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CYANOBACTERIA AND DRINKING WATER: OCCURRENCE, RISKS, MANAGEMENT AND KNOWLEDGE GAPS FOR PUBLIC HEALTH EXECUTIVE SUMMARY

PROJECT OVERVIEW

Harmful algal blooms (cyanoblooms), largely associated with toxin-producing cyanobacteria, pose a risk to drinking water supplies across Canada. This evidence review provides an overview of the scale of the issue in Canada and examines key areas of importance for public health in responding to current and future risks from cyanobacteria in drinking water sources. A review of grey and academic literature, reports and websites of relevant provincial and territorial agencies, as well as communications with key informants in B.C., Alberta, Saskatchewan, and Ontario were used to examine the occurrence of cyanoblooms in Canada, the risks to drinking water supplies, current approaches to management, and key knowledge and practice gaps for public health. A scan of current approaches used in each of Canada's provinces and territories is presented in this paper.

REPORT HIGHLIGHTS

Cyanobacteria can form cyanoblooms in lakes and reservoirs with sufficient levels of nutrients, warm temperatures (e.g. > 20°C) and calm water conditions. Pollution and increasing temperatures along with climate related factors such as precipitation, wind, and lake characteristics may affect the frequency of cyanoblooms in the future. Occurrence of cyanoblooms is common across several provinces between June and November (e.g. The Prairies, Ontario and Quebec) although cyanobloom season can be much longer in some waterbodies. In 2018 there were cyanobloom alerts or advisories on about 150 lakes and reservoirs across Canada, although the actual number of events is likely to be higher due to variation in surveillance and reporting. Approximately 5% of water treatment plants have identified cyanobacteria as a source water risk and cyanoblooms have occurred on waterbodies providing drinking water in all provinces except for P.E.I. where municipal source water is groundwater.

Cyanoblooms pose a risk to health due to the toxins produced by some cyanobacteria (cyanotoxins). These can affect the liver (hepatotoxins), nervous system (neurotoxins) and cause other effects such as skin and eye irritation, nausea, vomiting and fever. Data on exposure levels and illness reporting are scarce and few incidents of ill-health related to cyanotoxin exposure in Canada have been recorded. These have all been due to recreational contact with no incidents attributed to drinking water exposure. Globally, there have been few recorded events of ill health related to cyanotoxins in drinking water; however when events occur, a large number of individuals can be affected. The most catastrophic event attributed to cyanotoxin poisoning in treated source water occurred at a haemodialysis clinic in Caruaru, Brazil in 1996 where over 50 patients died due to acute liver failure linked to cyanotoxins.

Health Canada guidelines provide the basis for cyanotoxin monitoring in drinking water across Canada. A Maximum Acceptable Concentration (MAC) exists for one group of cyanotoxins, microcystins. Microcystins are hepatotoxins and one variant (LR) has been identified as Group 2B, possibly carcinogenic to humans after chronic exposure. Other cyanotoxins (anatoxins, saxitoxins, cylindrospermopsins, BMAA) are suspected to cause a range of health effects but due to lack of data on exposure levels and health effects, no other drinking water MACs exist. There has been limited research on the effects of chronic exposure to low levels of cyanotoxins in drinking water.

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Most large drinking water treatment plants are equipped to deal with a measure of cyanotoxin risk, using multi-barrier approaches to remove both intracellular and extracellular cyanotoxins and exceedances of the MAC for microcystins in treated water are rare but occasionally occur. In locations that lack situational assessments of vulnerable supplies and populations, standard operating procedures (SOPs) for operators, and access to rapid and cost effective monitoring tools the ability to evaluate risk and respond effectively to cyanoblooms may be limited. Users of small drinking water systems (SDWS) and private water systems (PWS) with limited treatment capability and drawing water from affected surface waterbodies may be at a greater risk of exposure than other drinking water users.

KNOWLEDGE AND PRACTICE GAPS

Approaches to managing risks to drinking water vary across the country, with several examples of good practices in assessing risk, reporting on blooms, and communicating with the public. Sharing of best practices across Canada could enhance regional capabilities to address some of the key knowledge gaps identified:

- There is a need for consistent approaches to surveillance and methods for sampling, analysis, and frequency of monitoring to help quantify the risk of exposure and the health effects of cyanotoxins; these are necessary to help develop threat assessment tools for public health.
- There is a need for rapid, reliable, and cost effective field tests to reduce reliance on laboratory testing, which is costly and involves lengthy time delays.
- There is limited data on the number of affected users of SDWS and PWS.
- There is a need for practical advice and solutions tailored to specific user groups, such as municipal or private SDWS, PWS, and vulnerable groups.
- There is a need for training and SOPs for operators in drinking water plants affected by cyanobloom events.
- There is a need for local champions and organisational leadership to help develop more coordinated and consistent responses across regions or provinces. Sharing good practices through a national best practice forum could assist in developing effective approaches to cyanobloom management and response.
- There is little known about the effects of low level chronic exposure to cyanotoxins in Canada. Studies are needed on the dynamics of cyanotoxins including behaviour in the environment, toxicity mechanisms, bioaccumulation, and additive, synergistic or antagonistic effects.
- There is a gap in readily accessible monitoring data for waterbodies affected by cyanoblooms for developing predictive models and targeting monitoring and surveillance efforts. Linking environmental data to health impacts could improve understanding of the links between exposure and health.
- Research gaps exist in understanding the mechanisms and level of human toxicity via various exposure routes for a range of cyanotoxins, including effects of cyanotoxins on other human systems, risks from exposure to mixtures of cyanotoxins and other chemical stressors in water supplies, and information on the most sensitive populations via various exposure routes.

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