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 night shift work, ionizing radiation, antineoplastic agents, formaldehyde, and artificial ultraviolet radiation (UVR). 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 night shift work estimates also include the social assistance subsector due to the aggregated data source used to develop these estimates, and our ionizing radiation estimates include medical workers that are monitored by the National Dose Registry.

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 night shift work, ionizing radiation*, antineoplastic agents, formaldehyde, and artificial UVR. 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.

*The ionizing radiation results are presented with a lower and upper range. The lower range represents workers monitored by the National Dose Registry (NDR). The upper range includes projections based on a literature review to include workers likely to be exposed, but not currently monitored in the NDR.
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 is available on the Tools page under the Resources section on our website.

Carcinogen profiles

The CAREX Canada profiles contains 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 on the Carcinogen Profiles page on our website.

Night shift work
Probable Carcinogen (IARC 2A)

What is night shift work?
Shift work is working time organized to cover more than the usual 8-hour workday, up to a 24-hour period. Some people perform shift work on rotation while others perform regularly scheduled evening or night shifts. Research shows that shift work 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.

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 among those working high-intensity shifts over long durations compared to those who do not work at night. Some studies suggest that prostate and colorectal cancer may also be associated with night shift work.

Non-cancer:
Night shift work 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. It may aggravate previous health conditions such as asthma, diabetes, and epilepsy and is linked to reproductive health problems in women.
Ionizing radiation
Known Carcinogen (IARC 1)

What is ionizing radiation?
Ionizing radiation consists of particles or rays that can damage DNA and other cellular components. It is emitted by natural and artificial radioactive materials, nuclear reactions, and radiation-producing machines.

What are the main uses of ionizing radiation in health care?
Ionizing radiation in the form of x-rays are used for diagnostic procedures including radiographic imaging, fluoroscopic imaging, positron emission tomography, and computed tomography. They are also used to treat cancer (radiation therapy).

Occupational exposure to ionizing radiation
Ionizing radiation includes x and gamma rays, which can penetrate the skin and internal organs, and alpha and beta particles, which can be inhaled, ingested, or injected. Health care professionals may be exposed during their patient’s medical procedures. Occupations with the largest number of exposed workers in the health care sector include nurses, medical radiation technologists, and orderlies.

What are its health effects?
Cancer:
There is a strong association between ionizing radiation and leukemia, as well as cancers of the thyroid, breast, salivary gland, esophagus, bone, stomach, colon, skin, brain and central nervous system, kidney, and lung. Many other cancer sites are also linked to ionizing radiation.

Non-cancer:
Overexposure may cause skin burns, hair loss, birth defects, cancer, intellectual disability, and death. Exposure to the fetus during pregnancy may cause miscarriage, birth defects, hereditary effects, and a higher risk of cancer in the offspring.

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

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 tumour 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.

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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.

Artificial Ultraviolet Radiation

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 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.

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.
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.
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.

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.

More information on our methods is available under the Occupational Approach section on our website.
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. Data for ionizing radiation was collected from the 2016 National Dose Registry, which contains ionizing radiation exposure monitoring data for over 150,000 Canadian workers.

More information on data sources is available under the Methods and Data section 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
Follow us on Twitter @CAREXCanada
Email us at info@carexcanada.ca

Relevant publications and reports

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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