Health Care Sector

Occupational Exposure Summary Package

This package summarizes CAREX Canada’s results on priority exposures to known or suspected carcinogens in the health care sector in Canada. Assembling various CAREX Canada data, tools, and resources, it provides an overview of the most prevalent exposures for those working in the sector, including shiftwork, antineoplastic agents, formaldehyde, artificial ultraviolet radiation (UVR), and diesel engine exhaust. Our aim is to provide a useful guide for those looking to better understand – and help reduce or eliminate – common carcinogenic exposures associated with working in the health care sector.

Health care sector in Canada

In 2006, the Canadian health care sector employed nearly 1.4 million workers, many of those located in Ontario (36%), Quebec (25%), and British Columbia (12%). For the purpose of this package, the health care sector is defined as establishments that primarily provide health care by diagnosis and treatment, and residential care for medical reasons. This includes ambulatory health care services (including home care), hospitals, and nursing and residential care facilities. It excludes social assistance. Please note, however, that our shiftwork estimates also include the social assistance subsector due to the aggregated data source used to develop these estimates.

Estimates of prevalent exposures

We classify carcinogens based on evaluations made by the International Agency for Research on Cancer (IARC). CAREX Canada’s estimates of the number of workers exposed to known (IARC 1), probable (IARC 2A), and possible (IARC 2B) carcinogens in the health care sector are summarized in Figure 1. They include shiftwork, antineoplastic agents, formaldehyde, artificial UVR, and diesel engine exhaust. Exposure level estimates, where available, are summarized in the Carcinogen Profiles below.

Figure 1: Top 10 prevalent carcinogen exposures among workers in the health care sector, CAREX Canada Database, 2006

Note: High prevalence does not necessarily indicate a high cancer risk. For more information or assistance interpreting the data in this table, please contact us at info@carexcanada.ca.
Exploring the CAREX Canada estimates

Our eWORK Tool allows users to explore CAREX exposure data by carcinogen, sector, occupation, province, sex, and exposure level. We offer two versions of the eWORK Tool: eWORK Excel and eWORK Online. eWORK Excel uses a Microsoft Excel PowerPivot interface that allows users to search for exposures of interest. eWORK Online is for users who prefer quick, accessible, yet high-quality statistics on occupational exposures to various carcinogens.

eWORK Excel and eWORK Online are available under the Tools tab of our website.

Carcinogen profiles

The CAREX Canada profiles contain detailed information on use, production and trade, exposure routes, and health effects for the top ten carcinogen exposures for the health care sector listed in Figure 1. A sample of these are summarized below.

More information, including regulations and guidelines for each agent, methods for calculating exposure level estimates, and a list of references, is available under the Profiles and Estimates tab of our website.

Shiftwork
Probable Carcinogen (IARC 2A)

What is shiftwork?
Shiftwork is working time organized to cover more than the usual 8-hour workday, up to a 24-hour period. Some people perform shiftwork on rotation while others perform regularly scheduled evening or night shifts. Research shows that shiftwork at night (generally between the hours of 12am and 5am) is the most disruptive to internal circadian rhythms, or the internal biological 'clock' that generates the sleep-wake cycle in humans. Circadian disruption suppresses melatonin, disrupts sleep patterns and food digestion, and affects genes related to cancer.

Occupational exposure to shiftwork
Occupations with the largest number of exposed workers in the health care sector include those that provide health care services directly to patients and support health care delivery. This includes technical occupations (e.g. medical technologists and technicians, ambulance attendants, licensed practical nurses), assisting occupations that support health services (e.g. nurse aides), physicians, and registered nurses and nurse supervisors.

What are its health effects?
Cancer:
Evidence of carcinogenicity is sufficient in animals and limited in humans. Epidemiological studies observed an increased risk of breast cancer in long-term (20 years or more) night shift workers (in particular, women working as nurses or flight attendants) compared to people not working at night.

Non-cancer:
Shiftwork is associated with changes in mental and physical performance at work, fatigue, stress, disruption to family and social life, depression, and anxiety. Other effects include digestive disorders such as indigestion, heartburn, nausea, and loss of appetite, as well as cardiovascular disorders such as hypertension. Shiftwork may aggravate previous health conditions such as asthma, diabetes, and epilepsy and is linked to reproductive health problems in women.
### Antineoplastic Agents

**Multiple Classifications (Known (IARC 1), Probable (IARC 2A), and Possible (IARC 2B) Carcinogens)**

<table>
<thead>
<tr>
<th>Exposure Level</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>6%</td>
</tr>
<tr>
<td>Medium</td>
<td>22%</td>
</tr>
<tr>
<td>High</td>
<td>72%</td>
</tr>
</tbody>
</table>

#### What are antineoplastic agents?

Antineoplastic agents are a group of drugs used to treat cancer and other medical conditions. This includes tamoxifen, cyclophosphamide, chlorambucil, adriamycin, cisplatin, and others.

#### What are the main uses of antineoplastic agents in health care?

Antineoplastic agents **prevent tumor cells from growing and spreading**. They are increasingly used as treatments for cancer and other conditions, such as rheumatoid arthritis and psoriasis. While these treatments are often a necessary medical intervention that benefits patients, workers handling antineoplastic agents are at risk of exposure and adverse health effects.

#### Occupational exposure to antineoplastic agents

Occupational exposure to antineoplastic agents may occur directly via skin contact, inhalation, ingestion, or needle stick injury, or indirectly via contaminated surfaces and objects. Occupations with the largest number of exposed workers in the health care sector include pharmacy technicians, nurses, and pharmacists.

#### What are their health effects?

Cancer:
Exposure to antineoplastic agents is associated with cancers of the **breast, lung, ovary, liver, bladder**, and the **hematopoietic system**.

Non-cancer:
Exposure to antineoplastic agents may cause gastrointestinal problems, kidney damage, neurotoxicity, bone marrow suppression, hair loss, and reproductive problems.

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### Formaldehyde

**Known Carcinogen (IARC 1)**

#### What is formaldehyde?

Formaldehyde is a **flammable and colourless gas with a pungent odour**. It is commonly used in liquid solutions.

#### What are the main uses of formaldehyde in health care?

Formaldehyde is an effective disinfectant and preservative that may be used in hospital wards and pathology labs.

#### Occupational exposure to formaldehyde

Inhalation is the main route of exposure for formaldehyde. Low-level exposure may also occur when formaldehyde is absorbed through the skin or ingested. Health care professionals may be exposed while using or cleaning up medical products and equipment where formaldehyde is used. Occupations with the largest number of exposed workers in the health care sector include registered nurses and medical laboratory technologists, pathologists’ assistants, and technicians.

*Note: This is a simplified summary; exposure levels for antineoplastic agents were developed differently across occupations. For more information, visit our occupational estimate page for antineoplastic agents.*

(continued on page 4)
Formaldehyde continued...

<table>
<thead>
<tr>
<th>Exposure Level</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
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<tbody>
<tr>
<td>7,500</td>
<td>47%</td>
<td></td>
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<tr>
<td>8,500</td>
<td>53%</td>
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</table>

What are its health effects?

Cancer:
There is sufficient evidence linking formaldehyde exposure with nasopharyngeal cancer and leukemia in humans, and limited evidence for sinonasal cancer.

Non-cancer:
Additional health effects include respiratory and eye irritation and contact dermatitis.

Artificial Ultraviolet Radiation
Known Carcinogen (IARC 1)

<table>
<thead>
<tr>
<th>Exposure Level</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,400</td>
<td>4%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11,000</td>
<td>96%</td>
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</table>

What is artificial ultraviolet radiation?

Ultraviolet radiation (UVR) is a type of radiation found between visible light and x-rays on the electromagnetic spectrum. Artificial sources of UVR emit a range of wavelengths specific to each source.

What are the main uses of artificial UVR in health care?

Artificial UVR is used for medical procedures such as treating skin diseases and neonatal jaundice, as well as managing chronic conditions such as seasonal affective disorder and sleep disorders. Ultraviolet lasers, used for a number of medical applications (e.g. surgery), and germicidal lamps, commonly used to sterilize materials in hospitals, also emit artificial UVR.

Occupational exposure to artificial UVR

Occupational exposure to artificial UVR occurs via skin and eye exposure. Occupations with the largest number of exposed workers in the health care sector include medical laboratory technologists, pathologists’ assistants, and technicians, as well as specialist physicians.

<table>
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What are its health effects?

Cancer:
Artificial UVR exposure is associated with skin and eye cancer in humans.

Non-cancer:
Exposure to UVR may result in short term skin damage such as burning, fragility, and scarring.

Diesel Engine Exhaust
Known Carcinogen (IARC 1)

What is diesel engine exhaust?

The combustion of diesel fuel in engines produces diesel engine exhaust, a complex mixture of gases and particulates that can contain other known and suspected carcinogens such as benzene, polycyclic aromatic hydrocarbons (PAHs), metals, and particulate matter. The composition of the mixture depends on a number of factors including the type of engine (heavy or light duty), the type of fuel and oil, sulphur levels, speed and load of operation, and emission control systems.

(continued on page 5)
Inhalation is the most common route of exposure. Assessing exposures to diesel engine exhaust is complex due to difficulty separating diesel exhaust from other air contaminants with similar characteristics, in addition to controversies in the best practices for measuring exposure. Occupations with the largest number of exposed workers in the health care sector include ambulance attendants and other paramedical occupations, delivery and courier service drivers, and truck drivers.

**What are its health effects?**

<table>
<thead>
<tr>
<th>Cancer:</th>
<th>Non-cancer:</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is sufficient evidence linking diesel engine exhaust to <strong>lung cancer</strong> and limited evidence for bladder cancer in humans.</td>
<td>Short-term exposure to diesel engine exhaust can irritate the eyes, throat, and bronchi, and cause lightheadedness, nausea, and respiratory symptoms such as cough and phlegm. Diesel exhaust may initiate allergic reactions or increase immunological response to other allergens.</td>
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**Exposure reduction strategies**

As outlined by the **Canadian Centre for Occupational Health and Safety** (CCOHS), a variety of strategies can be used to protect workers from exposures to harmful substances such as carcinogens. These strategies are listed in order of effectiveness in controlling a risk.

- **Elimination** is the most effective way to control a risk; it involves removing the hazard from the workplace. This process may also involve substitution.
  - *An example of substitution is switching from diesel-fueled vehicles to electric vehicles.*

- **Engineering controls** minimize risk of exposure through strategic designs or modifications, which include process controls, enclosure/isolation of the source, and ventilation.
  - *An example of an engineering control is using safety engineered needles and needleless systems when administering antineoplastic agents.*

- **Administrative controls** alter the way the work is done through rules or policies.
  - *An example of an administrative control is restricting access to areas where artificial UVR is being used and posting appropriate warning signs.*

- **Personal protective equipment (PPE)** provides a barrier between the worker and the hazard.
  - *Examples of PPE include respirators, eye protection, face shields, gloves, and footwear.*

For more information on these strategies and which one is appropriate for a situation, please visit the hazard control page of the CCOHS website.

A compilation of exposure reduction resources, including the Canadian Partnership Against Cancer’s Prevention Policies Directory and the Canadian Cancer Society’s Cancer Information portal, is available on our website.
Carcinogenic Exposures in the Health Care Sector

Data used in developing the occupational estimates were collected from several sources. Data for formaldehyde was collected from the Canadian Workplace Exposure Database (CWED), which contains approximately 10,500 measurements for formaldehyde exposure. These measurements were collected between 1981 and 2004 in Ontario and British Columbia workplaces. Data for shiftwork was collected from the Canadian Survey of Labour and Income Dynamics, a longitudinal survey comprised of workers aged 16-69 drawn from the Labour Force Survey. Data for antineoplastic agents were collected from the Canadian Census and Human Resources databases. Data for shiftwork, antineoplastic agents, formaldehyde, artificial UV radiation, and diesel engine exhaust was also collected from scientific peer reviewed publications that addressed exposure in Canada and the United States, as well as technical reports from governments and international bodies.

More information on data sources is available under the Data Sources and Methods tab on our website.

Methods

The goal of CAREX Canada is to estimate Canadians’ potential exposures to known and suspected carcinogens in the workplace, prioritizing agents that are most relevant to Canadians. Estimates of the numbers of workers exposed to these agents are calculated by sector, occupation, province and sex for 2006 (using the 2006 Census of Population, the most recent census that includes detailed information on sector and occupation). Where data are available, levels of exposure expected in Canadian workplaces are also estimated. CAREX Canada’s general approach to producing occupational prevalence and exposure level estimates is summarized in Figure 2.

Figure 2: CAREX Canada’s general approach to identifying occupational exposure level and prevalence estimates

Data sources

Data used in developing the occupational estimates were collected from several sources. Data for formaldehyde was collected from the Canadian Workplace Exposure Database (CWED), which contains approximately 10,500 measurements for formaldehyde exposure. These measurements were collected between 1981 and 2004 in Ontario and British Columbia workplaces. Data for shiftwork was collected from the Canadian Survey of Labour and Income Dynamics, a longitudinal survey comprised of workers aged 16-69 drawn from the Labour Force Survey. Data for antineoplastic agents were collected from the Canadian Census and Human Resources databases. Data for shiftwork, antineoplastic agents, formaldehyde, artificial UV radiation, and diesel engine exhaust was also collected from scientific peer reviewed publications that addressed exposure in Canada and the United States, as well as technical reports from governments and international bodies.

More information on data sources is available under the Data Sources and Methods tab for each carcinogen on our website.
Strengths and limitations

One of the key strengths of CAREX Canada’s approach is the **transparent, systematic, and scientifically rigorous methods** used to develop the estimates of occupational carcinogen exposure. A challenge that we face is a general lack of current occupational exposure data. Since the 1990s, regulatory agencies across Canada have significantly decreased workplace exposure sampling. Varied record retention and archiving policies, as well as reduced accessibility to non-electronic data also limit what is available to CAREX Canada. This lack of data may affect both our estimates of prevalence and levels of exposure, especially when the use of a substance has changed substantially since the 1990s. Another limitation is the lack of information about particular work environments, which can make it difficult to determine appropriate exposure proportions for some occupations and industries. These instances are noted in our documentation.

Where can you learn more?

- Visit our website at [www.carexcanada.ca](http://www.carexcanada.ca)
- Follow us on Twitter [@CAREXCanada](http://twitter.com/CAREXCanada)
- Email us at [info@carexcanada.ca](mailto:info@carexcanada.ca)

**Relevant publications and reports**

- **IARC Monographs Volume 105: Diesel and Gasoline Engine Exhausts and Some Nitroarenes**

- **IARC Monograph Volume 100D: A Review of Human Carcinogens: Radiation**

- **IARC Monograph Volume 100F: Chemical Agents and Related Occupations (Formaldehyde)**

- **IARC Monograph Volume 98: Painting, Firefighting, and Shiftwork**

- **IARC Monograph Volumes 26, 50, 76, 100A, 100C (Various Antineoplastic Agents)**

- **CAREX Canada: An enhanced model for assessing occupational carcinogen exposure**

- **Estimating national-level exposure to antineoplastic agents in the workplace: CAREX Canada findings and future research needs**

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