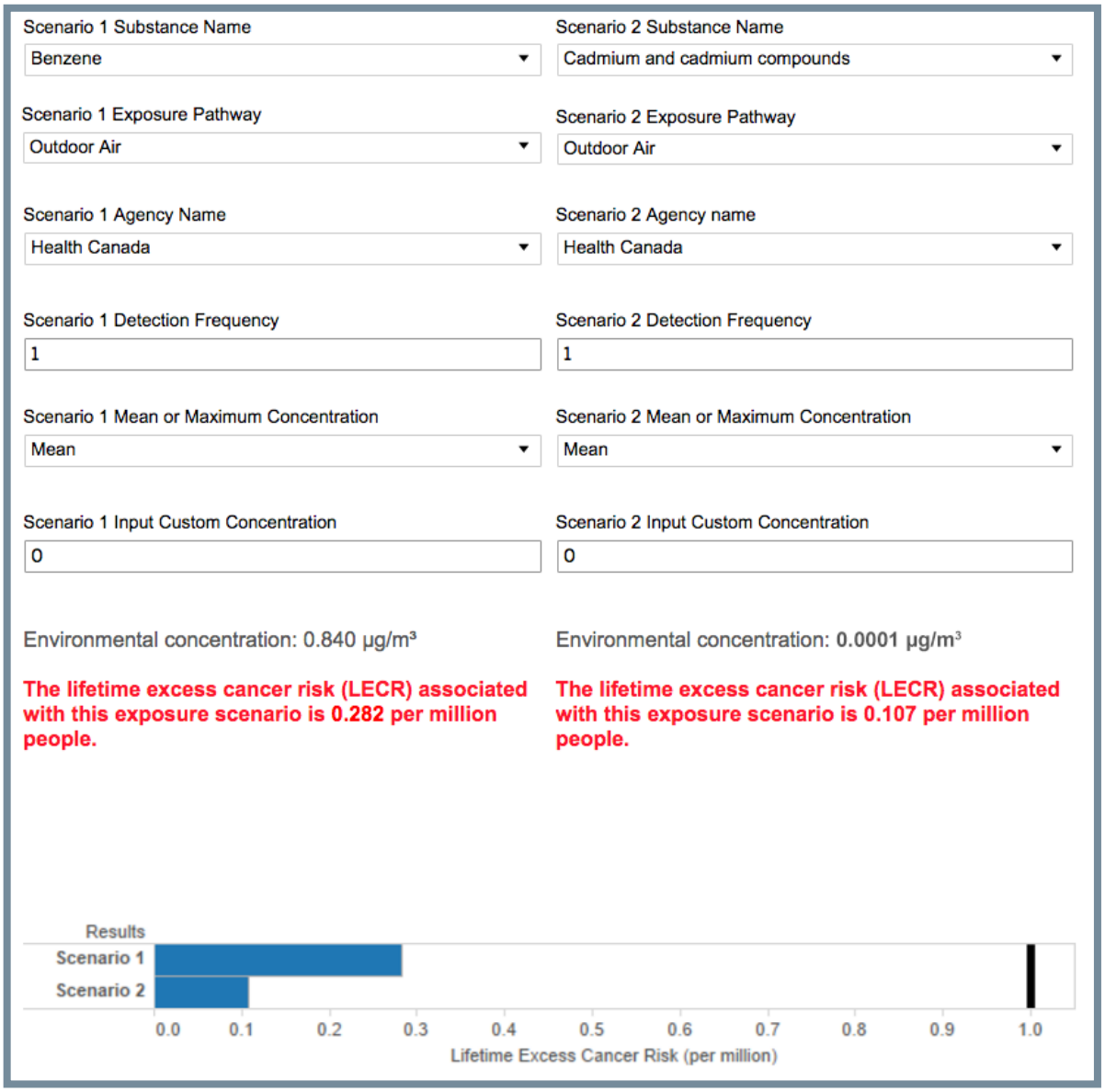
eRISK Online

User Manual



CAREX CANADA

CANADIAN PARTNERSHIP AGAINST CANCER
PARTENARIAT CANADIEN CONTRE LE CANCER

Contents

Acknowledgements

CAREX Canada is funded by the Canadian Partnership Against Cancer. The **eRISK** tool was conceived of and designed by Dr. Eleanor Setton, Co-Director of the Spatial Sciences Research Lab and an Adjunct Associate Professor in the Geography Department at the University of Victoria.

This **eRISK Online** tool was adapted from a previous version called **eRISK Access**, which used a Microsoft Access interface, in order to make it more easily accessible to users. The **eRISK Online** tool was developed by Mandy Pui, with support from CAREX Canada, Engage Data, and a MITACS Accelerate Internship. The contents of this manual was adapted from a previous version for **eRISK Access** by Mandy Pui.

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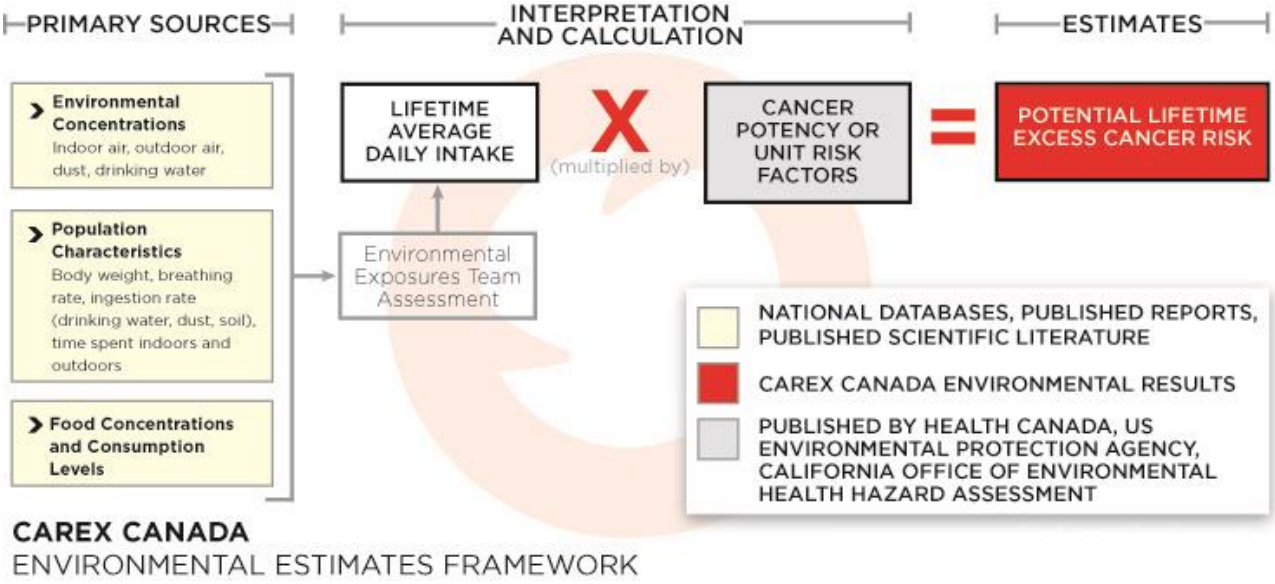
Before Getting Started

eRISK Online is a web-based tool that calculates a population's **potential lifetime excess cancer risk** due to the inhalation or ingestion of different known and suspected carcinogens given measured concentrations.



Lifetime excess cancer risk represents the **excess probability** of developing cancer due to exposure to the substance in question, **above and beyond the expected probability** of developing cancer without being exposed. These probabilities are often stated as 'risk per million people'. For example, based on recent Canadian data, the lifetime risk of developing any kind of cancer is 453,000 per million for men, and 404,000 per million people for women[1]. In other words, it is expected that just over 45 percent of men, and 40 percent of women in Canada will develop some kind of cancer in their lifetime, due to a wide range of factors including genetic characteristics, behaviours including smoking, consuming alcohol, and dietary practices, as well as exposures while at work, home, or outdoors.

Health Canada recognizes lifetime **excess** cancer risks between 1 per million and 10 per million as being essentially negligible, because of the precautionary nature of the assumptions used when calculating excess cancer risk[2]. This excess risk equates to increasing the expected lifetime risk from 453,000 per million men to 453,001 – 453,010 per million men.

LIFETIME EXCESS CANCER RISK

10,000 per million people	=	One extra cancer per 100 people
1,000 per million people	=	One extra cancer per 1,000 people
100 per million people	=	One extra cancer per 10,000 people
10 per million people	=	One extra cancer per 100,000 people

1 per million people	=	One extra cancer per 1,000,000 people
0.1 per million people	=	One extra cancer per 10,000,000 people
0.01 per million people	=	One extra cancer per 100,000,000 people
0.001 per million people	=	One extra cancer per 1,000,000,000 people

This approach is similar to that used to prioritize outdoor air pollutants by the National Air Toxics Assessments (NATA) program of the United States Environmental Protection Agency[3]. In addition to outdoor air, **eRISK** includes other important exposure pathways: indoor air, dust, soil, and foods and beverages. **NOTE:** To investigate food and beverages, get in touch with CAREX Canada at info@carexcanada.ca.

eRISK results assume that substance concentrations, and inhalation and ingestion rates remain the same for 24 hours per day over 70 years. This is highly unlikely to be true for any single individual or group, and these assumptions are more likely to overestimate lifetime excess cancer risks than to underestimate them. Conversely, multiple exposures to different carcinogens and the interaction between substances are likely to underestimate lifetime excess cancer risks than to overestimate them. However, using a standard set of assumptions allows users to rank and prioritize exposure pathways and substances. It is also assumed that all of the substance inhaled or ingested is bio-available and will be absorbed and/or transported throughout the body. This is not always the case.

eRISK results can be used to:

- prioritize known and suspected carcinogens
- identify exposure pathways of interest for further investigation
- inform monitoring and exposure risk reduction programs
- provide a starting point for local-scale assessments
- assess different scenarios based on predicted changes in concentrations

eRISK results cannot be used to:

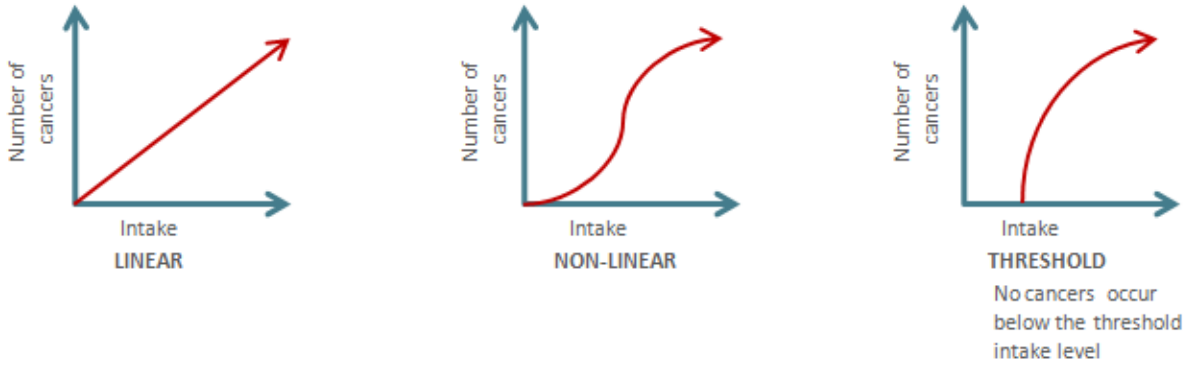
- identify risks for specific individuals
- calculate the expected number of excess cancer cases in a specific population

Calculating lifetime excess cancer risk requires inputs for a variety of characteristics describing an 'average' individual over 70 years of life. **eRISK** uses values for these characteristics that are recommended by Health Canada guidelines for exposure and risk assessments[4,5].

eRISK results rely on cancer potency factors published by Health Canada, the United States Environmental Protection Agency, and the California Office of Environmental Health Hazard Assessment. Cancer potency factors are typically developed from animal studies, where increasing doses of a substance are administered and the resulting number of cancers is observed. There is a lot of uncertainty around how well these studies reflect what would happen to humans given the same doses, and often the doses are much higher than what

occurs in normal daily life. Sometimes there are human-based studies, most often from occupational settings. Exposures in occupational settings are often higher than those experienced by most Canadians via inhaling air when outdoors or indoors at home, or ingesting dust, soil, or foods and beverages. Workers are not representative of the population in general. Additional uncertainty about cancer potency factors comes from assuming a linear dose response, and no safe threshold of exposure, especially when data are available only from higher dose studies.

The real relationship between dose and the number of cancers observed may not be linear:



While ongoing research continually provides new evidence about cancer potency and whether there is a safe threshold of exposure, the risk-based approach assumes a linear dose response and no safe threshold.

When interpreting **eRISK** results, it is important to keep these limitations in mind, as well as any limitations of the data used to represent measured levels. For example, **eRISK** contains results documented by CAREX Canada using published North American data on measured levels circa 2011.

Detailed information on these data is provided on the CAREX Canada website[6] and some of the limitations encountered while compiling the data include:

- the use of samples collected over short time periods to represent lifetime exposures
- comparability of data from studies using different collection and/or analytical methods
- the accuracy of the measured data given the analytical method
- the use of data from studies with small sample sizes
- the use of data from one geographic region to represent other geographic regions

Potential lifetime excess cancer risks greater than 1 per million in any particular exposure pathway may be higher priorities, and a more detailed risk assessment could be used to confirm whether or not exposure reduction efforts are warranted. Additional information that could help refine a risk assessment includes:

- more detailed measured data that better represent the range of exposures actually experienced by the population of interest
- more detailed information on the bioavailability of the substances inhaled or ingested

eRISK was developed to enable users to test and explore all of these limitations and their effects on the resulting lifetime excess risk calculations. These tests and explorations can help to prioritize actions aimed at reducing Canadians' exposures to known and suspected carcinogens, and thereby reduce the development of associated cancers in future decades.

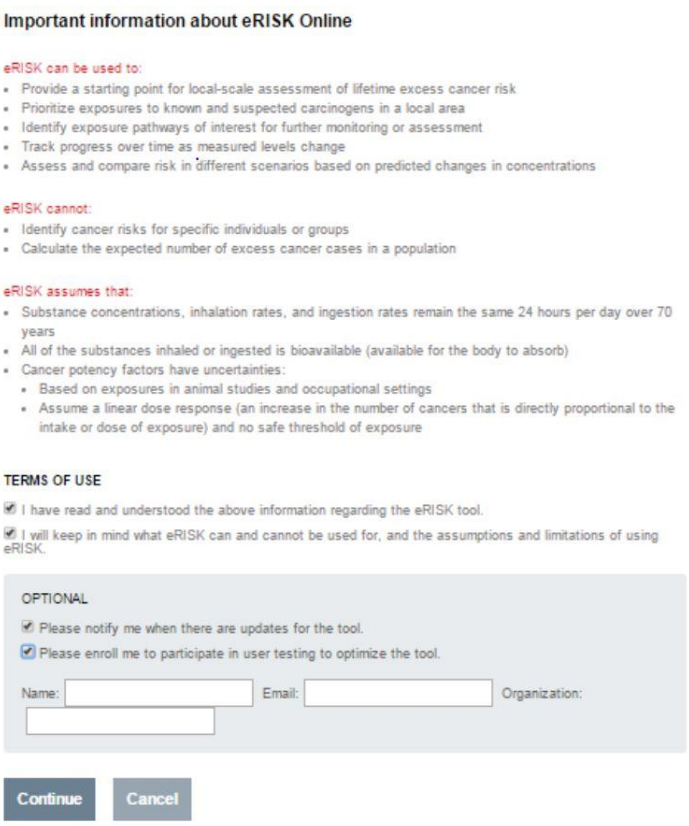
Overview

To use **eRISK Online**, you need to navigate to the CAREX Canada website on your online browser.

The tool is optimized for use in the Chrome browser. Refrain from using Internet Explorer. Also refrain from using a roll mouse with this tool.

Go to http://www.carexcanada.ca/eRISK.

The following window will pop up:



Read thoroughly **eRISK Online**'s uses, limitations, and assumptions. Check the checkboxes for terms of use. Check the optional checkboxes for updates and participation in user testing.

eRISK Online contains a set of data – called CAREX 2011 – by default. This project cannot be deleted or edited. It contains the data for all of the environmental estimates for 2011 shown on the CAREX Canada website (http://www.carexcanada.ca). It also includes data asbestos and radon[7], which were not included in **eRISK Access**.

NOTE: Refer to **eRISK Access** for food and beverages.

eRISK Online contains a series of selection boxes to guide you through the process of creating an estimate of lifetime excess cancer risk, based on the data and default values you select.

NOTE: eRISK Online uses values for life stage characteristics that are recommended by Health Canada guidelines for exposure and risk assessments[4,5]. Different values are used for each of five age groups, including bodyweights, intake rates for drinking water, dust, indoor air, outdoor air and soil, and time spent indoors and outdoors. These values cannot be edited in **eRISK Online.** Refer to **eRISK Access** if you wish to use different values.

AVERAGE DAILY VALUES:	Adult	Teen	Child	Small Child	Infant	Units:
Air inhaled	23	21	12	5	2	cubic meters
Drinking water ingested	1.5	1.3	0.9	0.8	0.75	litres
Dust ingested	0.02	0.02	0.035	0.05	0.035	grams
Soil ingested						grams
Time spent outdoors	0.0625	0.0625	0.082	0.082	0.082	percent of day
Time spent indoors	0.9375	0.9375	0.918	0.918	0.918	percent of day
BODYWEIGHT:						
Average bodyweight	70	57	27	13	7	kilograms
AGE GROUP:						
Start of lifestage	20	12	5	0.5	0	age in years
End of lifestage	70	20	12	5	0.5	age in years

The **eRISK Online** report can display lifetime excess cancer risk results for two scenarios at a time – either for two different substances, or for the same substance across two exposure pathways, or with two different government agencies' cancer potency factors, etc.

There are 6 steps involved in calculating lifetime excess cancer risk using eRISK Online:

Step 1. Choose Carcinogen – in this step, choose the carcinogen and explore the associated data used to develop the CAREX estimates.

Step 2. Choose Exposure Pathway – in this step, choose one out of five exposure pathways: Outdoor Air, Indoor Air, Drinking Water, Soil, and Dust.

Step 3. Choose Agency – in this step, select the government agency and explore the potency factors associated to support the CAREX estimates.

Step 4. Select Detection Frequency – the default value is 1, adjust if necessary.

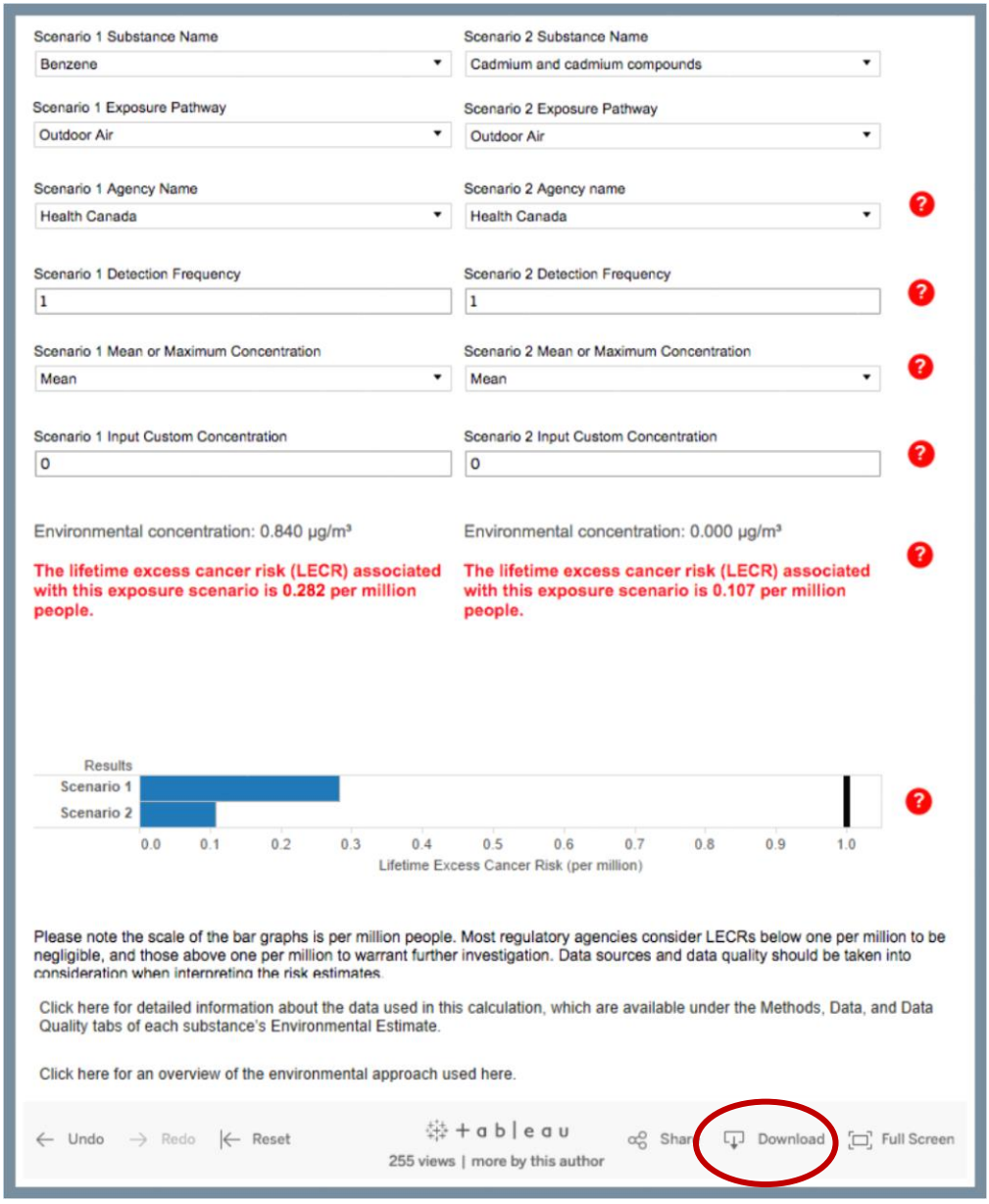
Step 5. Select Concentration Values – the default is CAREX 2011 values, adjust if necessary.

Step 6. Repeat Steps 1-5 for another scenario, to display lifetime excess cancer risk results for two scenarios at a time.

NOTE: It is not necessary to save selections. The results and reports generated are based on the selections displayed in each of the selection boxes.

Exporting/Printing Options

Export or print the results by:
Clicking the Download button along the bottom menu bar.



1. Download as a PDF file.

OR

2. Download as an image.

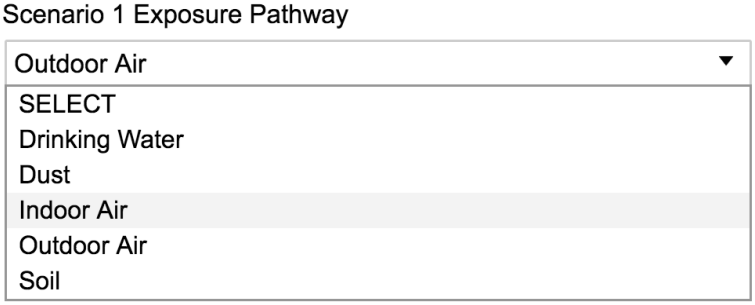
Step 1. Choose Carcinogen

Select a substance name in the "*Scenario 1 Name*" drop down box.

NOTE: eRISK Access included 88 known or suspected carcinogens, some of which have no reported cancer potency factors. Only 31 substances are included in **eRISK Online**. These substances have an environmental profile on the CAREX website and have published potency factors. See the complete list including associated cancer potency factors in Appendix 1.

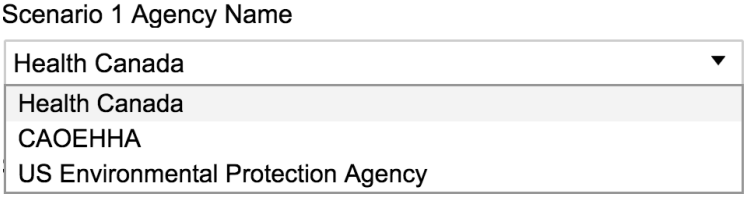
Step 2. Choose Exposure Pathway

Select an exposure pathway in the "*Scenario 1 Exposure Pathway*" drop down box. There are five exposure pathways to choose from: Outdoor Air, Indoor Air, Drinking Water, Soil, and Dust.



Step 3. Choose Agency

Select an agency in the "*Scenario 1 Agency*" drop down box to use the associated cancer potency factors.



Health Canada: cancer potency factors from the Health Canada, 2010. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment. Version 2.0. and Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors. Version 2.0.

CA OEHHA: cancer potency factors from the California Office of Environmental Health Hazard Assessment.

US EPA: cancer potency factors from the United States Environmental Protection Agency Integrated Risk Information System. If potency factors are not available, unit risk is converted to cancer potency factors.

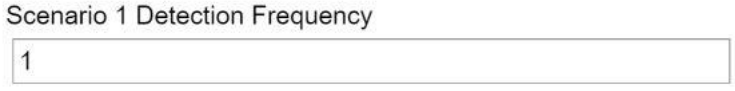
TIP: Users may want to start with the Health Canada cancer potency factor because many legislative requirements are guided by Health Canada, and use the other cancer potency factors for comparison purposes.

NOTE: Cancer potency factors are regularly updated by these agencies. **eRISK Online** contains only those available as of January 1, 2013. Check for updated versions of **eRISK** on the CAREX Canada website.

CAUTION: Professional assessment may be needed to choose the right cancer potency factor for the population. To choose the cancer potency factor that is the most protecting of the population (meaning the highest or most severe cancer potency factor) may or may not be the best and correct approach. Data sources and data quality should be taken into consideration. This information is available on the CAREX Canada website.

Step 4. Select Detection Frequency

Detection frequency in the "*Scenario 1 Detection Frequency*" text box always defaults to 1, which implies that the substance is always present at the levels indicated over a 70-year lifetime, for each exposure pathway.



This is unlikely to be true for any given substance or any individual, so the risk calculation should be considered as an indicator of **potential** lifetime excess cancer risk.

- If the indicated levels remain the same over an entire lifetime, the calculated lifetime excess cancer risk will remain the same.
- If measured levels in exposure pathway decrease, so will the calculated lifetime excess cancer risk.

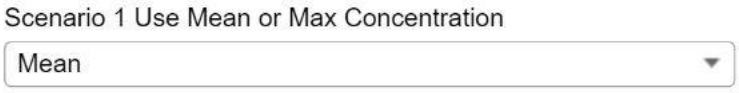
If you have detection frequency data (the number of samples in which the substance was detected and the total number of samples taken) you can adjust this value. For example, if a substance is typically detected only in 20 out of 100 samples, remove 1 and input 0.2 in the "*Scenario 1 Detection Frequency*" text box. This adjusts the calculation to reflect the presence of the substance at the measured level in only 20 percent of the inhaled or ingested quantity.

Step 5. Select Concentration Values

Data saved in the CAREX 2011 project comes from a variety of sources:

- Outdoor air: average and maximum measured levels in 2011 from the National Air Pollution Surveillance (NAPS) network operated by Environment Canada.
- Indoor air and dust: our estimate of average and maximum measured levels reported in published literature and government reports between 2000 and 2011.
- Drinking water: average and maximum measured levels in 2011 from the Ontario Drinking Water Surveillance Program (DWSP), with additional information on arsenic from Health Canada reviews.
- Soil: no data on measured levels in soil were summarized for the CAREX 2011 indicators

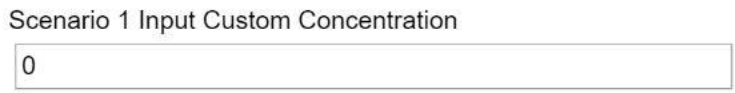
Select whether to use Mean or Max levels in the "*Scenario 1 Mean or Max Concentration*" pull down box. Minimum levels were not used for CAREX 2011. By default, the Mean concentration is selected. If the Maximum concentration is desired, switch to Max in the "*Scenario 1 Mean or Max Concentration*" pull down box.



CAUTION: Only use max levels in special circumstances when doing a risk assessment. Normally users would do a risk assessment with a conservative scenario and use the mean levels.

NOTE: If Mean is selected for "*Scenario 1 Mean or Max*", only fill in "*Scenario 1 Custom Mean*". If Max is selected for "*Scenario 1 Mean or Max*", only fill in "*Scenario 1 Custom Max*".

Once Mean or Max is selected, the concentration value in the CAREX 2011 project is shown. You have the option of using the existing CAREX values for this substance and exposure pathway (by proceeding to the next step), or to enter your own data in the "*Scenario 1 Input Custom Concentration*" text box:



TIP: Make sure to use the correct measurement units:

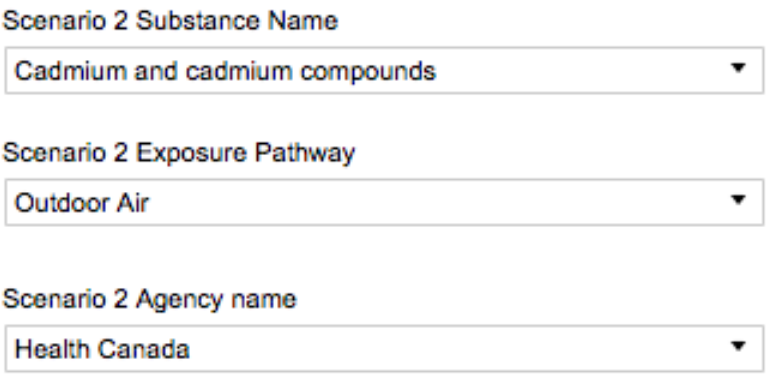
- Outdoor and indoor air: micrograms per cubic meter (µg/m^3)
  - Exception: Asbestos - fibres per millilitre (f/mL)
  - Exception: Radon - Bq per cubic meter (Bq/m^3)
- Dust and soil: micrograms per gram (µg/g) or milligrams per kilogram (mg/kg)
- Drinking water: micrograms per litre (µg/L) or parts per million (ppb)

NOTE: Complete details on the measured levels identified and summarized are available on the CAREX Canada website (http://www.carexcanada.ca). Go to the environmental estimate for the substance of interest, click on DATA in the left hand menu then the Overview and environmental pathway tabs.

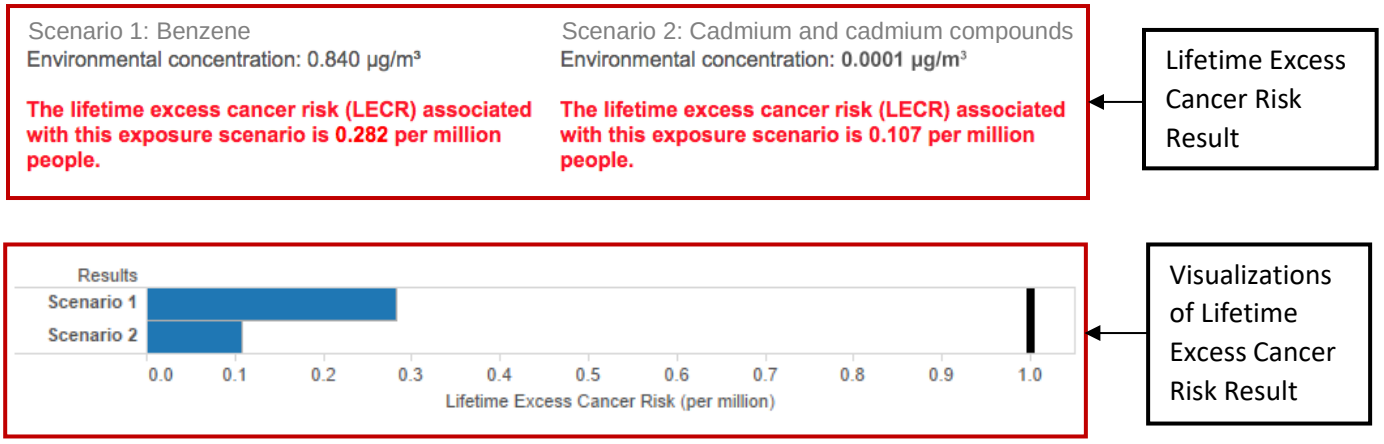
Step 6. Repeat Steps 1-5 for Another Scenario

eRISK Online can display results for two scenarios at a time. Skip if only one set of results is desired.

Repeat Steps 1-5 for "*Scenario 2*", to display lifetime excess cancer risk results for another scenario.



REPORT: Lifetime Excess Cancer Risk



If there is insufficient data in the CAREX 2011 project, an error message will show:

Insufficient data in CAREX 2011 database; NOT USER ERROR. Try another substance, exposure pathway, or agency: None per million people.

The blue bar represents the Lifetime Excess Cancer Risk result with the selected filters: substance name, exposure pathway, agency, detection frequency, and concentration values.

NOTE: The scale of the bar graphs may change depending on the results.

References

[1] Canadian Cancer Society's Steering Committee on Cancer Statistics. Canadian Cancer Statistics 2011. Toronto, ON: Canadian Cancer Society; 2011.

[2] Federal Contaminated Site Risk Assessment in Canada Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment (PQRA). Health Canada (2012).

[3] National Air Toxics Assessments (NATA) program

[4] Bodyweights and ingestion rates for air, drinking water and soil: Investigating Human Exposure to Contaminants in the Environment: A Handbook for Exposure Calculations. Health Canada. 1995. (Ingestion rate for dust is assumed to be the same as for soil).

[5] Time spent indoor and outdoor: Federal Contaminated Site Risk Assessment in Canada. Part VI: Guidance on Human Health Detailed Quantitative Radiological Risk Assessment (DQRARAD). Health Canada. 2010.

[6] Data and Data Quality pages for each substance, for example: http://www.carexcanada.ca/en/1,3-butadiene/environmental_estimate/#data and http://www.carexcanada.ca/en/1,3-butadiene/environmental_estimate/#data_quality

[7] Lifetime excess cancer risk estimates for asbestos and radon were calculated using a variation of the approach used for the substances included in eRISK.

Appendix 1. eRISK Known and Suspected Carcinogen List

KNOWN CARCINOGENS (IARC 1)		Inhalation Cancer Potency Factors			Ingestion Cancer Potency Factors		
Substance	**Chemical Abstracts Service number**	**CAOEHHA[1]**	**Health Canada[2]**	**US EPA[3]**	**CAOEHHA[1]**	**Health Canada[2]**	**US EPA[3]**
1,3-Butadiene	106-99-0	0.60		0.105	3.40		
2,3,7,8-Tetrachlorodibenzo-para-dioxin (TCDD)	1746-01-6	130,000			130,000		
Arsenic and arsenic compounds	7440-38-2	12.00	27.00	15.05	1.50	1.80	1.50
Asbestos	1332-21-4	1.9		0.23			
Benzene	71-43-2	0.10	0.0145	0.0273		0.0834	0.055
Benzo[a]pyrene	50-32-8	3.90	0.13		12.00	2.30	7.30
Cadmium and cadmium compounds	7440-43-9	15.00	42.00	6.30			
Chromium VI (hexavalent chromium)	18540-29-9	510.00	320.00	42.00	0.42		
Diesel engine exhaust		1.10					
Formaldehyde	50-00-0	0.021		0.0455			
Nickel (2B) and its compounds (1)	7440-02-0	0.91					
Radon	10043-92-2			4.86^{-10}			

1. California Office of Environmental Health Hazard Assessment
2. Health Canada, 2010. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment. Version 2.0. and Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors. Version 2.0.
3. United States Environmental Protection Agency Integrated Risk Information System

PROBABLE CARCINOGENS (IARC 2A)		Inhalation Cancer Potency Factors			Ingestion Cancer Potency Factors		
Substance	**Chemical Abstracts Service number**	**CAOEHHA[1]**	**Health Canada[2]**	**US EPA[3]**	**CAOEHHA[1]**	**Health Canada[2]**	**US EPA[3]**
Polychlorinated biphenyls (PCBs)	1336-36-3	2.00		0.4	2.00		2.00
Lead (2B) and lead compounds (2A)	7439-92-1	0.042			0.0085		
Tetrachloroethylene (PERC)	127-18-4	0.021		0.00091	0.051		0.0021

1. California Office of Environmental Health Hazard Assessment
2. Health Canada, 2010. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment. Version 2.0. and Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors. Version 2.0.
3. United States Environmental Protection Agency Integrated Risk Information System

POSSIBLE CARCINOGENS (IARC 2B)		Inhalation Cancer Potency Factors			Ingestion Cancer Potency Factors		
Substance	**Chemical Abstracts Service number**	**CAOEHHA[1]**	**Health Canada[2]**	**US EPA[3]**	**CAOEHHA[1]**	**Health Canada[2]**	**US EPA[3]**
2,4,6-trichlorophenol	88-06-2	0.07		0.011	0.07	0.02	0.011
Acetaldehyde (ethanal)	75-07-0	0.01		0.0077			
Benz[a]anthracene	56-55-3	0.39			1.20		
Benzo[b]fluoranthene	205-99-2	0.39			1.20		
Benzo[k]fluoranthene	207-08-9	0.39			1.20		
Bromodichloromethane - BDCM	75-27-4	0.13			0.13		0.062
Chloroform (trichloromethane)	67-66-3	0.019		0.0805	0.031		
Chlorothalonil	1897-45-6	0.0031			0.0031		
Chrysene	218-01-9	0.039			0.12		
Dichloroacetic acid - DCA	79-43-6						0.05
Dichloromethane (methylene chloride)	75-09-2	0.0035	0.0001	0.00004	0.014	0.00008	0.002
Dichlorvos	62-73-7	0.29			0.41		0.29
Ethylbenzene	100-41-4	0.0087			0.011		
Lindane (hexchloro-cyclohexanes)	58-89-9	1.10			1.10		
N-nitrosomethylethylamine	10595-95-6	22.00			22.00		22.00
Pentachlorophenol	87-86-5	0.018			0.018		0.4

1. California Office of Environmental Health Hazard Assessment
2. Health Canada, 2010. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment. Version 2.0. and Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors. Version 2.0.
3. United States Environmental Protection Agency Integrated Risk Information System