



**CAREX**  
CANADA

*Exposure surveillance of environmental and occupational carcinogens for cancer prevention*

## Occupational Exposure Summary

# Health Care Sector

*This report serves as a summary of 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, gasoline engine exhaust, and asbestos. Our aim is to provide a useful guide for those looking to better understand – and help reduce or eliminate – common carcinogenic exposures associated with the health care sector.*

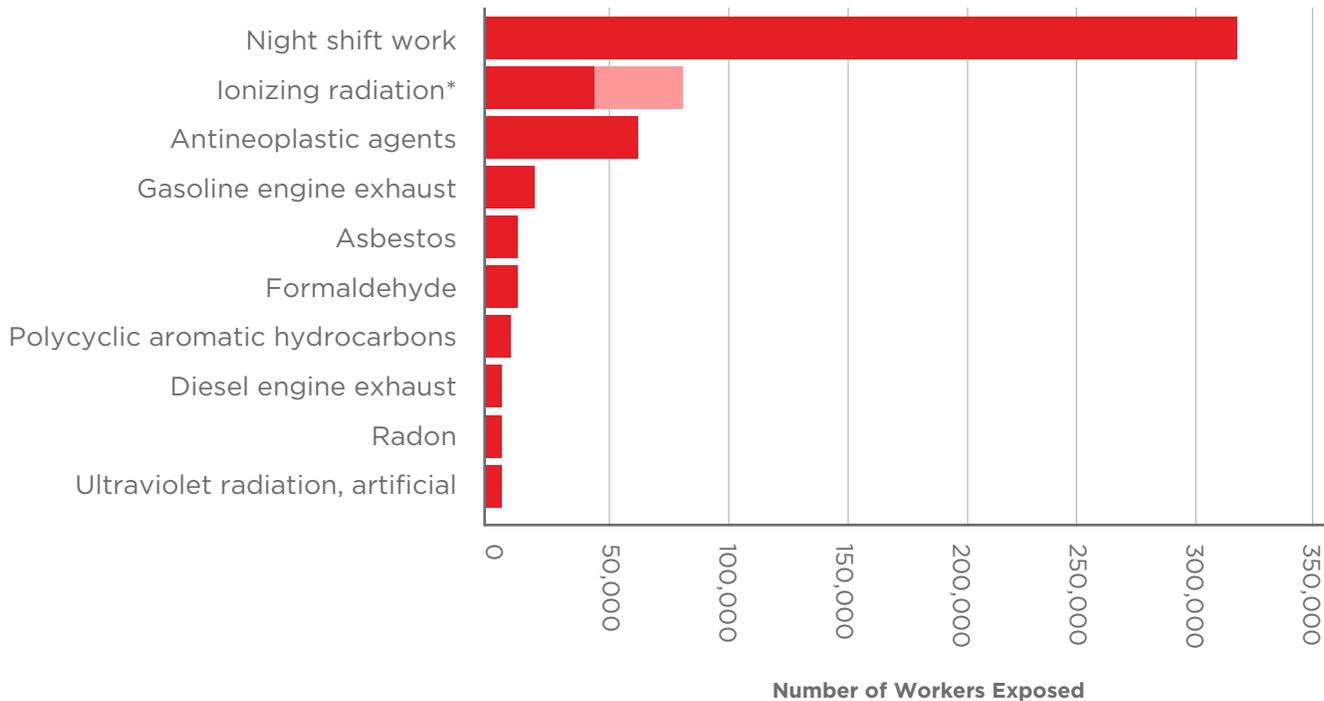
## Health care sector in Canada

In 2016, the Canadian health care sector employed nearly 1.7 million workers, many of those located in Ontario (36%), Quebec (24%), and British Columbia (13%). 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

CAREX Canada estimates of the number of workers exposed to carcinogens in the health care sector are summarized in Figure 1. They include night shift work, ionizing radiation\*, antineoplastic agents, gasoline engine exhaust, and asbestos. Exposure level estimates, where available, are summarized in the Carcinogen Profiles below.

**Figure 1.** Top 10 prevalent carcinogen exposures for the health care sector, CAREX Canada, 2016



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](mailto: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.

We classify carcinogens based on evaluations made by the [International Agency for Research on Cancer \(IARC\)](#). The agents listed in Figure 1 are classified known (IARC 1), probable (IARC 2A), or possible (IARC 2B) carcinogens.

 More information, including detailed carcinogen information, exposure estimates, methods, and references, is available under the Carcinogen Profiles tab of our website

## Carcinogen profiles

The CAREX Canada website contains detailed information on use, regulations and guidelines, production and trade, exposure routes, and health effects for the top ten carcinogen exposures for the health care sector listed above. A sample of these are summarized below.

# Night Shift Work

KNOWN 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.

## Occupational exposure to night shift work

Approximately **318,000 Canadians work night shifts in the health care sector**. 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, ambulance attendants), assisting occupations that support health services (e.g. nurse aides), physicians, and registered nurses and nurse supervisors.

### Workers exposed to night shift work in the health care sector by exposure level\*



\*Exposed = regular night or rotating shift; Possibly exposed = regular evening, split shift, on call, irregular schedule, or other; Unexposed = regular day

# 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)**.

## 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.

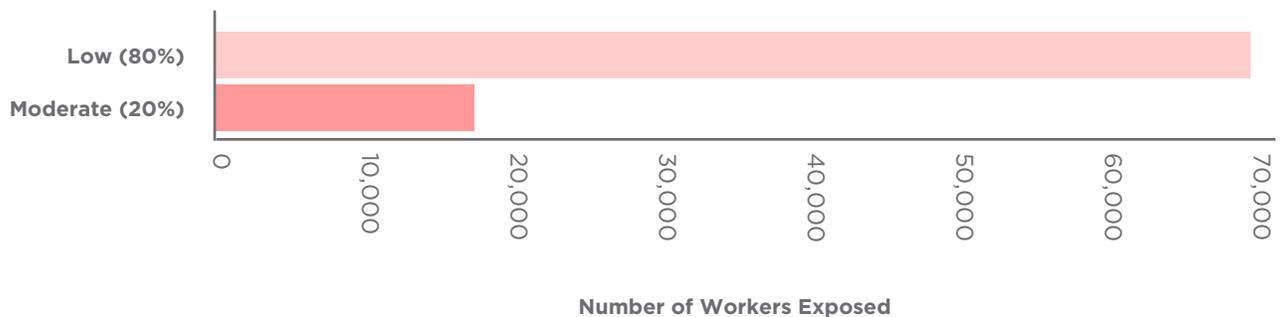
**Non-cancer:** Overexposure may cause skin burns, hair loss, birth defects, cancer, intellectual disability, and death. Exposure to the fetus during pregnancy may cause miscarriage, birth defects, hereditary effects, and a higher risk of cancer in the offspring.

## 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.

Approximately **35,000 to 86,000 workers are exposed to ionizing radiation in the health care sector**. Occupations with the largest number of exposed workers in this sector include nurses, aircrew, and ward aids/orderlies.

### Workers exposed to ionizing radiation in the health care sector by exposure level\*



\*Note: These exposure levels are for the upper range estimate of exposed workers

# 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.

## What are its 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.

## 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. Approximately **69,000 workers are exposed to ionizing radiation in the health care sector**. Occupations with the largest number of exposed workers in this sector include pharmacy technicians, nurses, and pharmacists.

### Workers exposed to antineoplastic agents in the health care sector by exposure level\*



*\*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](#).*



# 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 Online and eWORK Excel. eWORK Online is for users who prefer quick, accessible, yet high-quality statistics on occupational exposures to various carcinogens. eWORK Excel uses a Microsoft Excel PowerPivot interface that allows users to search for – and visualize – exposures of interest.

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

## Reducing exposures

CAREX Canada’s resources and estimates can be used to inform programs, policies, and practices related to carcinogen exposures. Identifying the priority exposure scenarios and substances for exposure reduction can help guide agenda- and priority-setting for cancer prevention.

As outlined by the **Canadian Centre for Occupational Health and Safety** (CCOHS), a variety of strategies can help 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 using lead-free paints and glazes instead of those that contain lead.*



**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 a process control is using wet methods instead of dry when grinding or drilling to reduce dust.*



**Administrative controls** alter the way the work is done through rules or policies. *An example of an administrative control is shorter work times in areas where exposure may occur.*



**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.*

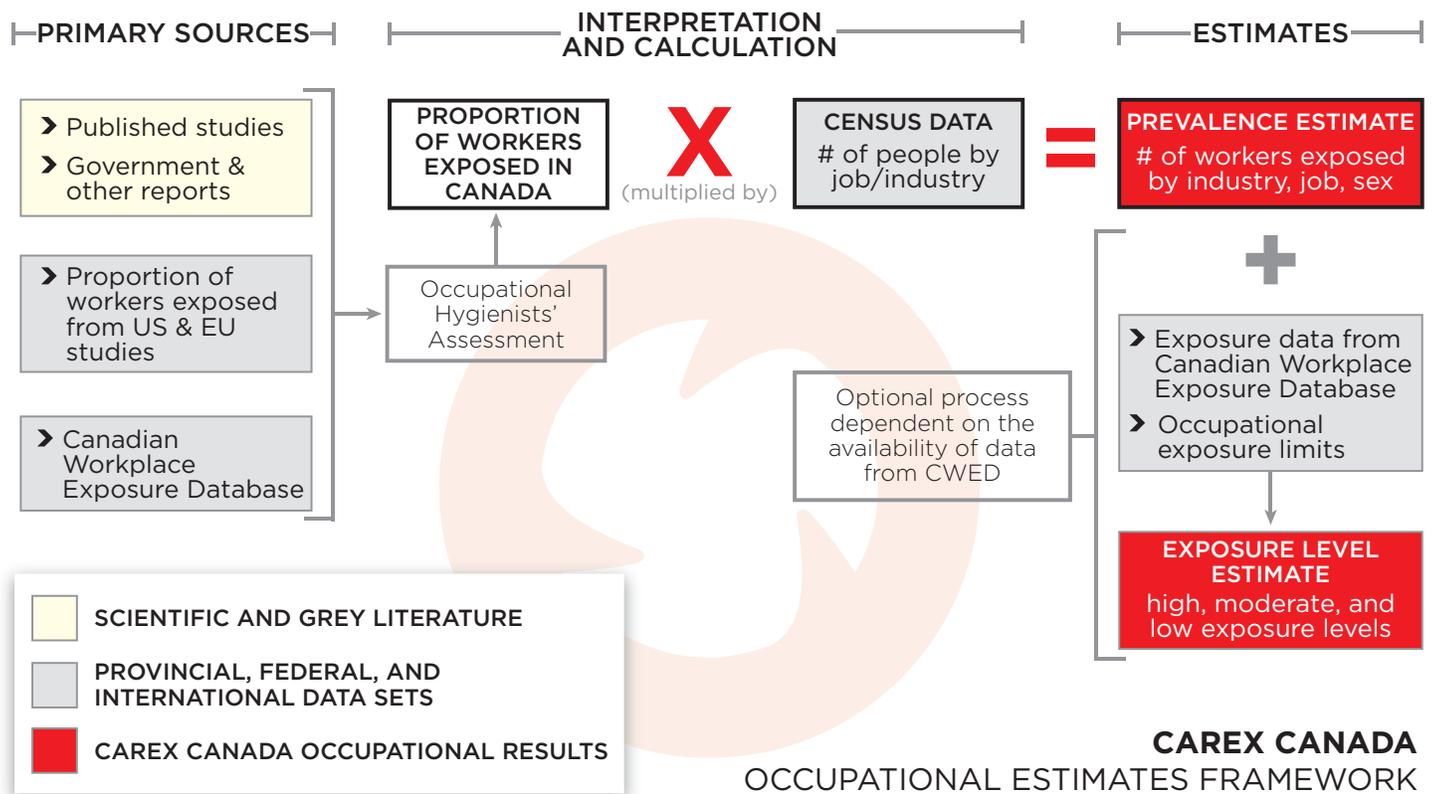
 A compilation of additional exposure reduction resources, including the Canadian Partnership Against Cancer’s Prevention Policies Directory and the Canadian Cancer Society’s Cancer Information portal, is available on our website.

# Methods

The goal of the CAREX Canada project 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, sex, and level of exposure (where data are available). They are developed using information gathered in a scientific literature review, data included in the Canadian Workplace Exposure Database (CWED), information from previous CAREX projects in Europe, Canadian-specific information on exposure from government and other sources, and CAREX occupational hygienists' expert assessment. Most of our estimates use the 2016 Census of Population, with some exceptions noted in our documentation. CAREX Canada's general approach to producing occupational prevalence and exposure level estimates is summarized in Figure 2.

 More information on our methods and data is available under the Carcinogen Profiles tab on our website

**Figure 2.** CAREX Canada's occupational estimates framework



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## Relevant publications and reports

**IARC Monograph Volume 100D: A Review of Human Carcinogens: Radiation** | International Agency for Research on Cancer, 2012.

**IARC Monograph Volume 98: Painting, Firefighting, and Shiftwork** | International Agency for Research on Cancer, 2010.

**IARC Monograph Volumes 26, 50, 76, 100A, 100C (Various Antineoplastic Agents)** | International Agency for Research on Cancer, 1987, 1990, 2000, and 2012.

**CAREX Canada: An enhanced model for assessing occupational carcinogen exposure** | Peters CE, Ge CB, Hall AL, Davies HW, Demers PA. *Occup Environ Med.* 2015;72(1):64-71.

**Prevalence and recent trends in exposure to night shift work in Canada** | Rydz E, Hall AL, Peters CE. *Ann Work Expo Health* 2020;64(3):270-281.

**Estimating national-level exposure to antineoplastic agents in the workplace: CAREX Canada findings and future research needs** | Hall AL, Peters CE, Ge C, Astrakianakis G DP. *Ann Work Expo Heal.* 2017

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CAREX Canada is hosted at Simon Fraser University and is funded by the Canadian Partnership Against Cancer



## Where can you learn more?

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

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Acknowledgments for photos: Andrew Curtis

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DECEMBER 2021