylthiouracil Metronidazole Mitoxantrone MNNG | MOPP and other combined chemotherapy 5-(Morpholinomethyl)-3-[(5-nitrofurfurylidene)amino]-2-oxazolidinone Mustard gas Nafenopin Niridazole Nitrogen mustard 1-[(5-Nitrofurfurylidene)amino]-2-imidazolidinone N-[4-(5-Nitro-2-furyl)-2-thiazolyl]acetamide N,N-Bis(2-chloroethyl)-2-naphthylamine (Chlornaphazine) Nitrogen mustard N-oxide Oxazepam Panfuran S (containing dihydroxymethylfuratrizine) Phenacetin, analgesic mixtures containing Phenacetin Phenazopyridine hydrochloride Phenobarbital Phenolphthalein Phenoxybenzamine hydrochloride Phenytoin Procarbazine hydrochloride Propylthiouracil Riddelliine Streptozotocin Surgical implants and other foreign bodies Tamoxifen Thioacetamide Thiotepa Thiouracil Thorium-232 and its decay products, administered intravenously Treosulfan Trichlormethine (Trimustine hydrochloride) Uracil mustard Zalcitabine Zidovudine (AZT) Talc-based body powder (perineal use of) Teniposide |

Table 2: Surveillance Priority Groups for Environmental Carcinogens

| Results of the Prioritization | | |
|--|---|---|
| Group A (n=30) | Group B (n=54) | Group C (Further investigation needed) (n=29) |
| <p>Industrial Chemicals 1,3-Butadiene 2,3,7,8-Tetrachlorodibenzo-p-dioxin Acetaldehyde Benzene Chloroform Dichloromethane Ethylbenzene Ethylene oxide Formaldehyde Polychlorinated biphenyls Styrene Tetrachloroethylene</p> <p>Metals Arsenic & its compounds Cadmium & its compounds Chromium, hexavalent Lead & its compounds Nickel & its compounds</p> <p>Pesticides 2,4-D Chlorothalonil Dichlorvos Lindane MCPA MCPP Pentachlorophenol</p> <p>Fibres & Dusts Asbestos</p> <p>Radiation Magnetic fields (extremely low frequency) Radon & its decay products</p> <p>Others Chlorination byproducts (MX, bromodichloromethane, etc.) Polycyclic Aromatic Hydrocarbons (considered as a group, including soot, benzo(a)pyrene, etc.) Particulate air pollution</p> | <p>Industrial Chemicals 1,2-Dichloroethane 1,2-Epoxybutane 1,4-Dioxane 2,6-Dimethylaniline 3,3'-Dimethylbenzidine 4,4'-Methylene bis(2-chloroaniline) (MOCA) Acrylamide Acrylonitrile Benzyl chloride Bitumens Carbon black Carbon tetrachloride Catechol Chlorinated paraffins Coal-tar & coal-tar pitches Creosotes Dichloroacetic acid Diesel fuel, marine Epichlorohydrin Ethyl acrylate Fuel oils, residual Furan Gasoline Hydrazine Isoprene Naphthalene Nitritotriacetic acid Nitrobenzene N-Nitrosodi-n-propylamine N-Nitrosomethylethylamine p-Chloroaniline Potassium bromate Propylene oxide Styrene-7,8-oxide Tetrafluoroethylene Toluene diisocyanates Trichloroethylene Vinyl acetate Vinyl chloride</p> <p>Metals Antimony trioxide Beryllium & its compounds Cobalt and its compounds Methylmercury compounds Vanadium pentoxide</p> <p>Pesticides 1,3-Dichloropropene 2,4-DP 2,4,5-T DDT Hexachlorobenzene p-Dichlorobenzene Sodium o-phenylphenate Toxaphene</p> <p>Fibres & Dusts Palygorskite</p> <p>Radiation Ionizing radiation & radioactive elements</p> | <p>Industrial Chemicals 1,2,3-Trichloropropane 2,2-bis(Bromomethyl)- propane-1,3-diol 2,4-Diaminotoluene 2,4-Dinitrotoluene 2,6-Dinitrotoluene 2-Nitropropane 4,4'-Methylenedianiline Acetamide Benzoyl chloride Chlorendic acid Chloroprene Citrus Red 2 Diethyl sulfate Dimethyl sulfate Disperse Blue 1 Ethyl carbamate N-Nitrosodiethylamine Nitromethane o-Toluidine Oil Orange SS Phenyl glycidyl ether Tris(2,3-dibromopropyl) phosphate Vinyl bromide</p> <p>Pesticides Chlordane Ethylene dibromide Polychlorophenols (except penta)</p> <p>Fibres & Dusts Erionite Talc containing asbestiform fibres</p> <p>Metals Titanium dioxide</p> |

Table 3: Group D: Carcinogens not prioritized (not used in Canada, or no environmental exposures expected) (n=85)

| | | |
|---|---|---|
| <p>Industrial Chemicals (n=67)</p> <p>1,1-Dimethylhydrazine 1,2-Diethylhydrazine 1,2-Dimethylhydrazine 1,3-Propane sultone 1-Chloro-2-methylpropene 2-Nitroanisole 2,3-Dibromopropanol 2,4-Diaminoanisole 2-Methyl-1-nitroanthraquinone 3,3'-Dichlorobenzidine 3,3'-Dichloro-4,4-diaminodiphenyl ether 3,3'-Dimethoxybenzidine 4-Chloro-ortho-toluidine 4,4'-Diaminodiphenyl ether 4,4'-Methylene bis(2-methylaniline) 4,4'-Thiodianiline 4-Aminobiphenyl 4-Chloro-o-phenylenediamine 4-Vinylcyclohexene 4-Vinylcyclohexene diepoxide Auramine Aziridine Benzidine based dyes Benzidine Benzyl violet 4B Bis(chloromethyl)ether & chloromethyl methyl ether b-Butyrolactone b-Propiolactone CI Acid red 114 CI Basic red 9 CI Direct blue 15</p> | <p>Diglycidyl Resorcinol Ether Diisopropyl sulfate Dimethylcarbamoyl chloride Glycidaldehyde Glycidol HC Blue No. 1 Hexachloroethane Hexamethylphosphoramide Magenta Methyl methanesulfonate Mineral oils, untreated & mildly treated N-Ethyl-N-nitrosourea N-methyl-N-nitrosourea N-Methyl-N-nitrosourethane N-Nitrosodimethylamine N,N-Diacetylbenzidine N-Nitrosodi-n-butylamine N-Nitrosodiethanolamine N-Nitrosomethylvinylamine N-Nitrosomorpholine N-Nitrosopiperidine N-Nitrosopyrrolidine N-Nitrososarcosine o-Aminoazotoluene o-Anisidine p-Aminoazobenzene p-Cresidine p-Dimethylaminoazobenzene Polybrominated biphenyls Ponceau 3R Ponceau MX Shale-oils Strong inorganic mists containing sulfuric acid Tetranitromethane Trypan blue Vinyl fluoride</p> | <p>Pesticides (n=9)</p> <p>Aramite 1,2 dibromo-3-chloropropane Captafol Chlordecone Silvex Heptachlor Mirex Nitrofen Sulfallate</p> <p>Metals (n=2)</p> <p>Gallium arsenide Indium phosphide</p> <p>Fibres and dusts (n=4)</p> <p>Refractory ceramic fibres Special purpose glass fibres Crystalline silica Wood dust</p> <p>Others (n=3)</p> <p>Involuntary smoking (Environmental tobacco smoke) Solar radiation UV Radiation, artificial *Note: Sun and tobacco smoke are important environmental exposures that are targeted by many other prevention initiatives, and therefore not included in this project.</p> |
|---|---|---|

Appendix A: IARC Carcinogens and Suspected Carcinogens

IARC Human Carcinogens (Group 1)

| Category | Agents, groups of agents, mixtures, exposure circumstances (reviewed by IARC) |
|-----------------------|--|
| Combustion Products | Benzo[a]pyrene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Household combustion of coal, indoor emissions from (Vol. 95; in preparation) |
| Combustion Products | Involuntary smoking (exposure to 'environmental' tobacco smoke) (Vol. 83; 2004) |
| Combustion Products | Soots (Vol. 35, Suppl. 7; 1987) |
| Combustion Products | Tobacco smoking and tobacco smoke (Vol. 83; 2004) |
| Dietary | Alcoholic beverages (Vol. 44; 1988) |
| Dietary | Areca nut (Vol. 85; 2004) |
| Dietary | Betel quid with tobacco (Vol. 85, 2004) |
| Dietary | Betel quid without tobacco (Vol. 85; 2004) |
| Dietary | Ethanol [64-17-5] in alcoholic beverages (Vol. 96, 2007) |
| Dietary | N'-Nitrosornicotine (NNN) & 4-(N-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK) (Vol. 37, Suppl. 7, Vol. 89; in preparation) |
| Dietary | Salted fish (Chinese-style) (Vol. 56; 1993) |
| Dietary | Tobacco, smokeless (Vol. 37, Suppl. 7, Vol. 89; in preparation) |
| Exposure Circumstance | Aluminium production (Vol. 34, Suppl. 7; 1987) |
| Exposure Circumstance | Auramine, manufacture of (Suppl. 7; 1987) |
| Exposure Circumstance | Boot and shoe manufacture and repair (Vol. 25, Suppl. 7; 1987) |
| Exposure Circumstance | Chimney sweeping (Vol. 92; in preparation) |
| Exposure Circumstance | Coal gasification (Vol. 34, Suppl. 7, Vol. 92; in preparation) |
| Exposure Circumstance | Coal-tar distillation (Vol. 92; in preparation) |
| Exposure Circumstance | Coke production (Vol. 34, Suppl. 7, Vol. 92; in preparation) |
| Exposure Circumstance | Furniture and cabinet making (Vol. 25, Suppl. 7; 1987) |
| Exposure Circumstance | Haematite mining (underground) with exposure to radon (Vol. 1, Suppl. 7; 1987) |
| Exposure Circumstance | Iron and steel founding (Vol. 34, Suppl. 7; 1987) |
| Exposure Circumstance | Isopropyl alcohol manufacture (strong-acid process) (Suppl. 7; 1987) |
| Exposure Circumstance | Magenta, manufacture of (Vol. 57; 1993) |
| Exposure Circumstance | Painter (occupational exposure as a) (Vol. 47; 1989) |
| Exposure Circumstance | Paving and roofing with coal-tar pitch (Vol. 92; in preparation) |
| Exposure Circumstance | Rubber industry (Vol. 28, Suppl. 7; 1987) |
| Exposure Circumstance | Strong-inorganic-acid mists containing sulfuric acid (occupational exposure to) (Vol. 54; 1992) |
| Fibres & Dust | Asbestos (Vol. 14, Suppl. 7; 1987) |
| Fibres & Dust | Erionite (Vol. 42, Suppl. 7; 1987) |
| Fibres & Dust | Silica, crystalline (inhaled in the form of quartz or cristobalite from occupational sources) (Vol. 68; 1997) |
| Fibres & Dust | Talc containing asbestiform fibres (Vol. 42, Suppl. 7; 1987) |
| Fibres & Dust | Wood dust (Vol. 62; 1995) |
| Hormone | Diethylstilboestrol (Vol. 21, Suppl. 7; 1987) |
| Hormone | Estrogen therapy, postmenopausal (Vol. 72; 1999) |
| Hormone | Estrogen-progestogen menopausal therapy (combined) (Vol. 72, Vol. 91; in preparation) |
| Hormone | Estrogen-progestogen oral contraceptives (combined) (Vol. 72, Vol. 91; in preparation) |
| Hormone | Estrogens, nonsteroidal (Suppl. 7; 1987) |
| Hormone | Estrogens, steroidal (Suppl. 7; 1987) |
| Hormones | Oral contraceptives, sequential (Suppl. 7; 1987) |

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| Industrial Chemical | 1,3-Butadiene (Vol. 71; 1999) |
| Industrial Chemical | 2,3,7,8-Tetrachlorodibenzo-para-dioxin [1746-01-6] (Vol. 69; 1997) |
| Industrial Chemical | 2-Naphthylamine (Vol. 4, Suppl. 7; 1987) |
| Industrial Chemical | 4-Aminobiphenyl (Vol. 1, Suppl. 7; 1987) |
| Industrial Chemical | Benzene (Vol. 29, Suppl. 7; 1987) |
| Industrial Chemical | Benzidine (Vol. 29, Suppl. 7; 1987) |
| Industrial Chemical | Bis(chloromethyl)ether and chloromethyl methyl ether (technical-grade)(Vol. 4, Suppl. 7; 1987) |
| Industrial Chemical | Coal-tar pitches (Vol. 35, Suppl. 7; 1987) |
| Industrial Chemical | Coal-tars (Vol. 35, Suppl. 7; 1987) |
| Industrial Chemical | Ethylene oxide (Vol. 60; 1994) |
| Industrial Chemical | Formaldehyde (Vol. 88; in preparation) |
| Industrial Chemical | Mineral oils, untreated and mildly treated (Vol. 33, Suppl. 7; 1987) |
| Industrial Chemical | Shale-oils (Vol. 35, Suppl. 7; 1987) |
| Industrial Chemical | Vinyl chloride (Vol. 19, Suppl. 7; 1987) |
| Metals | Arsenic and arsenic compounds (Vol. 23, Suppl. 7; 1987) |
| Metals | Arsenic in drinking-water (Vol. 84; 2004) |
| Metals | Beryllium and beryllium compounds (Vol. 58; 1993) |
| Metals | Cadmium and cadmium compounds (Vol. 58; 1993) |
| Metals | Chromium[VI] (Vol. 49; 1990) |
| Metals | Gallium arsenide (Vol. 86; 2006) |
| Metals | Nickel compounds (Vol. 49; 1990) |
| Microbiological Agents | Aflatoxins (naturally occurring mixtures of) (Vol. 56, Vol. 82; 2002) |
| Microbiological Agents | Epstein-Barr virus (Vol. 70; 1997) |
| Microbiological Agents | Helicobacter pylori (infection with) (Vol. 61; 1994) |
| Microbiological Agents | Hepatitis B virus (chronic infection with) (Vol. 59; 1994) |
| Microbiological Agents | Hepatitis C virus (chronic infection with) (Vol. 59; 1994) |
| Microbiological Agents | Human immunodeficiency virus type 1 (infection with) (Vol. 67; 1996) |
| Microbiological Agents | Human papillomavirus types 16, 18, 31, 33, 35, 39, 45, 51, 52, 56, 58, 59 and 66 (Vol. 64, Vol. 90; in preparation) |
| Microbiological Agents | Human T-cell lymphotropic virus type I (Vol. 67; 1996) |
| Microbiological Agents | Opisthorchis viverrini (infection with) (Vol. 61; 1994) |
| Microbiological Agents | <i>Schistosoma haematobium</i> (infection with) (Vol. 61; 1994) |
| Pharmacological | 1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (Methyl-CCNU; Semustine) (Suppl. 7; 1987) |
| Pharmacological | 1,4-Butanediol dimethanesulfonate (Busulphan; Myleran) (Vol. 4, Suppl. 7; 1987) |
| Pharmacological | 8-Methoxypsoralen (Methoxsalen) plus ultraviolet A radiation (Vol. 24, Suppl. 7; 1987) |
| Pharmacological | Azathioprine (Vol. 26, Suppl. 7; 1987) |
| Pharmacological | Chlorambucil (Vol. 26, Suppl. 7; 1987) |
| Pharmacological | Ciclosporin (Vol. 50; 1990) |
| Pharmacological | Cyclophosphamide (Vol. 26, Suppl. 7; 1987) |
| Pharmacological | Etoposide in combination with cisplatin and bleomycin (Vol. 76; 2000) |
| Pharmacological | Herbal remedies containing plant species of the genus <i>Aristolochia</i> (Vol. 82; 2002) |
| Pharmacological | Melphalan (Vol. 9, Suppl. 7; 1987) |
| Pharmacological | MOPP and other combined chemotherapy including alkylating agents (Suppl. 7; 1987) |
| Pharmacological | Mustard gas (Sulfur mustard) (Vol. 9, Suppl. 7; 1987) |
| Pharmacological | N,N-Bis(2-chloroethyl)-2-naphthylamine (Chlornaphazine) (Vol. 4, Suppl. 7; 1987) |
| Pharmacological | Phenacetin, analgesic mixtures containing (Suppl. 7; 1987) |
| Pharmacological | Tamoxifen (Vol. 66; 1996) |
| Pharmacological | Thiotepa (Vol. 50; 1990) |
| Pharmacological | Thorium-232 and its decay products, administered intravenously as a |

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| | colloidal dispersion of thorium-232 dioxide (Vol. 78; 2001) |
| Pharmacological | Treosulfan (Vol. 26, Suppl. 7; 1987) |
| Radiation | Neutrons (Vol. 75; 2000) |
| Radiation | Phosphorus-32, as phosphate (Vol. 78; 2001) |
| Radiation | Plutonium-239 and its decay products (may contain plutonium-240 and other isotopes), as aerosols (Vol. 78; 2001) |
| Radiation | Radioiodines, short-lived isotopes, including iodine-131, from atomic reactor accidents and nuclear weapons detonation (exposure during childhood) (Vol. 78; 2001) |
| Radiation | Radionuclides, a-particle-emitting, internally deposited (Vol. 78; 2001) |
| Radiation | Radionuclides, b-particle-emitting, internally deposited (Vol. 78; 2001) |
| Radiation | Radium-224 and its decay products (Vol. 78; 2001) |
| Radiation | Radium-226 and its decay products (Vol. 78; 2001) |
| Radiation | Radium-228 and its decay products (Vol. 78; 2001) |
| Radiation | Radon-222 and its decay products (Vol. 43, Vol. 78; 2001) |
| Radiation | Solar radiation (Vol. 55; 1992) |
| Radiation | X- and Gamma (g)-Radiation (Vol. 75; 2000) |

IARC Probable Human Carcinogens (Group 2A)

| Category | Agents, groups of agents, mixtures, exposure circumstances (reviewed by IARC) |
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| Combustion Products | Cyclopenta[<i>cd</i>]pyrene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Dibenz[<i>a,h</i>]anthracene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Dibenzo[<i>a,l</i>]pyrene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Diesel engine exhaust (Vol. 46; 1989) |
| Combustion Products | High-temperature frying, emissions from (Vol. 95, in preparation) |
| Combustion Products | Household combustion of biomass fuel (primarily wood), indoor emissions from (Vol. 95; in preparation) |
| Dietary | Hot mate (Vol. 51; 1991) |
| Dietary | IQ (2-Amino-3-methylimidazo[4,5- <i>f</i>]quinoline) (Vol. 56; 1993) |
| Dietary | Nitrate or nitrite (ingested) under conditions that result in endogenous nitrosation (Vol. 94; in preparation) |
| Exposure Circumstance | Art glass, glass containers and pressed ware (manufacture of) (Vol. 58; 1993) |
| Exposure Circumstance | Carbon electrode manufacture (Vol. 92; in preparation) |
| Exposure Circumstance | Hairdresser or barber (occupational exposure as a) (Vol. 57; 1993) |
| Exposure Circumstance | Petroleum refining (occupational exposures in) (Vol. 45; 1989) |
| Exposure Circumstance | Shiftwork that involves circadian disruption (Vol. 98; in preparation) |
| Exposure Circumstance | Sunlamps and sunbeds (use of) (Vol. 55; 1992) |
| Hormones | Androgenic (anabolic) steroids (Suppl. 7; 1987) |
| Industrial Chemical | 1,2,3-Trichloropropane (Vol. 63; 1995) |
| Industrial Chemical | 1,2-Dimethylhydrazine (Vol. 4, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | 4,4'-Methylene bis(2-chloroaniline) (MOCA) (Vol.57; 1993) |
| Industrial Chemical | 4-Chloro- <i>ortho</i> -toluidine (Vol. 77; 2000) |
| Industrial Chemical | a-Chlorinated toluenes (benzal chloride, benzotrichloride, benzyl chloride) and benzoyl chloride (combined exposures) (Vol. 29, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Acrylamide (Vol. 60; 1994) |
| Industrial Chemical | Benzidine-based dyes (Suppl. 7; 1987) |
| Industrial Chemical | Creosotes (Vol. 35, Suppl. 7, Vol. 92; in preparation) |
| Industrial Chemical | Diethyl sulfate (Vol. 54, Vol. 71; 1999) |
| Industrial Chemical | Dimethyl sulfate (Vol. 4, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Dimethylcarbamoyl chloride (Vol. 12, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Epichlorohydrin (Vol. 11, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Glycidol (Vol. 77; 2000) |

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| Industrial Chemical | Methyl methanesulfonate (Vol. 7, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | <i>N</i> -Ethyl- <i>N</i> -nitrosourea (Vol. 17; 1987) |
| Industrial Chemical | <i>N</i> -Methyl- <i>N</i> -nitrosourea (Vol. 17; 1987) |
| Industrial Chemical | <i>N</i> -Nitrosodiethylamine (Vol. 17; 1987) |
| Industrial Chemical | <i>N</i> -Nitrosodimethylamine (Vol. 17; 1987) |
| Industrial Chemical | <i>ortho</i> -Toluidine (Vol. 77; 2000) |
| Industrial Chemical | Polychlorinated biphenyls (Vol. 18, Suppl. 7; 1987) |
| Industrial Chemical | Styrene-7,8-oxide (Vol. 60; 1994) |
| Industrial Chemical | Tetrachloroethylene (Vol. 63; 1995) |
| Industrial Chemical | Trichloroethylene (Vol. 63; 1995) |
| Industrial Chemical | Tris(2,3-dibromopropyl) phosphate (Vol. 20, Suppl. 7, Vol. 71;1999) |
| Industrial Chemical | Urethane (Vol. 7, Suppl. 7; 1987) |
| Industrial Chemical | Vinyl bromide (Vol. 39, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Vinyl fluoride (Vol. 63; 1995) |
| Metals | Cobalt Metals with tungsten carbide (Vol. 86; 2006) |
| Metals | Indium phosphide (Vol. 86; 2006) |
| Metals | Lead compounds, inorganic (Vol. 87; 2006) |
| Microbiological Agents | <i>Clonorchis sinensis</i> (infection with) (Vol. 61; 1994) |
| Microbiological Agents | Kaposi's sarcoma herpesvirus/human herpesvirus 8 (Vol. 70; 1997) |
| Pesticides | Captafol (Vol. 53; 1991) |
| Pesticides | Ethylene dibromide (Vol. 15, Suppl. 7, Vol. 71; 1999) |
| Pesticides | Non-arsenical insecticides (occupational exposures in spraying and application of) (Vol. 53; 1991) |
| Pharmacological | 1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU) (Vol. 26, Suppl. 7; 1987) |
| Pharmacological | 5-Methoxypsoralen (Vol. 40, Suppl. 7; 1987) |
| Pharmacological | Adriamycin (Vol. 10, Suppl. 7; 1987) |
| Pharmacological | Aristolochic acids (naturally occurring mixtures of) (Vol. 82; 2002) |
| Pharmacological | Azacitidine (Vol. 50; 1990) |
| Pharmacological | Bischloroethyl nitrosourea (BCNU) (Vol. 26, Suppl.7; 1987) |
| Pharmacological | Chloramphenicol (Vol. 50; 1990) |
| Pharmacological | Chlorozotocin (Vol. 50; 1990) |
| Pharmacological | Cisplatin (Vol. 26, Suppl. 7; 1987) |
| Pharmacological | Etoposide (Vol. 76; 2000) |
| Pharmacological | Nitrogen mustard (Vol. 9, Suppl. 7; 1987) |
| Pharmacological | <i>N</i> -Methyl- <i>N'</i> -nitro- <i>N</i> -nitrosoguanidine(MNNG) (Vol. 4, Suppl. 7; 1987) |
| Pharmacological | Phenacetin (Vol. 24, Suppl. 7; 1987) |
| Pharmacological | Procarbazine hydrochloride (Vol. 26, Suppl. 7; 1987) |
| Pharmacological | Teniposide (Vol. 76; 2000) |
| Radiation | Ultraviolet radiation A (Vol. 55; 1992) |
| Radiation | Ultraviolet radiation B (Vol. 55; 1992) |
| Radiation | Ultraviolet radiation C (Vol. 55; 1992) |

IARC Possible Human Carcinogens (Group 2B)

| Category | Agents, groups of agents, mixtures, exposure circumstances (reviewed by IARC) |
|---------------------|---|
| Combustion Products | 1,6-Dinitropyrene (Vol. 46; 1989) |
| Combustion Products | 1,8-Dinitropyrene (Vol. 46; 1989) |
| Combustion Products | 1-Nitropyrene (Vol. 46; 1989) |
| Combustion Products | 2-Nitrofluorene (Vol. 46; 1989) |
| Combustion Products | 4-Nitropyrene (Vol. 46; 1989) |
| Combustion Products | 5-Methylchrysene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | 6-Nitrochrysene (Vol. 46; 1989) |
| Combustion Products | 7 <i>H</i> -Dibenzo[<i>c,g</i>]carbazole (Vol. 32, Suppl.7; 1987) |

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| Combustion Products | Benz[<i>a</i>]anthracene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Benz[<i>j</i>]aceanthrylene (Vol. 92; in preparation) |
| Combustion Products | Benzo[<i>b</i>]fluoranthene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Benzo[<i>c</i>]phenanthrene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Benzo[<i>j</i>]fluoranthene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Benzo[<i>k</i>]fluoranthene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Chrysene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Dibenz[<i>a,h</i>]acridine (Vol. 32, Suppl. 7; 1987) |
| Combustion Products | Dibenz[<i>a,j</i>]acridine (Vol. 32, Suppl. 7; 1987) |
| Combustion Products | Dibenzo[<i>a,h</i>]pyrene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Dibenzo[<i>a,l</i>]pyrene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Combustion Products | Engine exhaust, gasoline (Vol. 46; 1989) |
| Combustion Products | Indeno[1,2,3- <i>cd</i>]pyrene (Vol. 32, Suppl. 7, Vol. 92; in preparation) |
| Dietary | 3-(<i>N</i> -Nitrosomethylamino)propionitrile (Vol. 85; 2004) |
| Dietary | A-alpha-C (2-Amino-9 <i>H</i> -pyrido[2,3- <i>b</i>]indole) (Vol. 40, Suppl. 7; 1987) |
| Dietary | AF-2 [2-(2-Furyl)-3-(5-nitro-2-furyl)acrylamide] (Vol. 31, Suppl. 7; 1987) |
| Dietary | Azaserine (Vol. 10, Suppl. 7; 1987) |
| Dietary | Bracken fern (Vol. 40, Suppl. 7; 1987) |
| Dietary | Butylated hydroxyanisole (BHA) (Vol. 40, Suppl. 7; 1987) |
| Dietary | Caffeic acid (Vol. 56; 1993) |
| Dietary | Carrageenan, degraded (Vol. 31, Suppl. 7; 1987) |
| Dietary | Coffee (Vol. 51; 1991) |
| Dietary | Cycasin (Vol. 10, Suppl. 7; 1987) |
| Dietary | Daunomycin (Vol. 10, Suppl. 7; 1987) |
| Dietary | Dihydrosafrole (Vol. 10, Suppl. 7; 1987) |
| Dietary | Glu-P-1 (2-Amino-6-methyldipyrido[1,2- <i>a</i> :3',2'- <i>d</i>]imidazole) (Vol. 40, Suppl. 7; 1987) |
| Dietary | Glu-P-2 (2-Aminodipyrido[1,2- <i>a</i> :3',2'- <i>d</i>]imidazole) (Vol. 40, Suppl. 7; 1987) |
| Dietary | Iron-dextran complex (Vol. 2, Suppl. 7; 1987) |
| Dietary | Lasiocarpine (Vol. 10, Suppl. 7; 1987) |
| Dietary | MeA-alpha-C (2-Amino-3-methyl-9 <i>H</i> -pyrido[2,3- <i>b</i>]indole) (Vol. 40, Suppl. 7; 1987) |
| Dietary | MeIQ (2-Amino-3,4-dimethylimidazo[4,5- <i>f</i>]quinoline) (Vol. 56; 1993) |
| Dietary | MeIQx (2-Amino-3,8-dimethylimidazo[4,5- <i>f</i>]quinoxaline) (Vol. 56; 1993) |
| Dietary | Methylazoxymethanol acetate (Vol. 10, Suppl. 7; 1987) |
| Dietary | Mitomycin C (Vol. 10, Suppl. 7; 1987) |
| Dietary | Monocrotaline (Vol. 10, Suppl. 7; 1987) |
| Dietary | PhIP (2-Amino-1-methyl-6-phenylimidazo[4,5- <i>b</i>]pyridine) (Vol. 56; 1993) |
| Dietary | Pickled vegetables (traditional in Asia) (Vol. 56; 1993) |
| Dietary | Safrole (Vol. 10, Suppl. 7; 1987) |
| Dietary | Sterigmatocystin (Vol. 10, Suppl. 7; 1987) |
| Dietary | Trp-P-1 (3-Amino-1,4-dimethyl-5 <i>H</i> -pyrido[4,3- <i>b</i>]indole) (Vol. 31, Suppl. 7; 1987) |
| Dietary | Trp-P-2 (3-Amino-1-methyl-5 <i>H</i> -pyrido[4,3- <i>b</i>]indole) (Vol. 31, Suppl. 7; 1987) |
| Exposure Circumstance | Carpentry and joinery (Vol. 25, Suppl. 7; 1987) |
| Exposure Circumstance | Cobalt Metals without tungsten carbide (Vol. 86; 2006) |
| Exposure Circumstance | Dry cleaning (occupational exposures in) (Vol. 63; 1995) |
| Exposure Circumstance | Firefighter (occupational exposure as a) (Vol. 98, in preparation) |
| Exposure Circumstance | Printing processes (occupational exposures in) (Vol. 65; 1996) |
| Exposure Circumstance | Textile manufacturing industry (work in) (Vol. 48; 1990) |
| Fibres & Dust | Palygorskite (attapulgitite)(long fibres, > 5 micrometres)(Vol. 68; 1997) |
| Fibres & Dust | Refractory ceramic fibres (Vol. 43, Vol. 81; 2002) |
| Fibres & Dust | Special-purpose fibres such as E-glass & '475' glass fibres (Vol. 81; 2002) |
| Hormone | Medroxyprogesterone acetate (Vol. 21, Suppl. 7; 1987) |
| Hormones | Progestins (Suppl. 7; 1987) |

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| Hormones | Progestogen-only contraceptives (Vol. 72; 1999) |
| Industrial Chemical | 1,1-Dimethylhydrazine (Vol. 4, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | 1,2-Dichloroethane (Vol. 20, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | 1,2-Diethylhydrazine (Vol. 4, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | 1,2-Epoxybutane (Vol. 47, Vol. 71; 1999) |
| Industrial Chemical | 1,3-Dichloropropene (technical-grade) (Vol. 41, Suppl.7, Vol. 71; 1999) |
| Industrial Chemical | 1,3-Propane sultone (Vol. 4, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | 1,4-Dioxane (Vol. 11, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | 1-Chloro-2-methylpropene [513-37-1] (Vol. 63; 1995) |
| Industrial Chemical | 2,2-Bis(bromomethyl)propane-1,3-diol (Vol. 77; 2000) |
| Industrial Chemical | 2,3-Dibromopropan-1-ol (Vol. 77; 2000) |
| Industrial Chemical | 2,4-Diaminoanisole (Vol. 79; 2001) |
| Industrial Chemical | 2,4-Diaminotoluene (Vol. 16, Suppl. 7; 1987) |
| Industrial Chemical | 2,4-Dinitrotoluene (Vol. 65; 1996) |
| Industrial Chemical | 2,6-Dimethylaniline (2,6-Xylidine) (Vol. 57; 1993) |
| Industrial Chemical | 2,6-Dinitrotoluene (Vol. 65; 1996) |
| Industrial Chemical | 2-Methyl-1-nitroanthraquinone (uncertain purity) (Vol.27, Suppl. 7; 1987) |
| Industrial Chemical | 2-Nitroanisole (Vol. 65; 1996) |
| Industrial Chemical | 2-Nitropropane (Vol. 29, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | 3,3'-Dichloro-4,4'-diaminodiphenyl ether (Vol. 16, Suppl. 7; 1987) |
| Industrial Chemical | 3,3'-Dichlorobenzidine (Vol. 29, Suppl. 7; 1987) |
| Industrial Chemical | 3,3'-Dimethoxybenzidine (<i>ortho</i> -Dianisidine) (Vol. 4, Suppl. 7; 1987) |
| Industrial Chemical | 3,3'-Dimethylbenzidine (<i>ortho</i> -Tolidine) (Vol.1, Suppl. 7; 1987) |
| Industrial Chemical | 3,7-Dinitrofluoranthene (Vol. 65; 1996) |
| Industrial Chemical | 3,9-Dinitrofluoranthene (Vol. 65; 1996) |
| Industrial Chemical | 3-Chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (Vol. 84; 2004) |
| Industrial Chemical | 4,4'-Diaminodiphenyl ether (Vol. 29, Suppl. 7; 1987) |
| Industrial Chemical | 4,4'-Methylene bis(2-methylaniline) (Vol. 4, Suppl.7; 1987) |
| Industrial Chemical | 4,4'-Methylenedianiline (Vol. 39, Suppl. 7; 1987) |
| Industrial Chemical | 4,4'-Thiodianiline (Vol. 27, Suppl. 7; 1987) |
| Industrial Chemical | 4-Chloro- <i>ortho</i> -phenylenediamine (Vol. 27, Suppl.7; 1987) |
| Industrial Chemical | 4-Vinylcyclohexene (Vol. 60; 1994) |
| Industrial Chemical | 4-Vinylcyclohexene diepoxide (Vol. 60; 1994) |
| Industrial Chemical | 5-Nitroacenaphthene (Vol. 16, Suppl. 7; 1987) |
| Industrial Chemical | Acetaldehyde (Vol. 36, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Acetamide (Vol. 7, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Acrylonitrile (Vol. 71; 1999) |
| Industrial Chemical | Auramine (technical-grade) (Vol. 1, Suppl. 7; 1987) |
| Industrial Chemical | Aziridine (Vol. 9, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Benzofuran (Vol. 63; 1995) |
| Industrial Chemical | Benzyl violet 4B (Vol. 16, Suppl. 7; 1987) |
| Industrial Chemical | beta-Butyrolactone (Vol. 11, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | beta-Propiolactone (Vol. 4, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Bitumens, extracts of steam-refined and air-refined (Vol. 35, Suppl. 7; 1987) |
| Industrial Chemical | Bromodichloromethane (Vol. 52, Vol. 71; 1999) |
| Industrial Chemical | Carbon black (Vol. 65, Vol. 93; in preparation) |
| Industrial Chemical | Carbon tetrachloride (Vol. 20, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Catechol (Vol. 15, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Chlorendic acid (Vol. 48; 1990) |
| Industrial Chemical | Chlorinated paraffins of average carbon chain length C12 and average degree of chlorination approximately 60% (Vol. 48; 1990) |
| Industrial Chemical | Chloroform (Vol. 73; 1999) |
| Industrial Chemical | Chloroprene (Vol. 71; 1999) |
| Industrial Chemical | CI Acid Red 114 (Vol. 57; 1993) |
| Industrial Chemical | CI Basic Red 9 (Vol. 57; 1993) |
| Industrial Chemical | CI Direct Blue 15 (Vol. 57; 1993) |

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| Industrial Chemical | Citrus Red No. 2 (Vol. 8, Suppl. 7; 1987) |
| Industrial Chemical | Dichloroacetic acid (Vol. 84; 2004) |
| Industrial Chemical | Dichloromethane (methylene chloride) (Vol. 71; 1999) |
| Industrial Chemical | Diesel fuel, marine (Vol. 45; 1989) |
| Industrial Chemical | Diglycidyl resorcinol ether (Vol. 36, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Diisopropyl sulfate (Vol. 54, Vol. 71; 1999) |
| Industrial Chemical | Disperse Blue 1 (Vol. 48; 1990) |
| Industrial Chemical | Ethyl acrylate (Vol. 39, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Ethylbenzene (Vol. 77; 2000) |
| Industrial Chemical | Fuel oils, residual (heavy) (Vol. 45; 1989) |
| Industrial Chemical | Furan (Vol. 63; 1995) |
| Industrial Chemical | Gasoline (Vol. 45; 1989) |
| Industrial Chemical | Glycidaldehyde [765-34-4] (Vol. 11, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | HC Blue No. 1 [2784-94-3] (Vol. 57; 1993) |
| Industrial Chemical | Hexachloroethane (Vol. 73; 1999) |
| Industrial Chemical | Hexamethylphosphoramide (Vol. 15, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Hydrazine (Vol. 4, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Isoprene (Vol. 60, Vol. 71; 1999) |
| Industrial Chemical | Magenta (containing CI Basic Red 9) (Vol. 57; 1993) |
| Industrial Chemical | <i>N,N'</i> -Diacetylbenzidine (Vol. 16, Suppl.7; 1987) |
| Industrial Chemical | Naphthalene (Vol. 82; 2002) |
| Industrial Chemical | Nitrilotriacetic acid and its salts (Vol. 73; 1999) |
| Industrial Chemical | Nitrobenzene (Vol. 65; 1996) |
| Industrial Chemical | Nitromethane (Vol. 77; 2000) |
| Industrial Chemical | <i>N</i> -Methyl- <i>N</i> -nitrosourethane (Vol. 4, Suppl.7; 1987) |
| Industrial Chemical | <i>N</i> -Nitrosodiethanolamine (Vol. 17, Suppl. 7, Vol. 77; 2000) |
| Industrial Chemical | <i>N</i> -Nitrosodi- <i>n</i> -butylamine (Vol. 17, Suppl.7; 1987) |
| Industrial Chemical | <i>N</i> -Nitrosodi- <i>n</i> -propylamine (Vol. 17, Suppl.7; 1987) |
| Industrial Chemical | <i>N</i> -Nitrosomethylethylamine (Vol. 17, Suppl. 7; 1987) |
| Industrial Chemical | <i>N</i> -Nitrosomethylvinylamine (Vol. 17, Suppl. 7; 1987) |
| Industrial Chemical | <i>N</i> -Nitrosomorpholine (Vol. 17, Suppl. 7; 1987) |
| Industrial Chemical | <i>N</i> -Nitrosopiperidine (Vol. 17, Suppl. 7; 1987) |
| Industrial Chemical | <i>N</i> -Nitrosopyrrolidine (Vol. 17, Suppl. 7; 1987) |
| Industrial Chemical | <i>N</i> -Nitrososarcosine (Vol. 17, Suppl. 7; 1987) |
| Industrial Chemical | Oil Orange 5S (Vol. 8, Suppl. 7; 1987) |
| Industrial Chemical | <i>ortho</i> -Aminoazotoluene (Vol. 8, Suppl. 7; 1987) |
| Industrial Chemical | <i>ortho</i> -Anisidine (Vol. 73; 1999) |
| Industrial Chemical | <i>para</i> -Aminoazobenzene (Vol. 8, Suppl. 7; 1987) |
| Industrial Chemical | <i>para</i> -Chloroaniline (Vol. 57; 1993) |
| Industrial Chemical | <i>para</i> -Cresidine (Vol. 27, Suppl. 7; 1987) |
| Industrial Chemical | <i>para</i> -Dimethylaminoazobenzene (Vol. 8, Suppl. 7; 1987) |
| Industrial Chemical | Phenyl glycidyl ether (Vol. 47, Vol. 71; 1999) |
| Industrial Chemical | Polybrominated biphenyls (Vol. 41, Suppl. 7; 1987) |
| Industrial Chemical | Ponceau 3R (Vol. 8, Suppl. 7; 1987) |
| Industrial Chemical | Ponceau MX (Vol. 8, Suppl. 7; 1987) |
| Industrial Chemical | Potassium bromate (Vol. 73; 1999) |
| Industrial Chemical | Propylene oxide (Vol. 60; 1994) |
| Industrial Chemical | Styrene (Vol. 60, 82; 2002) |
| Industrial Chemical | Tetrafluoroethylene (Vol. 19, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Tetranitromethane (Vol. 65; 1996) |
| Industrial Chemical | Titanium dioxide (Vol. 47, Vol. 93; in preparation) |
| Industrial Chemical | Toluene diisocyanates (Vol. 39, Suppl. 7, Vol. 71; 1999) |
| Industrial Chemical | Trypan blue (Vol. 8, Suppl. 7; 1987) |
| Industrial Chemical | Vinyl acetate (Vol. 63; 1995) |
| Metals | Antimony trioxide (Vol. 47; 1989) |

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| Metals | Cobalt and cobalt compounds (Vol. 52; 1991) |
| Metals | Cobalt sulfate and other soluble cobalt(II) salts (Vol. 86; 2006) |
| Metals | Lead (Vol. 23, Suppl. 7; 1987) |
| Metals | Methylmercury compounds (Vol. 58; 1993) |
| Metals | Nickel, Metallic and alloys (Vol. 49; 1990) |
| Metals | Vanadium pentoxide (Vol. 86; in preparation) |
| Metals | Welding fumes (Vol. 49; 1990) |
| Microbiological Agents | Aflatoxin M1 (Vol. 56; 1993) |
| Microbiological Agents | Fumonisin B ₁ (Vol. 82; 2002) |
| Microbiological Agents | Human immunodeficiency virus type 2 (infection with) (Vol. 67; 1996) |
| Microbiological Agents | Human papillomavirus genus beta (some types) (Vol. 90; in preparation) |
| Microbiological Agents | Human papillomavirus types 6 and 11 (Vol. 90; in preparation) |
| Microbiological Agents | Microcystin-LR (Vol. 94; in preparation) |
| Microbiological Agents | Ochratoxin A (Vol. 56; 1993) |
| Microbiological Agents | <i>Schistosoma japonicum</i> (infection with) (Vol. 61; 1994) |
| Microbiological Agents | Toxins derived from <i>Fusarium moniliforme</i> (Vol. 56; 1993) |
| Pesticides | 1,2-Dibromo-3-chloropropane (Vol. 20, Suppl. 7, Vol. 71; 1999) |
| Pesticides | Aramite® (Vol. 5, Suppl. 7; 1987) |
| Pesticides | Chlordane (Vol. 79; 2001) |
| Pesticides | Chlordecone (Kepone) (Vol. 20, Suppl. 7; 1987) |
| Pesticides | Chlorophenoxy herbicides (Vol. 41, Suppl. 7; 1987) |
| Pesticides | Chlorothalonil (Vol. 73; 1999) |
| Pesticides | DDT [<i>p,p'</i> -DDT, 50-29-3] (Vol. 53; 1991) |
| Pesticides | Dichlorvos (Vol. 53; 1991) |
| Pesticides | Heptachlor (Vol. 79; 2001) |
| Pesticides | Hexachlorobenzene (Vol. 79; 2001) |
| Pesticides | Hexachlorocyclohexanes (Lindane) (Vol. 20, Suppl. 7; 1987) |
| Pesticides | Mirex (Vol. 20, Suppl. 7; 1987) |
| Pesticides | Nitrofen (technical-grade) (Vol. 30, Suppl. 7; 1987) |
| Pesticides | <i>para</i> -Dichlorobenzene (Vol. 73; 1999) |
| Pesticides | Polychlorophenols and their sodium salts (mixed exposures) (Vol. 41, Suppl. 7, Vol. 53, Vol. 71; 1999) |
| Pesticides | Sodium <i>ortho</i> -phenylphenate (Vol. 73; 1999) |
| Pesticides | Sulfallate (Vol. 30, Suppl. 7; 1987) |
| Pesticides | Toxaphene (Polychlorinated camphenes) (Vol. 79; 2001) |
| Pharmacological | 1-[(5-Nitrofurfurylidene)amino]-2-imidazolidinone (Vol. 7, Suppl. 7; 1987) |
| Pharmacological | 1-Hydroxyanthraquinone (Vol. 82; 2002) |
| Pharmacological | 2-(2-Formylhydrazino)-4-(5-nitro-2-furyl)thiazole (Vol. 7, Suppl. 7; 1987) |
| Pharmacological | 2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole (Vol. 7, Suppl. 7; 1987) |
| Pharmacological | 2-Methylaziridine (Propyleneimine) (Vol. 9, Suppl. 7, Vol. 71; 1999) |
| Pharmacological | 5-(Morpholinomethyl)-3-[(5-nitrofurfurylidene)amino]-2-oxazolidinone (Vol. 7, Suppl. 7; 1987) |
| Pharmacological | Amsacrine (Vol. 76; 2000) |
| Pharmacological | Bleomycins (Vol. 26, Suppl. 7; 1987) |
| Pharmacological | Dacarbazine (Vol. 26, Suppl. 7; 1987) |
| Pharmacological | Dantron (Chrysazin; 1,8-Dihydroxyanthraquinone) (Vol. 50; 1990) |
| Pharmacological | Ethyl methanesulfonate (Vol. 7, Suppl. 7; 1987) |
| Pharmacological | Griseofulvin [126-07-8] (Vol. 79; 2001) |
| Pharmacological | Merphalan (Vol. 9, Suppl. 7; 1987) |
| Pharmacological | Methylthiouracil (Vol. 79; 2001) |
| Pharmacological | Metronidazole (Vol. 13, Suppl. 7; 1987) |
| Pharmacological | Mitoxantrone (Vol. 76; 2000) |
| Pharmacological | <i>N</i> -[4-(5-Nitro-2-furyl)-2-thiazolyl]acetamide (Vol. 7, Suppl. 7; 1987) |
| Pharmacological | Nafenopin (Vol. 24, Suppl. 7; 1987) |
| Pharmacological | Niridazole (Vol. 13, Suppl. 7; 1987) |
| Pharmacological | Nitrogen mustard <i>N</i> -oxide (Vol. 9, Suppl. 7; 1987) |

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| Pharmacological | Oxazepam (Vol. 66; 1996) |
| Pharmacological | Panfuran S [794-93-4] (containing dihydroxymethylfuratrizine) (Vol. 24, Suppl. 7; 1987) |
| Pharmacological | Phenazopyridine hydrochloride (Vol. 24, Suppl. 7; 1987) |
| Pharmacological | Phenobarbital (Vol. 79; 2001) |
| Pharmacological | Phenolphthalein (Vol. 76; 2000) |
| Pharmacological | Phenoxybenzamine hydrochloride (Vol. 24, Suppl. 7; 1987) |
| Pharmacological | Phenytoin (Vol. 66; 1996) |
| Pharmacological | Propylthiouracil (Vol. 79; 2001) |
| Pharmacological | Riddelliine (Vol. 10, Suppl. 7, Vol. 82; 2002) |
| Pharmacological | Streptozotocin (Vol. 17, Suppl. 7; 1987) |
| Pharmacological | Surgical implants and other foreign bodies (Vol. 74; 1999): |
| Pharmacological | Talc-based body powder (perineal use of) (Vol. 93; in preparation) |
| Pharmacological | Thioacetamide (Vol. 7, Suppl. 7; 1987) |
| Pharmacological | Thiouracil (Vol. 79; 2001) |
| Pharmacological | <i>trans</i> -2-[(Dimethylamino)methylimino]-5-[2-(5-nitro-2-furyl)-vinyl]-1,3,4-oxadiazole (Vol. 7, Suppl. 7; 1987) |
| Pharmacological | Trichlormethine (Trimustine hydrochloride) (Vol. 50; 1990) |
| Pharmacological | Uracil mustard (Vol. 9, Suppl. 7; 1987) |
| Pharmacological | Zalcitabine (Vol. 76; 2000) |
| Pharmacological | Zidovudine (AZT) (Vol. 76; 2000) |
| Radiation | Magnetic fields (extremely low-frequency) (Vol. 80; 2002) |

Appendix B: Detailed Description of Resources Consulted

General Resources

HSDB: The U.S. Hazardous Substances Databank (<http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>)

The HSDB includes peer-reviewed toxicology, exposure, manufacturing and use information, and human health effects data for nearly all the chemicals on the IARC 2B list. The HSDB exists as a part of ToxNet (the Toxicology Data Network of the National Library of Medicine).

NTP: The U.S. National Toxicology Program's 11th Report on Carcinogens (<http://ntp.niehs.nih.gov/index.cfm?objectid=32BA9724-F1F6-975E-7FCE50709CB4C932>)

The NTP Report on Carcinogens was consulted for all available chemicals as it contains summary documentation of carcinogenic risks and exposure and use information (often separated into categories of occupational and environmental).

ATSDR: The U.S. Agency for Toxic Substances and Disease Registry Toxicologic Profiles (<http://www.atsdr.cdc.gov/>)

The ATSDR produces toxicological profiles for many substances that are included on the IARC 2B list. These voluminous documents include animal and human toxicity data, chemical uses, manufacturing information, sources of exposure, and other health effects.

Types of crops (for pesticides only):

This information mostly collected in general searches of the NTP and ATSDR (see above), and notes the types of crops that each pesticide is commonly used on, or the types of consumer products affected (where applicable). This information is included under "Potential exposure circumstances" in the tables in Appendix C for pesticides only.

IARC: The International Agency for Research on Cancer Monograph Summaries (<http://monographs.iarc.fr/>)

The summaries of all of their monographs available online that include the Types of cancer caused, other health effects, and results of animal studies (and human, where available).

General internet searches

General search strategies were also employed for all chemicals. This was especially useful for locating names of chemical companies who sell the products, or other government based documents not identified via the portals above, and often any of the most important peer-reviewed studies. Synonyms and CAS numbers were also often found in this way.

Description of Other Resources Included in Tables

CEPA: Canadian Environmental Protection Act (1999) (http://www.ec.gc.ca/TOXICS/EN/mainlist.cfm?par_actn=s2)

One of CEPA's mandates is to regulate the use of 'toxic' substances. CEPA defines a substance as 'toxic' if it enters or may enter the environment under conditions that (a) negatively affect the environment or biological diversity, (b) constitute a danger to the environment on which life depends, or (c) are a danger to human health. These letters are the paragraphs referred to in our tables. CEPA also requires that substances of interest be

evaluated for addition to the Toxic list periodically. When being considered, substances are added to Priority Substances Lists (PSL), after which they are either added to the Toxic list, deemed not toxic, or left on the PSL if a decision cannot be made. We have noted in our table those substances that appear on a PSL.

HC: Health Canada's Domestic Substances List (DSL) (http://www.hc-sc.gc.ca/ewh-semt/contaminants/existsub/categor/_result_substance/index_e.html)

The DSL is a list of approximately 23,000 chemicals reported by industry to be in use in Canadian facilities between 1984 and 1986. They were categorized with respect to their potential for exposure to Canadians by Health Canada (based on several criteria, but generally the amount in use and the number of facilities reporting use of the chemical at that time), as well as their toxicity to humans. The acronyms reported in our tables (LPE, IPE, and GPE) refer to chemicals classified as having a Low, Intermediate, or Greatest Potential for Exposure. There is also a category called "already risk managed", which refers to chemicals that were already targeted for some kind of regulatory action, and hence considered low priority by Health Canada.

NPRI 2006: The National Pollutant Release Inventory

(http://www.ec.gc.ca/pdb/querysite/query_e.cfm)

The NPRI contains the names of companies and yearly amounts released to the environment, disposed of, or sent for recycling for toxic chemicals since 1994. This database is maintained by Environment Canada. The numbers included in our tables are the sum of environmental release (to air, water, or soil) and disposals in 2006. Although reporting to the NPRI is a legal requirement, there are several criteria (depending on the chemical) that determine whether or not a company must report. For most of the chemicals on the list, reporting is not required unless ≥ 10 tonnes of the substance are used and 20,000 employee hours per year are worked. There are also some chemicals (i.e. some metals, dioxins) with lower reporting criteria.

TradeMap: TradeMap, a subsidiary of ExportSource Canada

(<http://www.trademap.net/canada/en/login.htm>)

This database tracks import/export data for a variety of chemicals and consumer products by year (in our report we report data from 2006). We used this resource to identify whether a chemical was likely to be manufactured, used, or imported into Canada, increasing its priority for further research.

IC: Industry Canada's Canadian Company Capabilities (CCC) Databank

(<http://strategis.ic.gc.ca/app/ccc/srch/cccBscSrch.do?lang=eng&prtl=1&app=1>)

The CCC is a voluntary databank where chemical names can be searched for, and companies providing a service or process that uses that chemical are listed. In the tables, the number of companies that were found to be associated with each chemical is reported.

Challenge: The Government of Canada's Challenge to Industry

(http://www.chemicalsubstanceschimiques.gc.ca/challenge-defi/index_e.html)

This section designates whether a substance was included in the Government's Challenge to Industry. This is a program that seeks to gather key information on Canadian production and uses of chemicals highlighted during the categorization of the DSL as high priorities for action. There are 12 'Batches' in the Challenge that divide up the approximately 200 substances into more manageable groups. The Challenge is a current initiative under the

recently created Chemical Substances program (Government of Canada). This information is only included in the tables for substances that appear in the Challenge.

CSI: ChemSources (Chemical Sources International) Database (http://db.chemsources.com/cgi-bin/foxweb.exe/validate_user@csi/login)

The ChemSources database is an online catalogue of chemical suppliers from around the world, searchable by chemical name or chemical abstract number (CAS). In our tables, we have noted how many (if any) Canadian suppliers were found in the database for each chemical.

CCOHS: Canadian Centre for Occupational Health and Safety MSDS Database

(<http://ccinfoweb.ccohs.ca/msds/search.html>)

The CCOHS maintains a databank of approximately 310,000 Material Safety Data Sheets (MSDS's) from over 2000 North American companies. In our tables, we include the number of MSDS's found for each chemical, which may give a sense of usage levels of chemicals in North America. In our searches, we also noted whether any Canadian companies were included as providers of the MSDS's (considered as part of the prioritization), although many commercial products cross the border.

US HPD: US National Library of Medicine Household Products Database (<http://hpd.nlm.nih.gov/>)

This American-based dataset is maintained by a branch of the National Library of Medicine in the National Institutes of Health in the US. It includes information (largely abstracted from MSDS's) about the ingredients in consumer goods on the market in the US (and because of free trade, most likely available in Canada as well). In our tables, we included the number of products found with the particular chemical in them, in addition to the general types of goods found (i.e. paints, adhesives, cleaning products, etc.).

Pathway: Pathway from NTP and ATSDR

This information, which was mostly collected in general searches of the NTP and ATSDR (see above), notes the potential routes of exposure for each substance, highlighting the most important one where available.

Environmental measurements: Preliminary Scan for Environmental Exposure Measurements

This section notes whether environmental data on potential exposures was found in our preliminary searches, if any. It should be noted that an exhaustive review of the literature for potential exposures has not yet been completed; this information is included to note where measurements are readily available.

Pesticide use surveys: Pesticide Surveys from Ontario and British Columbia (BC 1999:

http://www.pyr.ec.gc.ca/georgiaBasin/reports/Pesticide_Use_BC/GBEI_REPORT_01_032_e.pdf; BC 2003:

http://www.env.gov.bc.ca/epd/epdpa/ipmp/technical_reports/pesticide_survey2003/pest_survey_03.pdf;

Ontario 2003: <http://www.agcare.org/uploadattachments/pesticide%20survey%202003%20final%20report.pdf>).

Two surveys of pesticide usage patterns were carried out in British Columbia (one in 1999 and one in 2003). They were produced by a consulting firm for Environment Canada the BC Ministry of the Environment and include data on the types and quantities of pesticides sold and used in BC during those years. A similar pesticide use survey was produced in Ontario in 2003 by the Ontario Ministry of Agriculture and Food. These three surveys were used to ascertain pesticide usage patterns in these 2 provinces.

PMRA: The Pesticide Management Regulatory Agency Registration (http://pr-rp.pmra-arla.gc.ca/portal/page?_pageid=34,6928,34_6960:34_7232&_dad=portal&_schema=PORTAL)

PMRA is the governmental body in charge of the approval and review of all pesticides for use in Canada. The registration status of all pesticides on the 2B list was checked, and the tables include the number of registered products in Canada.

Mines/smelters and Geologic deposits: Information from NRCan and USGS

NRCan: Natural Resources Canada (<http://www.nrcan.gc.ca/>)

NRCan provides a variety of information on the location of mineral and metal geologic deposits in Canada, as well as the location and operational status of smelters (or other processing plants) and mines. This is in various forms, including the Mineral and Metal Commodity reviews, as well as many maps and other summaries.

USGS: US Geologic Survey (<http://minerals.usgs.gov/minerals/pubs/country/latin.html#ca>)

The USGS provides information on the mining industry worldwide, catalogued both by country and by commodity. These summaries were used to help determine whether active Canadian mining or exploration were taking place for each metal or mineral in the IARC 2B list.

Appendix C: Summary Table of Key Information Used in Prioritization Process, by category and in alphabetical order (begins with numbers)

Industrial chemicals

| Carcinogen (Industrial chemicals) | Carcinogenicity & Toxicity | Potential exposure circumstances (environmental) | Evidence of use/exposure | Priority |
|--|---|---|--|----------|
| 1,2-Dichloroethane (ethylene dichloride) | IARC 2B Neurotoxin; nephrotoxin; hepatotoxin CEPA: Toxic 'c' (human health) HC: Already risk managed | Living near industrial facilities; Using products in the home | NPRI 2006: 4 companies (9 tonnes) US HPD: 2 contact electronics cleaners Pathway: Inhalation (primarily); ingestion Environmental measurements: Yes, but outdated | Group B |
| 1,2-Epoxybutane (ethyloxirane; 1-butene oxide) | IARC 2B Moderate toxin CEPA: No HC: IPE | Using products in the home; Releases to the environment near chlorinated solvent plants | NPRI 2006: No releases since 2001 (0.1 tonne) US HPD: 2 contact electronics cleaners (aerosol) Pathway: Inhalation Environmental measurements: None noted | Group B |
| 1,3-Butadiene | IARC 1 Respiratory irritant; asphyxiant CEPA: Yes, paragraphs 'b' and 'c' HC: Already risk managed | Combustion byproducts (cigarette smoke, furnaces, lead smelters, petroleum refineries, traffic); Living near butadiene production facilities; Home-use products | NPRI 2006: 20 companies (82 tonnes) US HPD: 4 roofing cements/adhesives (many others in polymers) Pathway: Inhalation (primarily); ingestion (very minor) Environmental measurements: Yes, but outdated | Group A |
| 1,4-Dioxane (diethylene dioxide; dioxane) | IARC 2B Nephrotoxin; hepatotoxin CEPA: No HC: GPE | From residual in polyethylene glycol products (cosmetics, shampoos, auto fluids); In tap water (showers) | NPRI 2006: 3 companies (1 tonne) US HPD: 5 products (adhesives, paints, sealants) Pathway: Inhalation (primarily); ingestion; dermal Environmental measurements: Yes, but outdated | Group B |

CEPA = Canadian Environmental Protection Act; HC = Health Canada (GPE, IPE, LPE = greatest, intermediate, and lowest potential for exposure); CAREX = The Information System on Occupational Exposure to Carcinogens; NPRI = National Pollutant Release Inventory for 2006; US HPD = Household Products Database; Pathway = Routes of exposure; Environmental measurements = Literature-based data found (Note: comprehensive search not yet performed); Geologic deposits = Locations of geologic deposits in Canada (geology/mining information abstracted from USGS (United States Geologic Survey) and NRCan (Natural Resources Canada)); Pesticide Use Survey = Amounts used in BC and Ontario (from 3 reports; see references in Appendix B). Note: CNS = Central nervous system

| Carcinogen (Industrial chemicals) | Carcinogenicity & Toxicity | Potential exposure circumstances (environmental) | Evidence of use/exposure | Priority |
|---|---|--|--|---|
| 2,6-Dimethylaniline (xylidine) | IARC 2B Health effects not located CEPA: No HC: LPE | Breakdown product of many widely-used pesticides and anesthetics; Present in cigarette smoke | NPRI 2006: Not found US HPD: None listed Pathway: Inhalation (primarily); dermal; ingestion Environmental measurements: None noted | Group B: breakdown product of many registered drugs and pesticides |
| 2,3,7,8-Tetrachlorodibenzo-para-dioxin (dioxin; TCDD) | IARC 1 Chloracne; thyroid disease; liver disease; infectious agent CEPA: Yes, paragraphs 'a' and 'c' HC: No | Produced from waste incineration and metal smelting; Food (highly bioaccumulative - meat, milk, eggs, fish) | NPRI 2006: 4 companies (1 gram, TEQ) US HPD: None listed Pathway: Ingestion (foods) Environmental measurements: Yes | Group A: No longer produced, but minor amounts inadvertently released. Accumulates in food sources. |
| 3,3'-Dimethylbenzidine (o-tolidine) | IARC 2B Skin & eye irritant CEPA: No HC: LPE | Via swimming pools/hot tubs (chemical testing kits); In consumer products | NPRI 2006: Not found US HPD: None listed Pathway: Inhalation; dermal; ingestion Environmental measurements: Likely, but not noted | Group B: potential for exposure to many people at low levels |
| 4,4'-Methylene bis(2-chloroaniline) (MOCA or MBOCA) | IARC 2A Blood problems; kidney and liver damage CEPA: No HC: IPE | Trace amounts: polyurethane resin consumer products; Drinking water contamination | NPRI 2006: 7 companies (14 tonnes) US HPD: None listed Pathway: Ingestion (water); inhalation Environmental measurements: Yes | Group B: Exposures likely to be low, but releases still occurring. |
| Acetaldehyde (ethanal) | IARC 2B CNS depressant; severe irritant CEPA: Toxic 'b' and 'c' (environment; human health) HC: Already risk managed | Combustion product (especially motor vehicles); Metabolic byproduct of alcohol consumption, higher plants; Home-use products | NPRI 2006: 86 companies (1300 tonnes) US HPD: 3 hobby glues; 1 roof leveler Pathway: Inhalation (primarily) Environmental measurements: Yes | Group A: exposures from many sources |

CEPA = Canadian Environmental Protection Act; HC = Health Canada (GPE, IPE, LPE = greatest, intermediate, and lowest potential for exposure); CAREX = The Information System on Occupational Exposure to Carcinogens; NPRI = National Pollutant Release Inventory for 2006; US HPD = Household Products Database; Pathway = Routes of exposure; Environmental measurements = Literature-based data found (Note: comprehensive search not yet performed); Geologic deposits = Locations of geologic deposits in Canada (geology/mining information abstracted from USGS (United States Geological Survey) and NRCan (Natural Resources Canada)); Pesticide Use Survey = Amounts used in BC and Ontario (from 3 reports; see references in Appendix B). Note: CNS = Central nervous system

| Carcinogen (Industrial chemicals) | Carcinogenicity & Toxicity | Potential exposure circumstances (environmental) | Evidence of use/exposure | Priority |
|---|--|--|---|--|
| Acrylamide | IARC 2A Irritant; skin blistering; CNS depressant CEPA: No HC: GPE | Monomer found in drinking water (treated with polyacrylamide); Found in some foods (formed during cooking starchy foods) | NPRI 2006: 6 companies (2 tonnes) US HPD: >50 products with acrylamide polymers (personal care) Pathway: Ingestion (primarily); inhalation Environmental measurements: Likely, but not noted | Group B: Environmental releases occurring; found in food and drinking water. |
| Acrylonitrile (vinyl cyanide) | IARC 2B Hepatotoxin CEPA Toxic 'c' (human health) HC: Already risk managed | Living near industrial sites (polymer and resin production); Consumer products (low risk) | NPRI 2006: 11 companies (36 tonnes) US HPD: 1 auto defogger; 1 adhesive (acrylonitrile polymer only) Pathway: Inhalation (primarily); dermal Environmental measurements: Yes, but limited | Group B: Largely occupational concerns, but could be higher for specific pop's |
| Benzene | IARC 1 Irritant; CNS depressant; blood problems CEPA: Yes, paragraph 'c' HC: Already risk managed | Diesel and gasoline exhaust; Exposures during refueling; Contaminated drinking water; Proximity to industrial sites | NPRI 2006: 218 companies (1600 tonnes) US HPD: 2 paints; 1 wood finish; 1 adhesive remover; 1 degreaser Pathway: Inhalation (primarily); ingestion (water); dermal Environmental measurements: Yes | Group A |
| Benzyl chloride | IARC 2A Irritant; blood problems; CNS depressant; lung damage CEPA: No HC: GPE | Contaminated air (living near industrial sites) | NPRI 2006: 2 companies (34 tonnes) US HPD: None listed Pathway: Inhalation (primarily) Environmental measurements: Not noted | Group B: Point sources likely important for population sub-groups. |
| Bitumens, extracts of steam and air-refined (asphalt) | IARC 2B Severe burns; dermatitis; keratosis; skin, eye and respiratory irritant CEPA: No HC: GPE | Via home-use products; Living near where paving/roofing is occurring; Runoff from paved roads | NPRI 2006: Not found US HPD: >60 products (roofing cements and driveway sealants) Pathway: Inhalation (primarily); dermal; ingestion Environmental measurements: Yes, but few | Group B: this is normally measured as PAHs, so it could be included there |

CEPA = Canadian Environmental Protection Act; HC = Health Canada (GPE, IPE, LPE = greatest, intermediate, and lowest potential for exposure); CAREX = The Information System on Occupational Exposure to Carcinogens; NPRI = National Pollutant Release Inventory for 2006; US HPD = Household Products Database; Pathway = Routes of exposure; Environmental measurements = Literature-based data found (Note: comprehensive search not yet performed); Geologic deposits = Locations of geologic deposits in Canada (geology/mining information abstracted from USGS (United States Geologic Survey) and NRCan (Natural Resources Canada)); Pesticide Use Survey = Amounts used in BC and Ontario (from 3 reports; see references in Appendix B). Note: CNS = Central nervous system

| Carcinogen (Industrial chemicals) | Carcinogenicity & Toxicity | Potential exposure circumstances (environmental) | Evidence of use/exposure | Priority |
|--|---|---|--|--|
| Carbon black | IARC 2B Lung function problems; pneumoconiosis; skin problems CEPA: No HC: GPE | Combustion byproduct; Home-use products (including cosmetics) | NPRI 2006: Not found US HPD: >100 products (shoe polish, paints, inks, wood finishers, etc.) Pathway: Inhalation; dermal Environmental measurements: Likely, but not noted | Group B: prioritized by HC; home use exposures. Might include under PAH. |
| Carbon tetrachloride (tetrachloromethane) | IARC 2B Hepatotoxin; neurotoxin CEPA Toxic 'c' (human health) HC: Already risk managed | Living near industrial or waste sites (low levels ubiquitous, accumulates over time) | NPRI 2006: 2 companies (0.3 tonne) US HPD: 3 adhesive kits Pathway: Inhalation and ingestion (primarily - water); dermal (while showering, minor) Environmental measurements: Yes | Group B: most people exposed at some level. |
| Catechol (1,2-benzenediol) | IARC 2B CNS depressant; eczema & dermatitis CEPA: No HC: IPE | Cigarette smoke; Occurs naturally in fruits & vegetables; Living near industrial sites (paper mills); Biomarker of benzene exposure | NPRI 2006: 1 company (0.005 tonne) US HPD: None listed Pathway: Ingestion (primarily); inhalation Environmental measurements: None noted | Group B - exposure probable; further investigation on exposures needed though |
| Chlorinated paraffins, average length C12 and ~60% chlorination (short-chain chlorinated paraffins, or SCCP) | IARC 2B Relatively non-toxic CEPA: PSL1 HC: Already risk managed | Home-use products; Living near industrial sites (metalworking fluids; leaching from paints and coatings) | NPRI 2006: Not found US HPD: 3 products (auto sealants) under 'chlorinated paraffins' Pathway: Ingestion (primarily - food); dermal; inhalation; ingestion (water or breast milk) Environmental measurements: Yes | Group B: many sources of exposure to Canadians |
| Chloroform (trichloromethane) | IARC 2B CNS depressant CEPA: PSL2 HC: Already risk managed | Via chlorinated drinking water; Living near industrial sites (pulp and paper mills) | NPRI 2006: 13 companies (68 tonnes) US HPD: 1 adhesive remover Pathway: Ingestion (primarily - water); inhalation, ingestion (food) Environmental measurements: Yes | Group A: chlorination byproduct, as well as industrial sources. |
| Coal tar and coal tar pitches | IARC 1 Severe eye and skin problems CEPA: No HC: GPE | Via pharmaceutical use (registered in Canada in 57 products - skin treatments); Environmental contamination near petroleum refining | NPRI 2006: Not found US HPD: 5 driveway sealants (for coal-tar pitches) Pathway: Inhalation; ingestion; dermal Environmental measurements: Likely | Group B: Many exposure sources; most important is inhalation (most consumers exposed dermally) |

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| Carcinogen (Industrial chemicals) | Carcinogenicity & Toxicity | Potential exposure circumstances (environmental) | Evidence of use/exposure | Priority |
|---|--|--|---|--|
| Creosotes | IARC 2A Severe eye and skin problems; irritant CEPA: Yes, paragraph 'a' HC: LPE | Registered in 7 heavy-duty wood preservatives by the PMRA. Use: BC: 2200 tonnes in 2003, 5400 tonnes in 1999; Exposure via contaminated industrial sites; Potentially via food | NPRI 2006: Not found US HPD: None listed Pathway: Inhalation; dermal; ingestion Environmental measurements: Likely, but not noted | Group B: used as a pesticide |
| Dichloroacetic acid (DCA) | IARC 2B Neurotoxin; corrosive; irritant CEPA: No HC: LPE | Via chlorinated or ozonated drinking water; Most abundant haloacetic acid in the Canadian environment; Off-label use as a pharmaceutical | NPRI 2006: Not found US HPD: None listed Pathway: Ingestion (primarily - water) Environmental measurements: Likely, but not located | Group B: could be considered as a group with chlorination byproducts |
| Dichloromethane (methylene chloride; DCM) | IARC 2B CNS depressant, skin/lung irritant, mutagen CEPA Toxic 'c' (human health) HC: Already risk managed | Home-use products; Living near industrial sites (chemical manufacture; plastics - most DCM ultimately released to the environment) | NPRI 2006: 61 companies (361 tonnes) US HPD: 10 automotive cleaners & degreasers; 12 paints & adhesive removers; 1 lubricant; 1 herbicide Pathway: Inhalation (primarily); ingestion (water) Environmental measurements: Yes | Group A: envntl releases occurring; home-use products |
| Diesel fuel, marine | IARC 2B Skin irritant; ulceration; lung damage; renal failure and GI symptoms after acute exposure CEPA: No HC: GPE | Exposure during refueling (recreational); Environmental exposures from spills/ contamination | NPRI 2006: Not found US HPD: None listed Pathway: Dermal (refueling); inhalation (mostly of combustion products); ingestion (contaminated environments) Environmental measurements: None found | Group B: Unable to find specific information, but some likely exposed. |

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| Carcinogen (Industrial chemicals) | Carcinogenicity & Toxicity | Potential exposure circumstances (environmental) | Evidence of use/exposure | Priority |
|---|---|--|---|--|
| Epichlorohydrin (chloromethyl oxirane) | IARC 2A Skin burns; sensitization; bronchial asthma; dermatitis CEPA: No HC: GPE | Industrial emissions (air and water) | NPRI 2006: Yes, but no releases since 2003 (0.002 tonne) US HPD: 14 products (polymerized with Bisphenol A) Pathway: Inhalation (primarily); dermal Environmental measurements: Not noted | Group B: Minimal releases reported, but it is persistent in the environment. |
| Ethyl acrylate (acrylic acid ethyl ester) | IARC 2B Potent irritant; CNS depressant CEPA: No HC: GPE | Spills and industrial discharge (acrylic resin industry) | NPRI 2006: 6 companies (0.134 tonne) US HPD: 1 sealant Pathway: Inhalation (primarily); dermal, ingestion (water, fish) Environmental measurements: Likely, but not found | Group B: if exposures can be found, would be interesting |
| Ethylbenzene | IARC 2B Irritant; nervous system disorders; hepatotoxin CEPA: No HC: GPE | Home use products; Cigarette smoke; Living near industrial sites (especially petroleum refining, styrene and plastics); Combustion byproduct (traffic) | NPRI 2006: : 284 companies (1200 tonnes) US HPD: >300 products (mostly paints, as well as decorative snow); 4 insecticides Pathway: Inhalation (primarily - indoor air); ingestion Environmental measurements: Yes | Group A: many exposure routes, very common chemical, measures available. |
| Ethylene oxide | IARC 1 Irritant; CNS depressant; irritant-induced asthma CEPA: Yes, paragraph 'c' HC: Already risk managed | Living near an industrial site or hospital; Consumption / use of fumigated foods or medical items | NPRI 2006: 9 companies (18 tonnes) US HPD: 1 polisher; 1 rust remover; 1 paint; 2 sealants Pathway: Inhalation (primarily); ingestion Environmental measurements: Yes | Group A |

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| Carcinogen (Industrial chemicals) | Carcinogenicity & Toxicity | Potential exposure circumstances (environmental) | Evidence of use/exposure | Priority |
|-----------------------------------|---|---|---|--|
| Formaldehyde | IARC 1 Irritant; respiratory symptoms; nasal problems; dermatitis CEPA: Yes, paragraphs 'b' and 'c' HC: Already risk managed | Combustion product (vehicles, forest fires, etc.); Consumer products; Industrial/agricultural releases; Emissions from furnishings and wood products | NPRI 2006: 172 companies (2336 tonnes) US HPD: > 20 products (glues, insulation, shampoo, 1 aquatic plant fertilizer, 1 glaze); allowed in cosmetics Pathway: Inhalation (primarily) Environmental measurements: Yes | Group A |
| Fuel oils, residual (heavy) | IARC 2B CNS depressant; kidney damage CEPA: No HC: GPE | Exposure via home use of fuel oils (heating); Potentially spills from power plants; Living near transport corridors | NPRI 2006: Not found US HPD: None listed Pathway: Inhalation; dermal Environmental measurements: None noted | Group B - this likely captured under PAH. |
| Furan | IARC 2B CNS depressant; GI symptoms CEPA: No HC: LPE | Combustion byproduct (living near traffic, petroleum refining); Cigarette smoke; Via its use as a chemical intermediate | NPRI 2006: Not found US HPD: None listed Pathway: Inhalation (primarily); ingestion Environmental measurements: Yes, but limited | Group B: PAH, as well as a chemical intermediate |
| Gasoline | IARC 2B Eye irritant; CNS depressant; skin problems; death (at high exposures) CEPA: No HC: LPE | Off-gassing near spills; Home exposures from refueling lawnmowers; Exposures while refueling vehicles | NPRI 2006: Not found US HPD: None listed Pathway: Inhalation (primarily); dermal; ingestion (drinking water) Environmental measurements: Yes, very likely (literature) | Group B |
| Hydrazine | IARC 2B Severely corrosive; dermatitis; irritant; CNS depressant; kidney & liver damage CEPA: No HC: IPE | Cigarette smoke; Living near industrial sites (nuclear power plants or chemical manufacture) | NPRI 2006: 4 companies (2 tonnes) US HPD: None listed Pathway: Inhalation (primarily); ingestion (processed foods) Environmental measurements: Likely, but limited | Group B: IPE, but rapidly degraded in the envnt. |

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| Carcinogen (Industrial chemicals) | Carcinogenicity & Toxicity | Potential exposure circumstances (environmental) | Evidence of use/exposure | Priority |
|-----------------------------------|---|--|---|--|
| Isoprene | IARC 2B Irritant; CNS depressant CEPA: No HC: GPE | Natural organic sources (humans and plants); Biomass combustion; Cigarette smoke | NPRI 2006: 3 companies (15 tonnes) US HPD: None listed Pathway: Inhalation (primarily); ingestion (food, mostly plants) Environmental measurements: Yes | Group B |
| Naphthalene | IARC 2B Causes skin rashes; blood problems; neuropathy and chronic renal failure CEPA: No HC: GPE | Home use products (including mothballs); Combustion byproduct (wood smoke, traffic, etc.); Cigarette smoke | NPRI 2006: 80 companies (480 tonnes) US HPD: 15 gasoline additives/fuel injector cleaners; 8 paints; 1 oil product (outboard engines); 6 pesticides (repellants) Pathway: Inhalation (primarily); dermal; ingestion (mothballs) Environmental measurements: Yes | Group B: could also be included under PAH exposures. |
| Nitritotriacetic acid & its salts | IARC 2B Irritant; causes pain, coughing, dyspnea, GI irritant (if ingested); kidney and genetic damage CEPA: No HC: IPE | Chlorination of drinking water; Home-use products; Living near industrial sites (soap and other chemical manufacture; pulp and paper mills) | NPRI 2006: 7 companies (6 tonnes) US HPD: For "trisodium salt": one soap scum remover, one stain remover Pathway: Ingestion (primarily - water); dermal (home-use products) Environmental measurements: Yes | Group B: chlorination byproduct, as well as use in home products. |
| Nitrobenzene | IARC 2B Extremely toxic: blood problems; dyspnea; weakness; hepatotoxin; coma; potentially death CEPA: No HC: LPE | Living near production facilities (or petroleum refineries, leather finishing, etc.); Formed in the environment from benzene (higher in urban areas and in the summer) | NPRI 2006: Nothing recorded since 1994 US HPD: None listed Pathway: Inhalation (primarily); dermal Environmental measurements: Yes, but mostly outdated | Group B: production may be increasing; Group Aly toxic; major producer in Canada. |
| N-Nitrosodi-n-propylamine | IARC 2B No non-carcinogenic information found. CEPA: No HC: No | Nitrite treated foods (i.e .cheese, meat); Via contaminated pesticides (registered in Canada); Found in alcohol and cigarette smoke; New interest as a chlorination byproduct | NPRI 2006: Not found US HPD: n/a Pathway: Ingestion (primarily) Environmental measurements: Not located | Group B: a few exposures of interest. Should keep on the radar because it may be a chlorination byproduct. |

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| Carcinogen (Industrial chemicals) | Carcinogenicity & Toxicity | Potential exposure circumstances (environmental) | Evidence of use/exposure | Priority |
|---|---|--|---|--|
| N-Nitrosomethylethylamine | IARC 2B No non-carcinogenic information found. CEPA: No HC: No | Nitrite treated foods (i.e .cheese, meat); Found in alcohol and cigarette smoke; New interest as a chlorination byproduct | NPRI 2006: Not found US HPD: n/a Pathway: Ingestion (primarily) Environmental measurements: Not located | Group B: a few exposures of interest. Should keep on the radar because it may be a chlorination byproduct. |
| p-Chloroaniline | IARC 2B Blood problems (acute exposure) CEPA: No HC: LPE | Via the breakdown of pesticides, household products and dyes | NPRI 2006: Not found US HPD: No, but the pesticide triclocarban (of which p-chloroaniline is a break-down product) is found in 6 soaps Pathway: Dermal (textiles); ingestion (water, from clothing and food) Environmental measurements: Yes | Group B: found in many home-use products, pharmaceuticals, pesticides as a contaminant/break-down product. |
| Polychlorinated biphenyls (PCBs) | IARC 2A Irritant; blood problems; rashes; conjunctivitis; GI symptoms CEPA: Yes, paragraphs 'a', 'b', and 'c' HC: Already risk managed | Highly persistent - exposures via food, breast milk; Living near toxic waste sites | NPRI 2006: Not found US HPD: None listed Pathway: Ingestion; inhalation; dermal Environmental measurements: Yes, and in Health Measures Survey | Group A: High public interest, samples available, very persistent |
| Potassium bromate (potassium salt of bromic acid) | IARC 2B Irritant; kidney and liver damage CEPA: No HC: IPE | Via ozonated water (chlorination byproduct); Used as a dough conditioner (only in US food products); Potentially in home perm kits | NPRI 2006: Yes but no reports on record US HPD: None listed Pathway: Ingestion; dermal (speculating, from perm kits) Environmental measurements: Yes, limited | Group B: Not allowed in Canadian bread anymore - but is allowed in the US. Ozonation product as well. |
| Propylene oxide (PO; methyl oxirane) | IARC 2B CNS depressant; irritant CEPA: No HC: GPE | Food additive (almonds); Consumer products (i.e. automotive and paint products) | NPRI 2006: 1 company (0.04 tonne) US HPD: 1 engine lubricant Pathway: Ingestion; dermal Environmental measurements: Likely, but not noted | Group B: recently approved as a food additive; levels in consumer products needed. |

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| Carcinogen (Industrial chemicals) | Carcinogenicity & Toxicity | Potential exposure circumstances (environmental) | Evidence of use/exposure | Priority |
|-----------------------------------|--|---|--|--|
| Styrene | IARC 2B Neurotoxin, skin/lung irritant; 'styrene sickness' CEPA: Priority Substances List 1 (not CEPA toxic) HC: Already risk managed | Cigarette smoke + other combustion sources; Living near styrene, plastics, or rubber facilities (industrial waste); Food containers | NPRI 2006: 130 companies (2900 tonnes) US HPD: 10 autobody fillers and cements Pathway: Inhalation (primarily); ingestion; dermal (soil) Environmental measurements: Yes | Group A: Extensive releases; measurements available; varied exposure sources |
| Styrene-7,8-oxide (styrene oxide) | IARC 2A Skin irritant/sensitizer CEPA: No HC: LPE | Migration from resins/plastics into food; Living near styrene facilities (releases to air/water) | NPRI 2006: Yes but no release since 1998 (3 companies, 0.343 tonne) US HPD: None listed Pathway: Ingestion; inhalation Environmental measurements: Yes, in food | Group B: Exposures likely occurring, but extent unknown. |
| Tetrachloroethylene | IARC 2A Dermatitis; irritant; CNS depressant; liver and kidney damage CEPA: Yes, paragraph 'a' HC: Already risk managed | From dry-cleaned clothing; Home use products; Via food and drinking water (may be formed during chlorination also) | NPRI 2006: 39 companies (88 tonnes) US HPD: >30 products (auto part cleaners, lubricants, hobby adhesives, stain removers) Pathway: Inhalation; ingestion Environmental measurements: Yes | Group A |
| Tetrafluoroethylene (TFE) | IARC 2B Respiratory irritant CEPA: No HC: LPE | Released from overheating of Teflon® (non-stick pans); Living near TFE or Teflon® production facilities | NPRI 2006: Not found US HPD: None listed, but it is released when Teflon® is heated Pathway: Inhalation (primarily) Environmental measurements: Not noted | Group B |

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| Carcinogen (Industrial chemicals) | Carcinogenicity & Toxicity | Potential exposure circumstances (environmental) | Evidence of use/exposure | Priority |
|---|---|---|--|---|
| Toluene diisocyanates | IARC 2B Potent cause of occupational asthma; lung function problems; hypersensitivity pneumonitis CEPA: No HC: GPE | Consumer products (especially polyurethane varnishes) | NPRI 2006: 2,4-TDI: 6 companies (2.2 tonnes); 2,6-TDI, 5 companies (0.2 tonne); 'TDI-mixed isomers', 23 companies (3.7 tonnes). US HPD: 1 concrete sealant Pathway: Inhalation (primarily); ingestion (food) (very minor) Environmental measurements: Likely, but not noted | Group B: Levels released from consumer products needed. |
| Trichloroethylene (TCE) | IARC 2A Dermatitis, irritant, CNS depressant, liver and kidney damage CEPA: Yes, paragraphs 'a' and 'c' HC: Already risk managed | Via industrial effluents (primarily wastewater); Drinking water and food exposures; Home use products | NPRI 2006: 49 companies (710 tonnes) US HPD: 6 auto and home cleaners/ degreasers; 1 auto part undercoating; 2 hobby adhesives; 1 film cleaner (hobby); 1 printer toner Pathway: Inhalation; ingestion Environmental measurements: Yes | Group B |
| Vinyl acetate (acetic acid ethenyl ester) | IARC 2B Lung function problems; heart muscle deterioration; irritant CEPA: No HC: GPE | Consumer goods (glues, liquid caulking, bonding adhesives, paints, paper coatings, food additives) | NPRI 2006: 16 companies (200 tonnes) US HPD: 10 glues and other adhesives Pathway: Inhalation; dermal; ingestion (food) Environmental measurements: Not noted | Group B: levels in consumer goods and other environmental media needed. |
| Vinyl chloride | IARC 1 Reduced circulation; scleroderma; CNS depression; liver damage CEPA: Yes (paragraph not noted) HC: Already risk managed | Emissions (air & water) from industrial sites; May be present in some foods from packaging; Breakdown of trichloroethane, & tri- and tetra-chloroethylene | NPRI 2006: 7 companies (7 tonnes) US HPD: No, but many for polyvinyl chloride (pipe and plumbing cements) Pathway: Inhalation (primarily); ingestion; dermal Environmental measurements: Likely | Group B: Levels in food, water, and consumer products should be found. |

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Metals

| Carcinogen (Metals) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|-----------------------------------|--|---|---|--|
| Antimony trioxide | IARC 2B Pneumoconiosis, respiratory irritant, reproductive toxin CEPA: No HC: GPE | Migration from plastic water bottles; Combustion of coal and petroleum products Home use of insulation | NPRI 2006: 56 companies (127.5 tonnes) (as 'antimony & compounds') US HPD: 24 (insulations) Pathway: Inhalation; ingestion (drinking water) Environmental measurements: Yes, from bottled water; Health Measures Survey Geologic deposits: Lake George, NB, Beaver Brook, NFLD and by product of lead-zinc mine at Bathurst, NB | Group B: May be difficult to estimate exposures; many Canadians likely exposed though. |
| Arsenic and arsenic compounds | IARC 1 Extreme skin problems; GI symptoms; liver and kidney damage CEPA: Yes, paragraphs 'a' and 'c' HC: Already risk managed | Via arsenic-contaminated drinking water; Via paints and pigments containing arsenic; Environmental releases from industrial sources | NPRI 2006: 220 companies (533 tonnes) US HPD: 8 products (paints, cement colourants) Pathway: Ingestion (primarily); inhalation; dermal Environmental measurements: Yes, and in Health Measures Survey Geologic deposits: Found in every province. Hot spots mostly in Yukon and BC, Baffin Island, and New Brunswick | Group A |
| Beryllium and beryllium compounds | IARC 1 Chronic beryllium disease; other lung problems; severe skin problems; organ damage CEPA: No HC: LPE | Mostly via the combustion of coal; Ingestion of drinking water and food | NPRI 2006: Not found US HPD: 1 paint thinner Pathway: Inhalation; ingestion Environmental measurements: Yes Geologic deposits: Found at low levels in Canada (mostly as beryl-type minerals (i.e. emeralds), and bertrandite), mostly in northern BC and southern Yukon, as well as the NWT. | Group B: Mostly an occupational exposure of concern, but many US measurements noted for environmental. |

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| Carcinogen (Metals) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|-----------------------------------|---|---|---|----------|
| Cadmium and cadmium compounds | IARC 1 Pulmonary problems; blood problems; reproductive toxin CEPA: Yes, paragraphs 'a' and 'c' HC: Already risk managed | Hobbyist welders or amateur artists; Via food and drinking water | NPRI 2006: 358 companies (350 tonnes) US HPD: 50 products: 2 hobby ceramic glazes; >30 artistic oil paints; various other colourants and sealants Pathway: Ingestion (mostly food); inhalation Environmental measurements: Yes, and Health Measures Survey Geologic deposits: Often found in lead-zinc sulfide formations; widespread in Canada (important ones in BC, NWT, and ON). | Group A |
| Chromium VI (hexavalent chromium) | IARC 1 Pneumoconiosis; skin problems; irritant CEPA: Yes, paragraphs 'a' and 'c' HC: No | Living near industrial facilities that use chromium(VI) compounds or near chromium waste disposal; Via contaminated drinking water; Handling wood treated with chromated copper arsenate (CCA). | NPRI 2006: 257 companies (232 tonnes) US HPD: 7 concrete cements; 1 mortar - all trace amounts; 1 paint thinner; 1 sealant containing unspecified chromium compounds Pathway: Inhalation; ingestion (water); dermal (i.e. handling treated wood) Environmental measurements: Yes Geologic deposits: The main chromite deposits occur in QC, ON, BC, MB, and NL. Cr[VI] can be formed from Cr[III] under certain environmental conditions. | Group A |
| Cobalt and cobalt compounds | IARC 2B Skin reactions, asthma and other lung diseases CEPA: No HC: GPE | Combustion byproduct (vehicle exhaust, burning of fossil fuels); Living near industrial sites; Home use products; Occurs in vegetables and animal derived food | NPRI 2006: 68 companies (150 tonnes) US HPD: >70 (primarily paints, glazes, and stains) Pathway: Inhalation (primarily); dermal; ingestion Environmental measurements: Yes Geologic deposits: Manitoba; Ontario; Northern Quebec; Newfoundland. | Group B |

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| Carcinogen (Metals) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|-----------------------------------|---|---|---|----------|
| Lead (2B) and lead compounds (2A) | IARC 2A and 2B Neurotoxic, nephrotoxic, reproductive toxin, hypertension CEPA: Yes, paragraph 'c' HC: Already risk managed | Living near smelters, mines, processing facilities; Bioaccumulative; Older homes and paint; Consumer products (toys) | NPRI 2006: 673 companies (7900 tonnes) US HPD: 4 solder kits; 1 cement colourant; 1 ceramic glaze Pathway: Inhalation; ingestion (lead dust and drinking water); dermal Environmental measurements: Yes, and Health Measures Survey Geologic deposits: Every province except PEI, Alberta, and Saskatchewan | Group A |
| Methylmercury compounds (MeHg) | IARC 2B Severe neurotoxin (developmental and prenatal) CEPA: Only mercury listed; paragraph 'c'. HC: No | Consumption of fish & shellfish | NPRI 2006: For 'mercury and its compounds' 276 companies (60000 kg). MeHg likely small proportion. US HPD: None listed Pathway: Ingestion (fish) Environmental measurements: Yes, and Health Measures Survey Geologic deposits: For mercury, BC and ON | Group B |
| Nickel (2B) and its compounds (1) | IARC 1 & 2B Sarcomas, skin problems, chronic bronchitis CEPA: No (nickel compounds are, but not metallic) HC: Already risk managed | Contaminated food & drinking water; Living near industrial sites (mining or processing); Home-use products | NPRI 2006: For 'nickel and its compounds': 314 companies (13,800 tonnes) US HPD: 6 concrete colourants & sealants; 1 joint grease; 1 paint thinner Pathway: Ingestion (primary); dermal; inhalation Environmental measurements: Yes, and in Health Measures Survey Geologic deposits: Across Canada | Group A |
| Vanadium pentoxide | IARC 2B Respiratory and skin irritant CEPA: No HC: GPE | Living near industrial sources (coal and oil combustion) | NPRI 2006: 62 companies (1750 tonnes) US HPD: None listed Pathway: Inhalation (primary); dermal Environmental measurements: Likely, and in Health Measures Survey Geologic deposits: Northern Manitoba, northern Quebec | Group B |

CEPA = Canadian Environmental Protection Act; HC = Health Canada (GPE, IPE, LPE = greatest, intermediate, and lowest potential for exposure); CAREX = The Information System on Occupational Exposure to Carcinogens; NPRI = National Pollutant Release Inventory for 2006; US HPD = Household Products Database; Pathway = Routes of exposure; Environmental measurements = Literature-based data found (Note: comprehensive search not yet performed); Geologic deposits = Locations of geologic deposits in Canada (geology/mining information abstracted from USGS (United States Geologic Survey) and NRCan (Natural Resources Canada)); Pesticide Use Survey = Amounts used in BC and Ontario (from 3 reports; see references in Appendix B). Note: CNS = Central nervous system

Pesticides

| Carcinogen (Pesticides) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|------------------------------|--|--|---|----------|
| 1,3-Dichloropropene (telone) | IARC 2B Irritant and sensitizer CEPA: No HC: No | Contaminated drinking water; Also likely a chlorination byproduct; Used as a soil fumigant for root rot, and a nematocide for a wide variety of crops. | NPRI 2006: Not found US HPD: None listed Pathway: Inhalation; ingestion (drinking water); dermal Environmental measurements: None noted, but organochlorine pesticides in Health Measures Survey Pesticide use survey: BC: None (2003, 1999), > 6 tonnes (1991); ON: ~250 tonnes (2003) | Group B |
| 2,4-D | IARC 2B Irritant, CNS and GI toxin CEPA: No HC: LPE | Living near areas of use; Residues on food/water; Home-use of herbicides; Primarily used on cereal crops, but allowed on many others | NPRI 2006: Not found US HPD: 18 herbicides Pathway: Inhalation; ingestion; dermal Environmental measurements: Yes, and in the Health Measures Survey Pesticide use survey: BC: >18 tonnes (1999), 15 tonnes (2003); ON: 87 tonnes (2003) | Group A |
| 2,4-DP (dichlorprop) | IARC 2B Irritant, CNS and GI toxin CEPA: No HC: No | Living near areas of use; Residues on food/water; Home-use of herbicides; Primarily used on cereal crops and orchards | NPRI 2006: Not found US HPD: 1 herbicide Pathway: Inhalation; ingestion; dermal Environmental measurements: None noted Pesticide use survey: BC: 161 kg (1999); not listed (2003); ON: 9 tonnes (2003) | Group B |
| 2,4,5-T | IARC 2B Irritant, CNS and GI toxin CEPA: No HC: No | Contaminated food or water; Not used any longer on crops | NPRI 2006: Not found US HPD: None listed Pathway: Ingestion Environmental measurements: None noted Pesticide use survey: Not included | Group B |
| Chlorothalonil | IARC 2B Dermatitis, photosensitization, eye irritant CEPA: No HC: LPE | Living near areas of use; Food residues, drinking water; Home-use products; Allowed on many crops: fruits, vegetables, cereals, etc. | NPRI 2006: Not found US HPD: 9 paints; 3 fungicides Pathway: Inhalation; dermal; ingestion Environmental measurements: Yes Pesticide use survey: BC: >26 tonnes (1999), >33 tonnes (2003); ON: >38 tonnes (2003) | Group A |

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| Carcinogen (Pesticides) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|----------------------------------|---|---|--|----------|
| DDT | IARC 2B Severe neurotoxin CEPA: Schedule 1 HC: Already risk managed | Bioaccumulates: most current exposure via food (especially fish); Not allowed for use on crops | NPRI 2006: Not found US HPD: None listed Pathway: Ingestion (contaminated food) Environmental measurements: Yes, and organo-chlorine pesticides are in the Health Measures Survey Pesticide use survey: Not included | Group B |
| Dichlorvos | IARC 2B Neurotoxin CEPA: No HC: LPE | Food residues (low); Living near areas of use; Home-use products (pet collar/insect strips); Not used on crops, mostly in food storage areas | NPRI 2006: Not found US HPD: 2 pest strips Pathway: Inhalation; dermal; ingestion (low) Environmental measurements: Likely, and organophosphate pesticides are in the Health Measures Survey. Pesticide use survey: BC: 137 kg (1999), 658 kg (Naled - parent compound) (1999), dichlorvos listed but no amounts (2003). ON: dichlorvos not listed, 315 kg of Naled (2003) | Group A |
| Hexachlorobenzene | IARC 2B Hepatotoxin; neurotoxin; skin problems CEPA: Yes, paragraphs 'a' and 'c' HC: Already risk managed | During production of chlorinated hydrocarbons, aluminum casting, waste burning; No longer used on crops | NPRI 2006: 335 companies (24 kg) US HPD: None listed Pathway: Ingestion (primarily) Environmental measurements: None noted, but organochlorine pesticides in Health Measures Survey Pesticide use survey: No | Group B |
| Lindane (hexchloro-cyclohexanes) | IARC 2B Neurotoxin; hepatotoxin; nephrotoxin CEPA: Schedule 3 (export control list) HC: LPE | Contaminated food (meat, dairy products, breast milk); Bioaccumulative and volatile (long range transport); Home use products (shampoo) | NPRI 2006: Not found US HPD: None listed Pathway: Ingestion (primary - contaminated food); dermal Environmental measurements: None noted, but organochlorine pesticides in Health Measures Survey Pesticide use survey: BC: 239 kg (1999); 152 kg (2003) | Group A |

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| Carcinogen (Pesticides) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|-------------------------|--|---|---|----------|
| MCPA | IARC 2B Irritant; CNS and GI toxin CEPA: No HC: No | Living near areas of use; Residues on food/water; Home-use of herbicides; Mostly used on cereals, also aquatic weeds | NPRI 2006: Not found US HPD: 1 herbicide Pathway: Inhalation; ingestion; dermal Environmental measurements: None noted Pesticide use survey: BC: >10 tonnes (1999); 13 tonnes (2003); ON: 130 tonnes (2003) | Group A |
| MCPP (Mecoprop) | IARC 2B Irritant; CNS and GI toxin CEPA: No HC: No | Living near areas of use; Residues on food/water; Home-use of herbicides; Mostly used on cereal crops | NPRI 2006: Not found US HPD: 8 herbicides Pathway: Inhalation; ingestion; dermal Environmental measurements: None noted Pesticide use survey: BC: > 4 tonnes (1999), specifics not listed, but 669 kg used by licensed applicators in the Lower Mainland alone, also used on 58% of Lower Mainland golf courses (2003); ON: 0.7 tonnes (2003) | Group A |
| p-Dichlorobenzene | IARC 2B Irritant; hepatotoxin; CNS depressant CEPA: Priority Substance List 1 HC: Already risk managed | Home use products (deodorizers and moth balls); Living near incinerators; Fumigant and moth repellent | NPRI 2006: 3 companies (13 tonnes) US HPD: 1 moth insecticide Pathway: Ingestion; inhalation Environmental measurements: Yes, and organo-chlorine pesticides in Health Measures Survey Pesticide use survey: No | Group B |
| Pentachlorophenol | IARC 2B Liver damage; severe acne CEPA: No HC: IPE | Drinking water and contaminated food; Low likelihood of exposure; Used in heavy-duty wood preservation | NPRI 2006: Not found US HPD: None listed Pathway: Ingestion (drinking water); dermal; inhalation Environmental measurements: Yes, and organo-chlorine pesticides in Health Measures Survey Pesticide use survey: BC: >200 tonnes (1999); 150 tonnes (2003); ON: None reported | Group A |

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| Carcinogen (Pesticides) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|----------------------------------|--|---|--|----------|
| Sodium orthophenylphenate (SOPP) | IARC 2B Skin; eye; and respiratory tract irritant CEPA: No HC: LPE | Home use of products; Not used on crops, but in paints, glue, construction materials, etc. | NPRI 2006: None since 2003 (0.003 tonne) US HPD: 1 laundry starch Pathway: Dermal (primary); ingestion; inhalation Environmental measurements: None noted Pesticide use survey: BC: 156 kg (1999); none reported (2003); ON: none | Group B |
| Toxaphene | IARC 2B Irritant; respiratory effects; severely toxic CEPA: No HC: No | Contaminated food (fish, milk) (bioaccumulative); Living near disposal sites (ambient air); Not used on crops anymore | NPRI 2006: Not found US HPD: None listed Pathway: Ingestion (primary - contaminated food); inhalation Environmental measurements: Yes, and organo-chlorine pesticides in Health Measures Survey Pesticide use survey: Not included | Group B |

Fibres & Dusts

| Carcinogen (Fibres & dusts) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|-----------------------------|--|--|---|----------|
| Asbestos | IARC 1 Asbestosis; blood problems; severe skin problems CEPA: Yes, paragraph not listed but likely 'c' HC: Already risk managed | During construction and remediation; Auto maintenance; Mining; Manufacture of asbestos products (i.e. cements, fabrics) | NPRI 2006: 69 companies (14000 tonnes) US HPD: Chrysotile - 5 roofing sealant cements, Anthophyllite - 1 paint primer, Tremolite - 2 primers; 2 driveway filler/sealants Pathway: Inhalation Environmental measurements: Yes | Group A |

CEPA = Canadian Environmental Protection Act; HC = Health Canada (GPE, IPE, LPE = greatest, intermediate, and lowest potential for exposure); CAREX = The Information System on Occupational Exposure to Carcinogens; NPRI = National Pollutant Release Inventory for 2006; US HPD = Household Products Database; Pathway = Routes of exposure; Environmental measurements = Literature-based data found (Note: comprehensive search not yet performed); Geologic deposits = Locations of geologic deposits in Canada (geology/mining information abstracted from USGS (United States Geologic Survey) and NRCan (Natural Resources Canada)); Pesticide Use Survey = Amounts used in BC and Ontario (from 3 reports; see references in Appendix B). Note: CNS = Central nervous system

| Carcinogen (Fibres & dusts) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|-----------------------------|---|--|--|----------|
| Palygorskite (attapulgite) | IARC 2B Pneumoconiosis; pleural thickening; lung function problems CEPA: No HC: No | Home-use products (especially where powdered) Living near geologic deposits | NPRI 2006: Not found US HPD: 74 products (paints, caulking, adhesives, plaster, cosmetics, textured sprays) Pathway: Inhalation Environmental measurements: Not noted | Group B |

Radiation

| Carcinogen (Radiation) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|---|----------------------------|--|--|----------|
| Ionizing radiation & radioactive elements | IARC 1 | Living near uranium deposits; Living near nuclear reactors; Via medical treatments | Environmental measurements: Uranium is in the Health Measures Survey | Group B |
| Magnetic fields, extremely low frequency | IARC 2B | Via electric power, including domestic appliances, electric power distribution systems; Via computer monitors, photocopiers, fluorescent lights, etc. | Environmental measurements: Yes, likely to find in literature | Group A |
| Radon & its decay products | IARC 1 | The general population is exposed in their home (inhalation exposures from radon decay in underlying geology) | Environmental measurements: Yes | Group A |

Others

| Carcinogen (Other) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|--|----------------------------|--|---|----------|
| Chlorination byproducts (i.e. MX; dibromo-chloromethane) | IARC 3 | Via chlorinated drinking water (ingestion) | Environmental measurements: Yes, likely monitored at the community level, also via published literature | Group A |

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| Carcinogen (Other) | Carcinogenicity & Toxicity | Potential exposure circumstances (Environmental) | Evidence of use/exposure | Priority |
|---|---|---|---|----------|
| Particulate air pollution | IARC Not listed | Sources include commercial and residential fuel consumption, gas and diesel-powered vehicles and forest fires | Environmental measurements: Yes, many (in the literature as well as via exposure monitoring sites across Canada) | Group A |
| Polycyclic aromatic hydrocarbons (PAH), considered as a group | IARC varies Other health effects not noted CEPA: Yes, paragraphs 'a' and 'c' HC: Not as a group, but some individually | Diesel exhaust, kerosene lamps, forest fires, etc; Low levels ubiquitous | NPRI 2006: 15 companies (3700 kg); many others listed individually as well US HPD: 14 driveway sealants and adhesives Pathway: Inhalation (primarily); dermal; ingestion Environmental measurements: Yes | Group A |

CEPA = Canadian Environmental Protection Act; HC = Health Canada (GPE, IPE, LPE = greatest, intermediate, and lowest potential for exposure); CAREX = The Information System on Occupational Exposure to Carcinogens; NPRI = National Pollutant Release Inventory for 2006; US HPD = Household Products Database; Pathway = Routes of exposure; Environmental measurements = Literature-based data found (Note: comprehensive search not yet performed); Geologic deposits = Locations of geologic deposits in Canada (geology/mining information abstracted from USGS (United States Geologic Survey) and NRCan (Natural Resources Canada)); Pesticide Use Survey = Amounts used in BC and Ontario (from 3 reports; see references in Appendix B). Note: CNS = Central nervous system

Appendix D: Environmental carcinogens needing further investigation (Group C)

| Carcinogen | Category | IARC | Further investigation needed |
|---------------------------------------|----------------------|------|---|
| 1,2,3-Trichloropropane | Industrial chemicals | 2A | Exposures may occur from contaminated drinking water (it's a chlorinated solvent used as a paint & varnish remover, and degreaser). Exposure levels needed. |
| 2,2-bis(Bromomethyl)-propane-1,3-diol | Industrial chemicals | 2B | May be used in the production of plastics and epoxies. Environmental levels needed. |
| 2,4-Diaminotoluene | Industrial chemicals | 2B | Used in the production of toluene diisocyanates, and therefore could be found near to industrial sites. Potentially found in consumer textile products and some breast implants (levels not found). |
| 2,4-Dinitrotoluene | Industrial chemicals | 2B | Used in munitions production, as well as isocyanates. Not expected in consumer products, but there have been some large releases reported to the NPRI in recent years. |
| 2,6-Dinitrotoluene | Industrial chemicals | 2B | Used in munitions production, as well as isocyanates. Not expected in consumer products, but there have been some large releases reported to the NPRI in recent years. |
| 2-Nitropropane (Nipar S-20) | Industrial chemicals | 2B | Could be found in food and beverage container linings - levels in food found were outdated (current levels should be found). Also formed in cigarette smoke. |
| 4,4'-Methylenedianiline | Industrial chemicals | 2B | May be used in isocyanate production; potentially found in consumer products (e.g. polyurethane cushions or medical tubing). |
| Acetamide | Industrial chemicals | 2B | May be used in the plastics industry. Industrial emissions possible. |
| Benzoyl chloride | Industrial chemicals | 2A | Information limited, but it may be used to make benzoyl peroxide in Canada (exposures via industrial emissions). At least 1 company makes benzoyl peroxide. |
| Chlorendic acid | Industrial chemicals | 2B | It is a breakdown product of organochlorine pesticides. Extent of environmental contamination not found. |
| Chloroprene | Industrial chemicals | 2B | Used to make neoprene and neoprene-based products. Levels in consumer goods? |
| Citrus Red 2 | Industrial chemicals | 2B | This dye may be used on unpeeled oranges. |
| Diethyl sulfite | Industrial chemicals | 2A | Current uses unknown (many vague uses as a chemical intermediate, some which may occur in Canada). |
| Dimethyl sulfite | Industrial chemicals | 2A | Current uses unknown (many vague uses as an intermediate). Included in the Challenge to Industry. |
| Disperse Blue 1 | Industrial chemicals | 2B | Found in hair dyes (1 in the HPD), but Canadian exposures to consumers not quantified. |
| Ethyl carbamate (urethane) | Industrial chemicals | 2A | Many searches find reference to polyurethane, which ethyl carbamate is not related to. Canadian uses should be confirmed. |
| N-Nitrosodiethylamine | Industrial chemicals | 2A | Assessed in CAREX, environmental exposures largely expected from foods (cheese, beer, etc.). Exposure measurements needed. |

| Carcinogen | Category | IARC | Further investigation needed |
|------------------------------------|----------------------|------|---|
| Nitromethane | Industrial chemicals | 2B | Most exposure likely from combustion sources, however it is found in some model engine fuels for home use. |
| o-Toluidine | Industrial chemicals | 2A | Could be used in the manufacture of pigments and dyes (potentially in consumer products?) |
| Oil Orange SS | Industrial chemicals | 2B | No evidence of Canadian use except in consumer products (shampoos and soaps). Exposure measurements needed. |
| Phenyl glycidyl ether | Industrial chemicals | 2B | May be used in epoxy resin production; also potential for exposure via consumer goods, and the breakdown of certain pesticides. |
| Tris(2,3-dibromopropyl) phosphate | Industrial chemicals | 2A | Persistent, therefore use of old clothing or mattresses could create current exposures. |
| Vinyl bromide | Industrial chemicals | 2A | Newly added to the list of reportable chemicals by the Canadian Chemical Producers Association. Potentially used as a flame retardant in polymers. |
| Chlordane | Pesticides | 2B | No current uses (phased out in the 70's), but persistent in the food chain (especially fish). |
| Ethylene dibromide | Pesticides | 2A | No longer registered for use in Canada as a pesticide, but potential use as a gasoline additive and chemical intermediate. |
| Polychlorophenols except penta | Pesticides | 2B | Tetra is a common contaminant in penta formulations. Dichlorophenol may still be used to produce other pesticides. |
| Erionite | Fibres & dusts | 1 | Not specifically mined in Canada, but zeolite deposits are. Could be found at low environmental levels. |
| Talc containing asbestiform fibres | Fibres & dusts | 1 | Talc has many contemporary applications, but the extent to which asbestiform contamination occurs was not found. |
| Titanium dioxide | Metals | 2B | Found in many home use products (mostly in paste or liquid form). Seems that inhalation of powders is the exposure route of interest for carcinogenicity, but this should be confirmed. |