

Health Impacts

Information on Chlorination Disinfectant By-Products (CDBPs)

Chlorination disinfectant by-products are formed when chlorine used for disinfection reacts with natural organic matter (e.g., decaying leaves and vegetation) in the water.



Why is Drinking Water Disinfected?

The source water that supplies drinking water systems, especially surface water, contains microbiological organisms that can be very harmful to humans. In the 1900's the introduction of disinfectant into water systems led to a dramatic decrease in illnesses and fatalities caused by waterborne diseases such as typhoid, cholera and dysentery. As seen in Walkerton, Ontario in 2000, pathogens such as strains of e-coli are an immediate public health risk that can result in severe illness and even death. Chlorination is the most common disinfectant used in Canada. Efforts to reduce potential health risks from chlorination disinfectant by-products (CDBPs) must not compromise disinfection that is used for pathogen control.

How can I be Exposed to CDBPs?

Ingestion <ul style="list-style-type: none">• Drinking water containing CDBPs	Drinking water containing CDBPs has been found to be the main route of exposure ¹ .
Inhalation <ul style="list-style-type: none">• Breathing CDBPs in the air• Showering, bathing• Boiling water	Some trihalomethanes (THMs) are volatile, though inhalation of trihalomethanes due to volatilization is negligible when compared to consumption rates through drinking water ² .
Absorption <ul style="list-style-type: none">• Showering, bathing• Swimming	While not all THMs can be absorbed, chloroform can be absorbed through the skin, and contributes a significant amount of the THM exposure that swimmers experience. HAAs are not volatile, and cannot be absorbed by the skin, exposure through routes other than consumption is considered negligible ⁴ .

Exposure from a 10-minute shower or 30-minute bath is about the same as drinking two and a half litres of cold water⁵.

“Efforts to reduce DBPs must not compromise the effectiveness of disinfection”
-Health Canada

The current CDBPs tested for in NL are Trihalomethanes (THMs) and Haloacetic acids (HAAs). There are other types of disinfectant by-products, however they are not tested for in NL.

What are the Possible Health Impacts of CDBPs?

Type of CDBP	Compound	Rating	Potential Health Effects
THMs	Chloroform	B2	Cancer, liver, kidney and reproductive effects
	Dibromochloromethane	C	Nervous system, liver, kidney and reproductive effects
	Bromodichloromethane	B2	Cancer, liver, kidney and reproductive effects
	Bromoform	B2	Cancer, nervous system, liver and kidney effects
HAAs	Dichloroacetic acid	B2	Cancer, reproductive, developmental effects
	Trichloroacetic acid	C	Liver, kidney, spleen, developmental effects

A: Human carcinogen; **B1:** Probable human carcinogen (with some epidemiological evidence); **B2:** Probable human carcinogen (sufficient laboratory evidence); **C:** Possible human carcinogen; **D:** Non classifiable⁶.

How are Health Guidelines Created?

- “The Health Canada guidelines are established at a level at which the increased cancer risk is **‘essentially negligible’** when humans are exposed at that level over a lifetime (70 years). In the context of drinking water guidelines, Health Canada has defined this term as a range from one new cancer above background per 100,000 people to one new cancer above background per 1 million people (i.e., 10^{-5} to 10^{-6}) over a lifetime” (Health Canada, 2009, p.4).
- “The World Health Organization’s guidelines are based on the tolerable burden of disease which is defined as an upper limit of 10^{-6} DALY per person per year. This upper-limit DALY is approximately equivalent to a 10^{-5} excess lifetime risk of cancer (i.e., **1 excess case of cancer per 100,000 people ingesting drinking-water at the water quality target daily over a 70-year period**), which is the risk level used in these Guidelines to determine guideline values for genotoxic carcinogens.” (WHO, 2011, p. 38).
 - DALY stands for Disability-Adjusted Life Years, where disability refers to a condition that detracts from good health and the DALY metric weights each health impact in terms of severity within the range of 0 for good health to 1 for death².

What are the Health Guidelines?^{2,6}

Health Canada/NL (2008)	The province bases their guidelines on the Guidelines for Canadian Drinking Water Quality: Total THMs: 100 µg/L Total HAAs: 80 µg/L
United States (2003)	Total THMs: 80 µg/L Total HAAs: 60 µg/L
World Health Organization (2011)	THMs (no total guidelines): Bromodichloromethane 60 µg/L; Chloroform 300 µg/L; Bromoform 100 µg/L; Dibromochloromethane 100 µg/L HAAs (no total guidelines): Dichloroacetic acid 50 µg/L; Trichloroacetic acid 200 µg/L

What are Academic Studies Finding?

Cancer associations

- Out of a sample of ten studies reviewed concerning cancers risks of THMs and /or HAAs, three studies indicated there was a risk in some geographic locations^{7;3;8}. Four studies said that there may be a risk associated with CDBPs and cancers^{9;10;11;12} and three studies found there to be a weak association in studies done on humans between CDBPs and certain cancers^{13;14;15}.
- One study showed that both inhalation and dermal contacts contribute to approximately 40% of total cancer risks of CDBPs³.
- All studies agreed that more research is needed.

Reproductive effects

- There have been some toxicological and epidemiological studies that point towards an association between THMs, and (low) birth weight, although the evidence is not conclusive. Some studies have shown associations for DBPs and other outcomes such as spontaneous abortions, stillbirth and birth defects. There is no evidence for an association between THMs and preterm delivery¹⁶. More research is needed.

Resources for Further Reading

- Government of Newfoundland and Labrador:
 - http://www.env.gov.nl.ca/env/faq/thm_facts.html
 - <http://www.env.gov.nl.ca/env/waterres/reports/cwws/index.html>
- Health Canada
 - Drinking water chlorination: <http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/envIRON/chlor-eng.php>
 - THMs: <http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/trihalomethanes/index-eng.php>
 - HAAs: <http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/haloaceti/index-eng.php>
- World Health Organization
 - http://whqlibdoc.who.int/ehc/WHO_EHC_216.pdf?ua=1
 - http://whqlibdoc.who.int/publications/2011/9789241548151_eng.pdf?ua=1
- US Environmental Protection Agency:
 - [http://www.hse.ie/eng/services/Publications/Environmentalhealth/Joint Position Statement Trihalomethanes in Drinking Water.pdf](http://www.hse.ie/eng/services/Publications/Environmentalhealth/Joint%20Position%20Statement%20Trihalomethanes%20in%20Drinking%20Water.pdf)

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