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Abbreviations

AI	adequate intake
BIA	budget impact analysis
CIHI	Canadian Institute of Health Information
CPI	consumer price index
CWF	community water fluoridation
dmft	decayed, missing, and filled deciduous teeth
DMFT	decayed, missing, and filled permanent teeth
HTA	health technology assessment
IR	incidence rate
MAC	maximum acceptable concentration
PHAC	Public Health Agency of Canada
ppm	parts per million
UL	upper limit

Introduction

Dental caries is a common public health problem in Canada,¹ and it affects about 57% of children aged six to 11 years and 59% of adolescents aged 12 to 18 years.² It has been estimated that the prevalence of coronal caries and the prevalence of root caries for Canadian adults aged 19 years and older is 96% and 20.3%, respectively.² Dental caries can result in pain, infection, premature tooth loss, and misaligned teeth.³ Untreated dental caries in children are associated with poor overall growth, iron deficiency, behaviour problems, low self-esteem, and a reduction in school attendance and performance.⁴⁻⁹ In pregnant women, periodontal diseases are risk factors for preterm low birth weight.^{10,11} By adulthood, about 96% of Canadians have experienced dental caries.² In 2018, the cost of dental services was estimated to be approximately \$17 billion in Canada, about \$461 per Canadian, based on total national health expenditure estimated from both the private sector (\$15.2 billion) and public sector (\$1.8 billion).¹² Poor oral health is experienced by Canadians who cannot access regular dental care, including lower income families with no insurance, seniors in long-term care, new immigrants, and Indigenous peoples.^{2,13}

Fluoride is a negative ion (F^-) of the element fluorine (F_2).¹⁴ The term fluoride also refers to compounds containing F^- , such as sodium fluoride (NaF), calcium fluoride (CaF_2), fluorosilicic acid (H_2SiF_6), or sodium fluorosilicate (Na_2SiF_6).¹⁴ In water, these compounds dissociate to release F^- .¹⁴ Fluoride compounds exist in soil, air, plants, animals, and water.¹⁵ Epidemiological studies in the 1930s and 1940s found that people living in areas with high naturally occurring fluoride levels in water had lower incidence of dental caries (i.e., cavities and tooth decay), a chronic and progressive disease of the mineralized and soft tissue of the teeth. This finding led to the controlled addition of fluoride to community drinking water with low fluoride levels in order to prevent dental caries.^{16,17} In 1945, Brantford, Ontario, was the first city in Canada and the third city in the world to implement drinking water fluoridation.^{18,19}

Fluoride helps to prevent dental caries both systemically (pre-eruptive or before the teeth emerge) and topically (post-eruptive or on the tooth surface).^{20,21} The systemic effect occurs through the incorporation of ingested fluoride into enamel during tooth formation, which strengthens the teeth, making them more resistant to decay.²¹⁻²³ The major sources of systemic fluoride are fluoridated water and foods and beverages prepared in areas with fluoridated water.^{24,25} Fluoride from other sources such as toothpaste, mouth rinses, gels, varnishes, or foams provides a topical effect (unless swallowed) through direct contact with exposed tooth surface; this increases tooth resistance to decay against bacterial acid attack by inhibiting tooth de-mineralization, facilitating tooth remineralization, and inhibiting the activity of bacteria in plaque.²⁶ As well, after being absorbed systemically, a small portion of fluoride is excreted into the saliva where it provides a topical effect from the continuous bathing of saliva over the teeth.²⁷ Evidence has suggested that CWF is associated with a decrease in dental caries, a decline in numbers of hospital attendances for general anesthesia and tooth extractions, and a reduction in the cost of dental treatment in children.²⁸⁻³⁴

Daily intake levels of fluoride in humans vary depending on many factors, these include sources of fluoride (water, foods or beverages, or dental products), levels of fluoride in water or foods, the amount of water or food consumed, and individual characteristics and habits.¹⁴ About 75% to 90% of ingested fluoride is absorbed through the gastrointestinal tract, and up to 75% of the absorbed fluoride is deposited in calcified tissues (such as bones and teeth) in the form of fluorapatite within 24 hours.^{35,36} The rest is excreted primarily in the urine, with small amounts excreted in perspiration, saliva, breast milk, and feces.^{35,36} In 2007, a dietary

survey of the Canadian population estimated that the average intake of fluoride in children aged one to four years old in fluoridated and non-fluoridated communities was 0.026 mg/kg/day and 0.016 mg/kg/day, respectively.¹⁴ The average dietary intake of fluoride in adults 20 years and older ranged from 0.038 mg/kg/day to 0.048 mg/kg/day in fluoridated communities, and ranged from 0.024 mg/kg/day to 0.033 mg/kg/day in non-fluoridated communities.¹⁴ Based on the average daily dietary fluoride intakes in fluoridated areas (i.e., 0.7 to 1.1 ppm) in Canada and US, the recommended adequate intake (AI) of fluoride from all sources that is sufficient to prevent dental caries is 0.05 mg/kg/day, irrespective of age groups, sex, and pregnancy status.^{37,38} The tolerable upper limit (UL) value for infants through children aged eight years is 0.10 mg/kg/day.³⁷ The UL for children older than eight years and for adults including pregnant women is 10 mg/day.³⁷

According to the 2010 Health Canada *Guidelines for Drinking Water Quality*, the maximum acceptable concentration (MAC) of fluoride in drinking water is 1.5 ppm (parts per million or mg/L), while the optimal level of fluoride in drinking water is recommended to be 0.7 ppm (reduced from the previous range of 0.8 ppm to 1.0 ppm) for providing optimal dental health benefits and minimizing dental fluorosis.¹⁵ MAC was determined with moderate dental fluorosis as the end point of concern.¹⁵ Thus, community water fluoridation (CWF) in Canada is the process of controlling fluoride levels (by adding or removing fluoride) in the public water supply to reach the recommended optimal level of 0.7 ppm and to not exceed the maximum acceptable concentration of 1.5 ppm.¹⁵ Most sources of drinking water in Canada have low levels of naturally occurring fluoride.¹⁵ According to a Canadian survey conducted between 1984 and 1989, the average, provincial, naturally occurring fluoride levels in drinking water ranged from less than 0.05 ppm in British Columbia and Prince Edward Island, to 0.21 ppm in Yukon.¹⁵ The provincial and territorial data on drinking water in 2005 provided by the Federal-Provincial-Territorial Committee on Drinking Water showed that the average fluoride concentrations in fluoridated drinking water across Canada ranged between 0.46 ppm and 1.1 ppm.¹⁵ As of 2017, about 38.7% of Canadians were exposed to CWF for the protection of dental caries.³⁹ The decision to fluoridate drinking water is not regulated at the federal, provincial, or territorial levels, but rather the decision is made at the municipal level and is often taken by means of a community vote (i.e., by referendum or plebiscite).¹⁴

While public and dental health agencies and organizations, and about 60% of Canadians, view CWF as an effective and equitable means of improving and protecting the dental health of populations, there continues to be opposition, resistance, and skepticism about CWF, especially in terms of human and environmental health.⁴⁰⁻⁴² There are a variety of different perspectives on CWF, some of which centre on the scientific evidence of dental benefit,^{42,43} while others include the availability of alternative oral public health programs or interventions that avoid perceived concerns of CWF.^{43,44} Alternative publicly funded oral public health programs, such as school-based topical fluoride varnishes, though available, are not consistent across Canadian jurisdictions.⁴⁵⁻⁴⁷ Importantly, the available programs are not universal in nature and mainly target high-risk populations.^{45,46} Furthermore, public health programming is often targeted toward youth, excluding the adult and elderly populations. CWF, in contrast, is an intervention that reaches a broader population, so long as persons drink from municipal water supplies. Still, others cite potentially harmful side effects of fluoridation, for example, fluorosis, thyroid function, lowered average intelligence quotient (IQ) in populations, and negative environmental impact^{14,48} as motivation for water fluoridation cessation. Additional concerns include possible relationships between industry and fluoridation.^{14,48} Finally, an unsettled tension exists around the ethics of CWF in terms of distribution of benefits to all persons who consume fluoridated tap water, removing (or making very difficult) the ability to “choose” fluoridation.^{43,49-51}

It is within this context that some municipalities are choosing to cease water fluoridation, leading to its decline.³⁹ Notably, large Canadian cities such as Calgary, Quebec City, Windsor, Moncton, and Saint John have discontinued their water fluoridation programs in recent years.⁵²⁻⁵⁴ Other municipalities have also discontinued CWF across provinces and territories since 2012.³⁹ Although the total percentage of Canadians with access to CWF has increased from 2012 (37.4%) to 2017 (38.7%), some provinces and territories have shown a significant decline in fluoridated water system coverage.³⁹ As of 2017, the provinces and territories with the fewest municipalities with CWF systems include British Columbia, Quebec, New Brunswick, Newfoundland and Labrador, and Yukon.³⁹ The impact of CWF cessation on dental health is unclear.

Policy Question

This Health Technology Assessment (HTA) is intended to provide guidance to policy- and decision-makers at the municipal levels to help orient discussions and decisions about water fluoridation in Canada. This HTA seeks to address the following policy question: Should community water fluoridation be encouraged and maintained in Canada? The analytic framework informing this HTA is presented in Appendix 1.

Objectives

The aim of this HTA is to inform the above-mentioned policy question through an assessment of the effectiveness and safety,⁵⁵ economic considerations,⁵⁶ implementation issues,⁵⁷ environmental impact,⁵⁸ and ethical considerations⁵⁹ for CWF. An analysis of the evidence related to these considerations comprises different chapters of the HTA, each with specific and different research questions and methodologies. The following budget impact analysis (BIA) report addresses the economic considerations. Other sections have been published separately.

Research Questions

The HTA addressed the following research questions:

Review of Dental Caries and Other Health Outcomes

1. What is the effectiveness of community water fluoridation (fluoride level between 0.4 ppm and 1.5 ppm) compared with non-fluoridated drinking water (fluoride level < 0.4 ppm) in the prevention of dental caries in children and adults?
2. What are the effects of community water fluoridation cessation (fluoride level < 0.4 ppm) on dental caries in children and adults compared with continued community water fluoridation (fluoride level between 0.4 ppm and 1.5 ppm), the period before cessation of water fluoridation (fluoride level between 0.4 ppm and 1.5 ppm), or non-fluoridated communities (fluoride level < 0.4 ppm)?
3. What are the negative effects of community water fluoridation (at a given fluoride level) compared with non-fluoridated drinking water (fluoride level < 0.4 ppm) or fluoridation at different levels on human health outcomes?

Economic Analysis

4. From a societal perspective, what is the budget impact of introducing water fluoridation in a Canadian municipality without an existing community water fluoridation program?
5. From a societal perspective, what is the budget impact of ceasing water fluoridation in a Canadian municipality that currently has a community water fluoridation program?

Implementation Issues

6. What are the main challenges, considerations, and enablers related to implementing or maintaining community water fluoridation programs in Canada?
7. What are the main challenges, considerations, and enablers related to the cessation of community water fluoridation programs in Canada?

Environmental Assessment

8. What are the potential environmental (toxicological) risks associated with community water fluoridation?

Ethical Considerations

9. What are the major ethical issues raised by the implementation of community water fluoridation?
10. What are the major ethical issues raised by the cessation of community water fluoridation?
11. What are the major ethical issues raised by the legal, social, and cultural considerations to consider for implementation and cessation?

This economic analysis addressed research questions 4 and 5.

Financial considerations from the broader societal context in terms of the distribution of budget impact among jurisdictional stakeholders and indirect costs related to dental care (e.g., transportation and productivity loss costs) were deemed to be of key interest in addressing the decision problem given that the cost impact of CWF is likely to extend across many different stakeholders in Canada. While fluoridation falls within the purview of municipalities, dental care is covered through a mix of public and private sectors. The potential budgetary impact specific to each stakeholder from a decision to either implement or cease fluoridation of community water is likely to be different and a proper understanding of how cost impacts are distributed across different budgets is therefore important to understanding the cost implications to each stakeholder.

Of note, the research questions reflect different decision problems that would be faced by two different types of municipalities whose current practice of fluoridating community water differs. Question 4 is applicable to a municipality that currently does not fluoridate municipal water supplies and is deciding between introducing CWF into its existing water treatment infrastructure (which include a water treatment plant and a treated water delivery system) and continuing with the status quo (i.e., without fluoridation). Question 5 is applicable to a municipality that currently fluoridates its municipal water supplies and is deciding between the status quo (i.e., continuing water fluoridation) and ceasing CWF.

Review of Published Economic Literature

Prior to conducting this BIA, a literature review of published economic studies (e.g., economic evaluations and BIAs) related to the introduction and cessation of CWF was conducted to assess whether existing evidence could sufficiently address the research questions. The literature search identified five studies.⁶⁰⁻⁶⁴

The studies all addressed the potential impacts from the introduction of water fluoridation to communities whose water is presently not fluoridated and shared some common findings. The introduction of CWF was found to produce net cost savings under a societal perspective compared with the status quo (i.e., no CWF). The studies generally reported consistent findings across a range of community sizes and age groups, though two studies reported that CWF was no longer cost saving for smaller community population sizes (between 1,000⁶⁴ people and 5,000⁶⁰ people). Although none of these studies self-reported as BIAs, the studies shared some common approaches to quantifying the costs and benefits of CWF. The costs of CWF generally included fixed costs (such as equipment) and variable costs (such as labour), while the benefits of CWF were characterized as averted caries treatment costs. Four out of five studies accounted for productivity losses associated with caries treatment,⁶⁰⁻⁶³ and one study additionally accounted for transportation costs associated with caries treatment.⁶³ Most studies also considered a mix of deciduous and permanent dentitions in evaluating the potential impact of water fluoridation to the development of dental caries, with only two studies^{61,64} focusing solely on permanent dentition caries. Only one of the studies was conducted for a Canadian setting⁶³ — specifically in Quebec. The studies also shared similar limitations as most did not clearly define the analytic time horizon, with the exception of a study that explicitly stated adopting a 30-year period.⁶⁴ Furthermore, potential changes in population demographic (e.g., birth, mortality, migration) do not appear to be considered in these studies.

No studies were identified that have explored the potential financial impact of ceasing CWF in existing fluoridated communities.

As noted in this report, there are two research questions of interest: one relating to introduction and another relating to cessation of CWF in a Canadian context. For the first research question, a single published study was found that addressed the economic considerations of introducing CWF in Quebec; however, there remains uncertainty to the generalizability of these findings to a broader Canadian perspective. For the second question relating to cessation, none of the identified literature specifically investigated this topic. Given these uncertainties and evidence gaps in the identified literature, de novo BIAs were deemed necessary to address both research questions.

Budget Impact Analyses

Methods

A protocol was developed a priori⁶⁵ and was followed throughout the research process.

BIAs were conducted on Microsoft Excel to address the decision problems previously introduced. This section details the methodological specifications of the two BIAs, referred as CWF introduction (the analysis addressing Question 4) and CWF cessation (the analysis addressing Question 5).

Perspective

Although municipal governments make decisions regarding CWF in Canada, its impact on caries incidences extends to multiple budget holders. Therefore, the BIAs adopted a broader societal perspective and reflected cost considerations from federal, provincial, territorial, municipal, and private (i.e., private health insurer and individual) budgets. Federal, provincial, and territorial budgets reflected direct medical costs covered under the public health insurance plans of each government body. Municipal budget reflected direct dental costs that may be covered by municipality-funded dental programs, as well as CWF capital expenditure and operation costs. Private budget accounted for direct medical costs that may be covered under private dental insurance plans or by patients themselves as out-of-pocket expenses, alongside the costs of transportation and productivity loss incurred from seeking health care services associated with caries.

Time Horizon

A twenty-year time horizon was used for both BIAs to reflect municipal asset management practices in Canada,⁶⁶⁻⁶⁹ and to capture the expected life of the capital investment, and the impact over generations of people who could be affected by a CWF decision. More specifically, the analyses account for years 2018 to 2037.

Population

As the decision to implement or cease water fluoridation is at the level of a municipality, the populations modelled in both BIAs reflect that of municipal residents. As most Canadians generally live in an urban municipality,⁷⁰ the size of the municipality for the base-case analyses was assumed to be that of an average large urban municipality in Canada (N = 675,429), estimated based on the 2016 Canadian census data.⁷¹

As the time horizon captured in the model reflects a long-time period of 20 years, a dynamic population was considered. Specifically, the analyses captured a dynamic open population in which the demographic composition of a municipality, by age and sex, changed over the modelled time horizon to account for the expected long-term demographic changes within a municipality. Changes in the municipal population were important to consider given that the impact of a municipal CWF decision in terms of burden of caries extends over a long term and the municipal population is expected to change during this period. Projections of birth, mortality, and migration rates were adapted from Statistics Canada population projections.^{72,73}

Non-permanent residents, in particular, were not considered as part of the analyses. Given that these individuals only stay temporarily in a municipality and represent a small subset of the total Canadian population (i.e., less than three per cent),⁷⁴ this exclusion would be unlikely to impact the overall population estimates over the time horizon.

Community Water Fluoridation Strategies

The CWF strategies assessed were unique to each BIA and its decision problem.

Community Water Fluoridation Introduction (I.E., Question 4)

For municipalities currently without CWF, the decision problem of choosing between the strategy of introducing CWF (referred henceforth as Strategy 1a) and the strategy of maintaining the current status quo (which represents no CWF, and is henceforth referred to

as Strategy 1b) was modelled. In the former strategy, equipment and processes for CWF were assumed to be introduced in the first year as additional capital expenses to an existing municipal water treatment infrastructure. The municipality considered in this analysis therefore reflects one with an existing water treatment infrastructure and the decision problem of introducing CWF would be in the context of upgrading an existing municipal water treatment infrastructure.

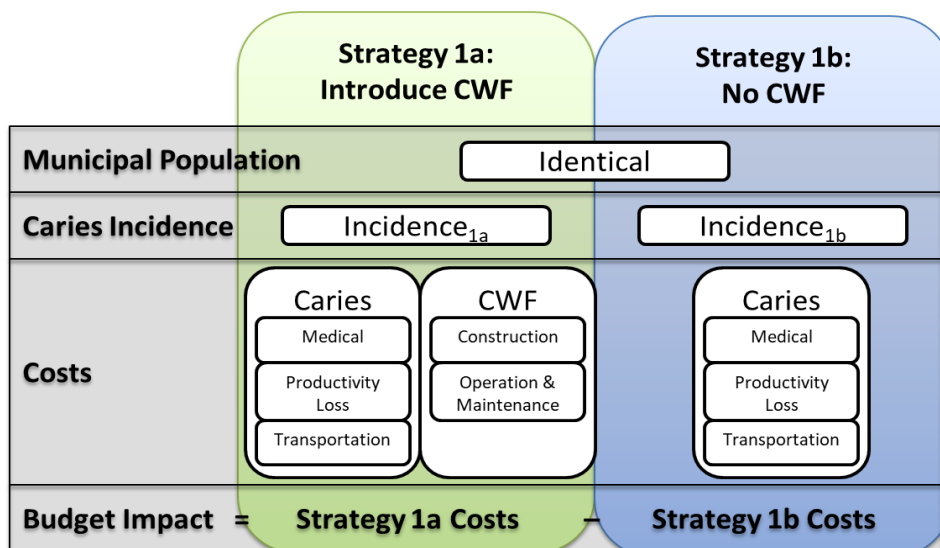
Community Water Fluoridation Cessation (I.E., Question 5)

For municipalities that presently adjust fluoride levels in their community water supplies to optimal levels, the decision problem of choosing between the strategy where a municipality ceases fluoridation (referred to henceforth as Strategy 2a) and the strategy of maintaining the current status quo (which represents continuation of CWF, and is henceforth referred to as Strategy 2b) was modelled. In the latter strategy, it was assumed that CWF continuation would necessitate renewed capital expenditures to retrofit (i.e., upgrade or replace) old equipment and processes for fluoridation within an existing water treatment infrastructure.

Analytic Framework

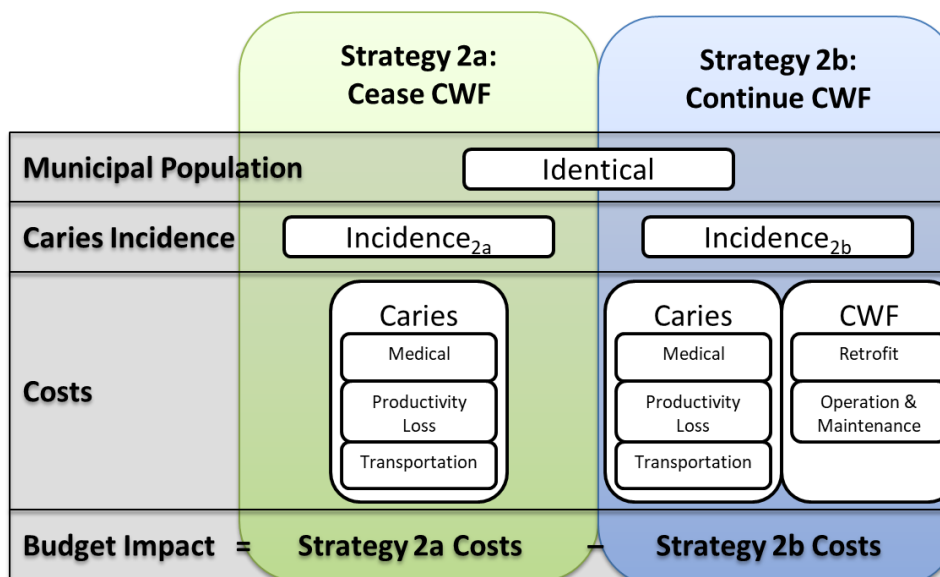
The analytic framework for the BIAs are as described in Figure 1 and Figure 2, and illustrate how the cost comparisons between strategies are structured for each BIA. For each analysis, the population size, factoring in demographic change over time, was first projected. Different caries incidence rates specific to each strategy were applied to estimate the prevalence of caries over the modelled time horizon. Differences in the prevalence of caries between the two strategies resulted in differences in both direct (i.e., medical) and indirect (i.e., transportation and productivity loss) costs. Costs directly associated with CWF construction, operation, and maintenance were also considered for the CWF introduction and CWF continuation strategies (i.e., strategies 1a and 2b). Budget impact was defined as the difference in the sum of total costs between the compared strategies.

Figure 1: Comparison of Strategies for Community Water Fluoridation Introduction Budget Impact Analysis



CWF = community water fluoridation.

Figure 2: Comparison of Strategies for Community Water Fluoridation Cessation Budget Impact Analysis



CWF = community water fluoridation.

Input Data

Details to the input parameters that were used as part of the base-case analysis are subsequently summarized.

Population Projection — Demographic Inputs

As previously noted, the total population considered in the BIA was at the level of a municipal population.

Municipal population projection was modelled based on a cohort component method. An initial municipal population (i.e., for the year 2018), categorized by age and sex, was defined (Figure 3). Over the 20-year time horizon, a growing municipal population was modelled based on factoring components of births, mortality, and migration. To project the change in population demographics over time, the population from the start of a year was used to estimate, within each age and sex group, the number of individuals who remained alive by the start of the next year. The number of live births by sex that would occur was also estimated and added to the population projection. Migration was handled by adding immigrants and subtracting emigrants. As the population analyzed was those still residing within the municipality, potential health outcome and cost impacts of drinking fluoridated water in emigrants who have since left the municipality were not considered.

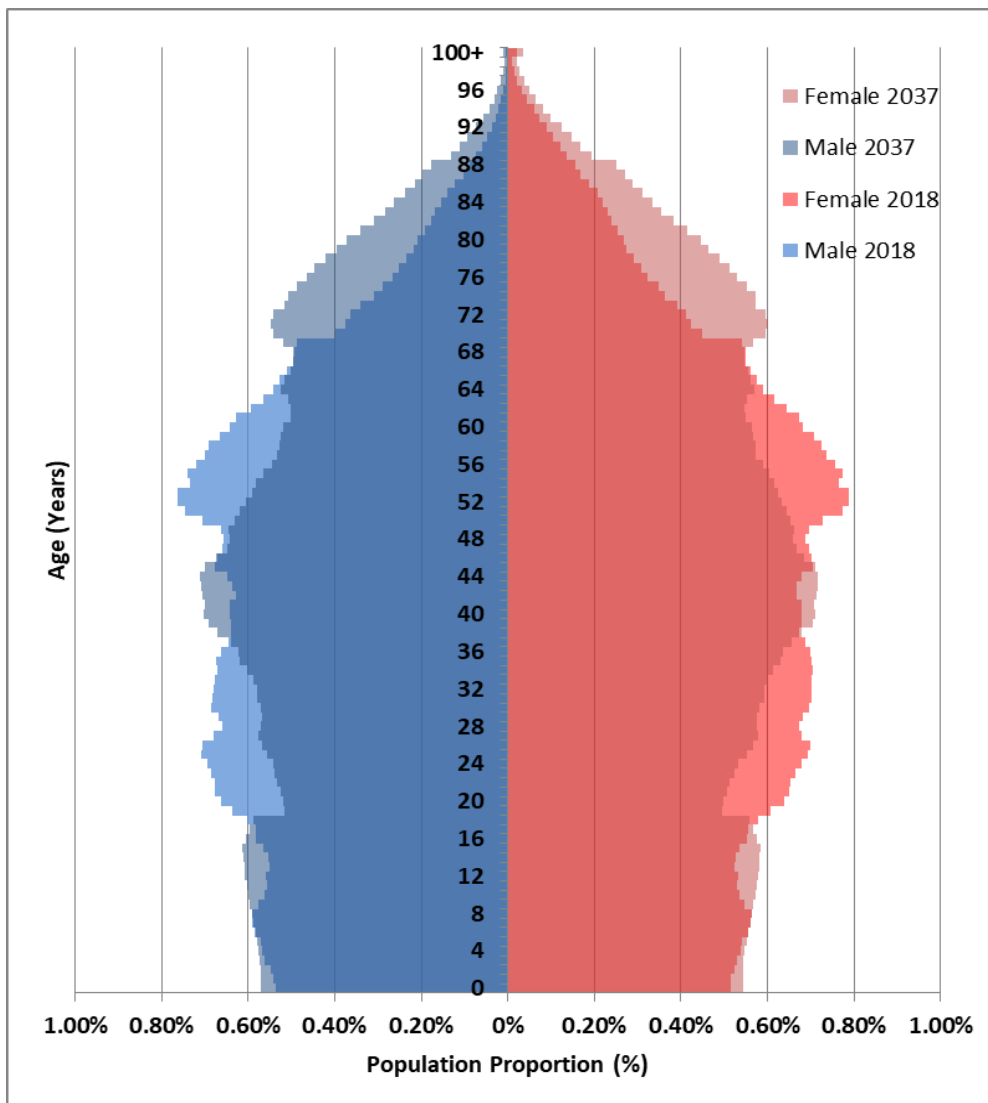
The municipality's population pyramid for 2018 and the forecasted population distribution (by age and sex groups) for 2037 are illustrated in Figure 3.

Initial Population

For the base case, as previously noted, the size of the initial municipality reflected the average size of large population centres reported in the 2016 Canadian census (N = 675,429). The age-sex composition of the initial population represented a large urban municipality given that 81.3% of the Canadian population live in urban areas⁷⁵ and this was considered to best reflect the municipality of an average person residing in Canada. The division of the initial population by age and sex subgroups was therefore based on the demographic composition of the most populous census subdivisions in 2016, which account for 81.3% of the national population.⁷⁶ Sensitivity analyses were conducted to explore scenarios for smaller municipalities, including medium urban, small urban, and rural municipalities.

The proportions of the initial population (by age and sex subgroup) are reported in Table 26, Appendix 3.

Figure 3: 2018 and 2037 Population Pyramids



Births

Base-case birth rates for 2018 to 2037 were based on medium scenario birth projections from Statistics Canada.⁷³ Male-to-female birth ratio was assumed to be 1.05, the same ratio that was used in Statistic Canada projections.⁷² Low and high birth rate scenarios were explored in sensitivity analyses.

Mortality

Base-case annual mortality rates for 2018 to 2037 were based on adjusted medium scenario projections from Statistics Canada.⁷² Statistics Canada reported sex- and age-specific mortality rate projections for two time periods: 2011 and 2062. With these values, age- and sex-specific mortality rates were linearly interpolated for each of the years from 2018 to 2037. As the Statistics Canada projections had incorporated an older life table in its

estimates, these mortality rates were further adjusted to reflect the latest available life table (2013 to 2015).⁷⁷ As ages older than 99 years were modelled as an age group of 100 and older, the life table mortality rates for 100 to 109 years of age were averaged for this group. Low and high mortality scenario rates were also adjusted similarly by using the reported 95% confidence intervals of the life table's mortality rates and were explored in sensitivity analyses.

Migration

International immigration is a significant source of population growth for Canada and is therefore important to incorporate into population projections along with international emigration. Overall immigration and emigration rates were combined with age- and sex-specific distributions of immigrants and emigrants to inform changes in the modelled municipal population's age and sex composition over the time horizon. Of note, migration was only incorporated for the purposes of projecting changes in the size of a municipal's population and a simplifying assumption was made that the baseline rate of caries of new immigrants would be similar to residents of Canada. More details of how caries prevalence was estimated can be found in the next section.

Although Statistics Canada projected the expected number of immigrants from 2018 to 2037, a report published by Immigration, Refugees and Citizenship Canada suggested that the targeted total number of immigrants from 2018 to 2020 will be much higher than these projections.⁷⁸ These immigration targets were therefore used to update Statistics Canada's projections. As immigration targets were only available for the next three years, immigration rates were further estimated for the subsequent years (i.e., 2021 to 2037). Immigration rates were forecasted by assuming a constant growth in the immigration rate based on the annual change in immigration rates reported from the medium immigration scenario that was projected by Statistics Canada. Sensitivity analyses were conducted to explore alternative immigration rates based on combining the upper and lower immigration target ranges planned by Immigration, Refugees and Citizenship Canada with the high and low immigration scenarios projected by Statistics Canada respectively.

The overall annual net emigration rate was 0.0019, which was based on a medium emigration projection scenario by Statistics Canada for 2018.⁷² This rate was assumed to be equal across all years analyzed, which was consistent with Statistics Canada's population projection methods.⁷² The low and high emigration rates used by Statistic Canada were explored in sensitivity analysis.

The overall immigration and emigration rates were used to estimate the overall change in the size of the population. In addition, age- and sex-specific profiles of immigrating and emigrating populations were obtained from Statistic Canada's average annual estimates⁷⁹ from 2012 to 2017 in order to determine the expected age- and sex-specific distribution of immigrants and emigrants.

Intermunicipal migration (i.e., movement between Canadian municipalities) was assumed not to occur in the base case. However, a threshold analysis was conducted to explore the impact of a declining municipal population on the decisions to either introduce or cease CWF.

Health Outcome Inputs

Caries Prevalence and Incidence

Overall caries prevalence for deciduous and permanent teeth were reported by Health Canada for the years of 2007 to 2009 for five age subgroups: 6 years to 11 years, 12 years to 19 years, 20 years to 39 years, 40 years to 59 years, and 60 years to 79 years (Table 1).² Although this data provides the best available estimate of caries prevalence for the Canadian general population, it is limited by the reporting of caries prevalence as a number of decayed, missing, and filled teeth. Given that teeth can be missing due to reasons other than caries, the use of this data may overestimate caries prevalence in the general population. However, the extent of this overestimation is likely reduced because the reported prevalence excluded adults without any teeth.

Table 1: Mean Caries Reported in the General Canadian Population

Dentition Type, Age Range	Reported Number of Decayed, Missing, and Filled Teeth
Deciduous, 6 Years to 11 Years	1.99
Permanent, 6 Years to 11 Years	0.49
Permanent, 12 Years to 19 Years	2.49
Permanent, 20 Years to 39 Years	7.02
Permanent, 40 Years to 59 Years	13.06
Permanent, 60 Years to 79 Years	17.23

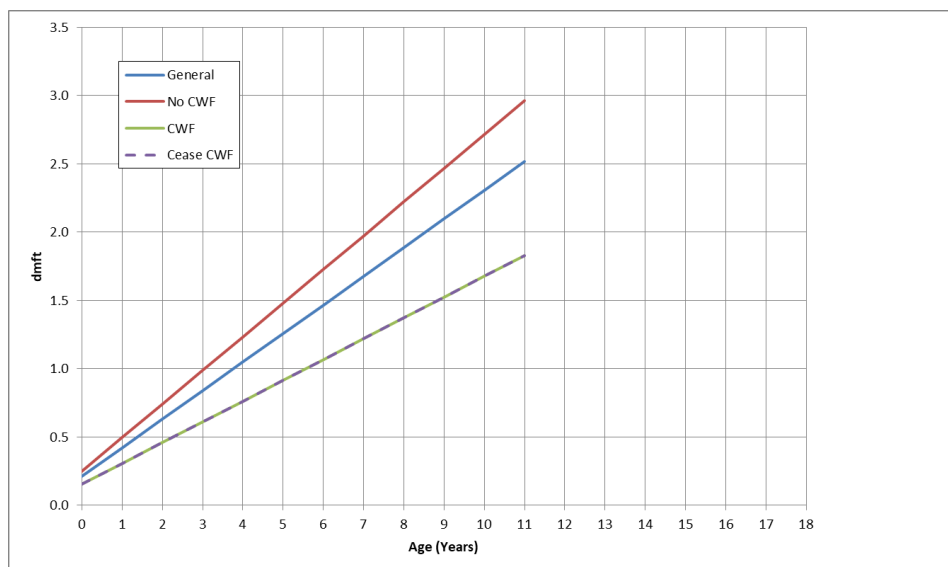
Source: Health Canada, 2010.²

Age-specific incidence rate for caries in the general population were derived from this prevalence data based on the approach subsequently described. Caries prevalence in deciduous teeth was assumed to begin from zero decayed, missing, and filled deciduous teeth (dmft) at birth. According to Health Canada, the reported number of caries for 6- to 11-year-old children was 1.99 dmft (Table 1).² As such, age-specific caries prevalence was linearly interpolated from birth to 8.5 years (i.e., the average age in this subgroup’s reported age range), where dmft was artificially set to 1.99. Caries prevalence for deciduous teeth from ages 9 to 11 were based on extrapolation, which was fitted to replicate a mean of 1.99 dmft for the subgroup of 6- to 11-year-old children. Age-specific incidence rates of dmft for the general population (IR_G) can then be calculated by subtracting the prevalence rates between adjacent single-age cohorts. All of the deciduous teeth were assumed to have been exfoliated by 12 years of age, and dmft was therefore not modelled for older ages.

A similar approach was taken to estimate age-specific incidence rates for permanent dental caries in the general population. Permanent caries prevalence was assumed to begin at zero decayed, missing, and filled permanent teeth (DMFT) at age 5, and was interpolated using the approach described for dmft to derive age-specific incidence rates for DMFT. Of note, Health Canada reports DMFTs separately for coronal and root caries (root caries is less common and contribute to at most 10% of total caries) and, in our analysis, coronal and root caries were summed together to estimate the general DMFT (i.e., this assumes coronal and root caries would occur in separate teeth). Permanent DMFTs aged 80 years or older were not explored due to a lack of data and uncertainties regarding edentulism in this population.

The estimated general population caries prevalence is displayed in Figure 4 and Figure 5.

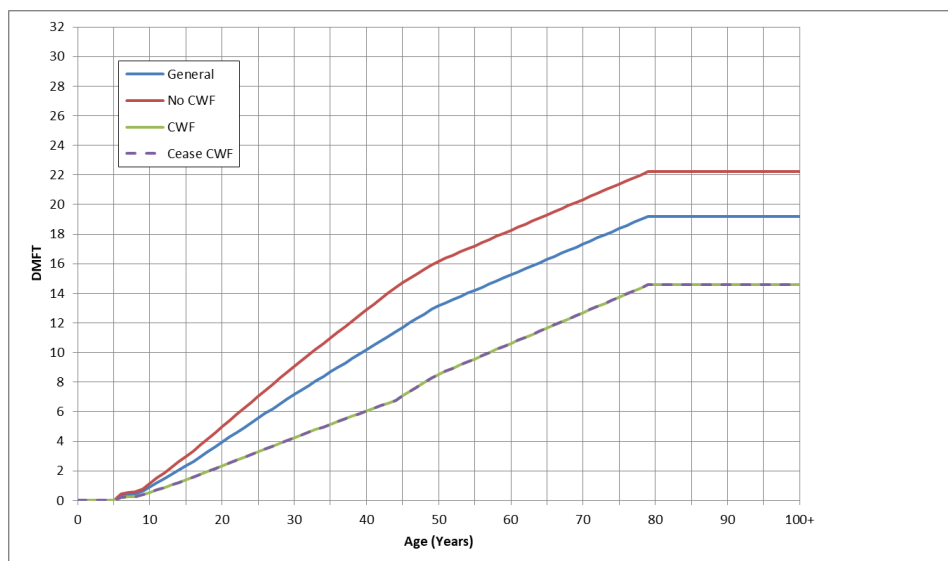
Figure 4: Age-Specific Prevalence of Caries (Decayed, Missing, and Filled Deciduous Teeth) in the General Population and by Community Water Fluoridation Exposure Status^a



CWF = community water fluoridation; dmft = decayed, missing, and filled deciduous teeth.

^aPrevalence of caries in deciduous teeth is estimated to linearly increase with age and at different rates based on exposure to CWF. Prevalence is estimated to be highest for those who have never been exposed to CWF, while the estimated prevalence in those previously exposed to CWF and in those who are currently exposed to CWF are assumed to be equivalent.

Figure 5: Age-Specific Prevalence of Caries (Decayed, Missing, and Filled Permanent Teeth) in the General Population and by Community Water Fluoridation Exposure Status^a



CWF = community water fluoridation; DMFT = decayed, missing, and filled permanent teeth.

^aPrevalence of caries in permanent teeth is estimated to increase with age and at different rates based on exposure to CWF. Prevalence is estimated to be highest for those who have never been exposed to CWF, while the estimated prevalence in those previously exposed to CWF and in those who are currently exposed to CWF are assumed to be equivalent. The rate of increase was assumed to be equivalent after 45 years of age with the incidence rate of caries equal to zero after age 79 (i.e., no further increase in the prevalence of caries).

CWF Treatment Effects on the Incidence of Dental Caries

The estimated age-specific incidence rates of dmft and DMFT for the general population (IR_G) reflect a Canada-wide average incidence rate and, therefore, capture the incidence rates observed in mixed populations exposed to and not exposed to CWF programs (Figure 6 and Figure 7). With these incidence rates, the impact of CWF on unexposed, exposed, and previously exposed populations were separately estimated. To determine caries incidences (with respect to dmft and DMFT) for the CWF-exposed and CWF-unexposed populations, we merged two identity equations:

i) age-specific incidence rate of caries for the general population (IR_G) reflects the sum of the incidence rates of caries in the CWF-exposed population (IR_E) weighted by the proportion of Canadians residing in municipalities with CWF ($\%CWF_{Exposed}$), and the incidence rates of caries in a CWF-unexposed population (IR_U) weighted by the proportion of Canadians residing in municipalities without CWF ($1 - \%CWF_{Exposed}$), (equation 1); and

$$(1) IR_G = (\%CWF_{Exposed} \times IR_E) + ([1 - \%CWF_{Exposed}] \times IR_U)$$

ii) Incidence rates of caries in a CWF-unexposed population (IR_U) can be calculated by multiplying the relative effect of no CWF on caries development (IRR_{UE}) on the incidence rates of caries in a CWF-exposed population (IR_E) (equation 2).

$$(2) IR_U = IRR_{UE} \times IR_E$$

By substituting IR_U in equation 1 with equation 2, equation 3 was derived:

$$(3) IR_G = (\%CWF_{Exposed} \times IR_E) + ([1 - \%CWF_{Exposed}] \times IRR_{UE} \times IR_E)$$

To solve for IR_E , equation 3 was rearranged (to create equation 4).

$$(4) IR_E = \frac{IR_G}{(\%CWF_{Exposed}) + ([1 - \%CWF_{Exposed}] \times IRR_{UE})}$$

Subsequently, IR_U was solved (via equation 2).

For the population previously exposed to CWF (in the CWF cessation strategy), the same set of equations were used, with the exception of equation 2, which was instead replaced by equation 5. Equation 5 calculates the incidence rate of caries in a previously exposed population (IR_{PE}) by adjusting the baseline incidence rate of caries in an exposed population (IR_E) by the relative effect of previous exposure to CWF on caries development (IRR_{PE}):

$$(5) IR_{PE} = IRR_{PE} \times IR_E$$

The input parameters for computing age-specific incidence rates by fluoridation status are listed in Table 2.

Table 2: Community Water Fluoridation Treatment Effect Parameters

Parameter	Value	Source
Population proportion with CWF exposure	39.4%	PHAC, 2017. ³⁹
dmft IRR_{UE}	1.62	Arrow, 2016. ⁸⁰
DMFT IRR_{UE}	2.13	Arrow, 2016. ⁸⁰
CWF exposure effect weaning age	45 years	Do et al., 2017. ⁸¹
dmft IRR_{PE}	1	Assumption
DMFT IRR_{PE}	1	Assumption
Caries incidence halt age	80 years	Assumption

CWF = community water fluoridation; dmft = decayed, missing, and filled deciduous teeth; DMFT = decayed, missing, and filled permanent teeth; IRR_{PE} = caries incidence rate ratio of population previously exposed to CWF to population currently exposed to CWF; IRR_{UE} = caries incidence rate ratio of CWF-unexposed population to CWF-exposed population; PHAC = Public Health Agency of Canada.

The relative effect of CWF exposure on caries development in deciduous and permanent teeth, also referred to as the incidence rate ratio (dmft and DMFT IRR_{UE} , respectively), were based on CADTH’s Review of Dental Caries and Other Health Outcomes of CWF compared with no CWF, and CWF cessation compared with CWF continuation.⁵⁵

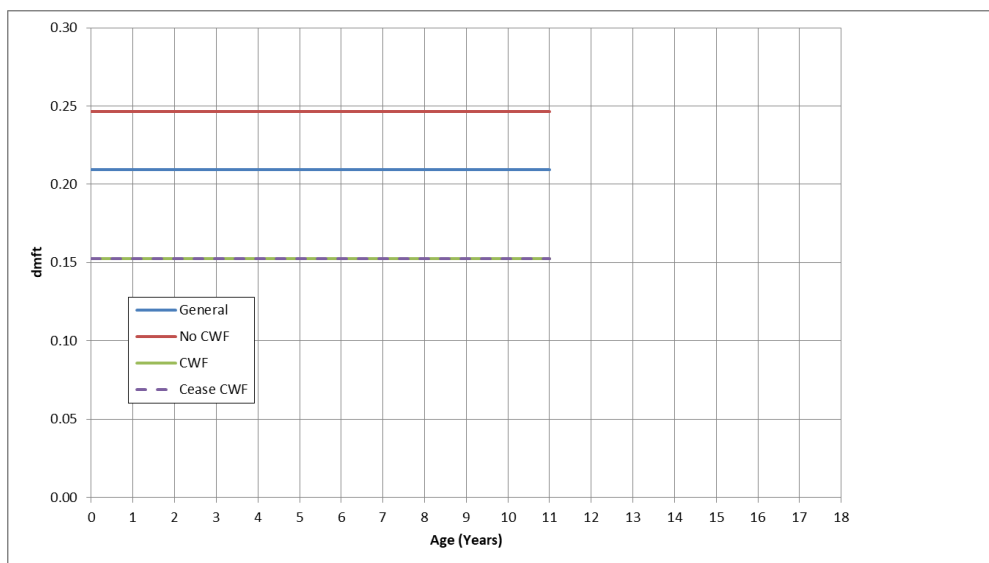
The CADTH Review of Dental Caries and Other Health Outcomes concluded that consistent evidence exists for an association between water fluoridation at current Canadian levels and the reduction of dmft and DMFT. Specifically, IRR_{UE} were extracted from Arrow (2016), an Australian cross-sectional study that investigated caries of deciduous and permanent dentition in schoolchildren aged 5 years to 15 years old.⁸⁰

Given that the CADTH Review of Dental Caries and Other Health Outcomes found insufficient evidence of an association between CWF cessation and an increased risk of dmft or DMFTs compared with continuing CWF, IRR_{PE} was assumed to be one in the base-case analyses. This would mean that the analysis conservatively assumed that, in a municipality stopping CWF, the incidence of caries would remain identical between a situation whereby fluoridation continued and a situation whereby fluoridation ceased for teeth that have been previously exposed to CWF. The incidence rate of caries in a population with no prior exposure to CWF (i.e., newborns entering model) was assumed to equal the incidence rate of no CWF (IRR_{UE}).

Different incidence rates by CWF exposure status for both deciduous and permanent teeth were estimated until the age of 45 years. It was conservatively assumed that CWF exposure would not significantly affect caries incidence in those aged 45 years and older as a study reported limited impact of fluoride on the incidence of caries past this age.⁸¹ It was therefore assumed that the CWF-exposed, -unexposed, and -previously exposed groups would progress at the same DMFT incidence rate starting from this age. A sensitivity analysis was conducted to explore the impact of lowering this age on the BIA results.

The resulting incidence rates by strategy are illustrated in Figure 6 and Figure 7.

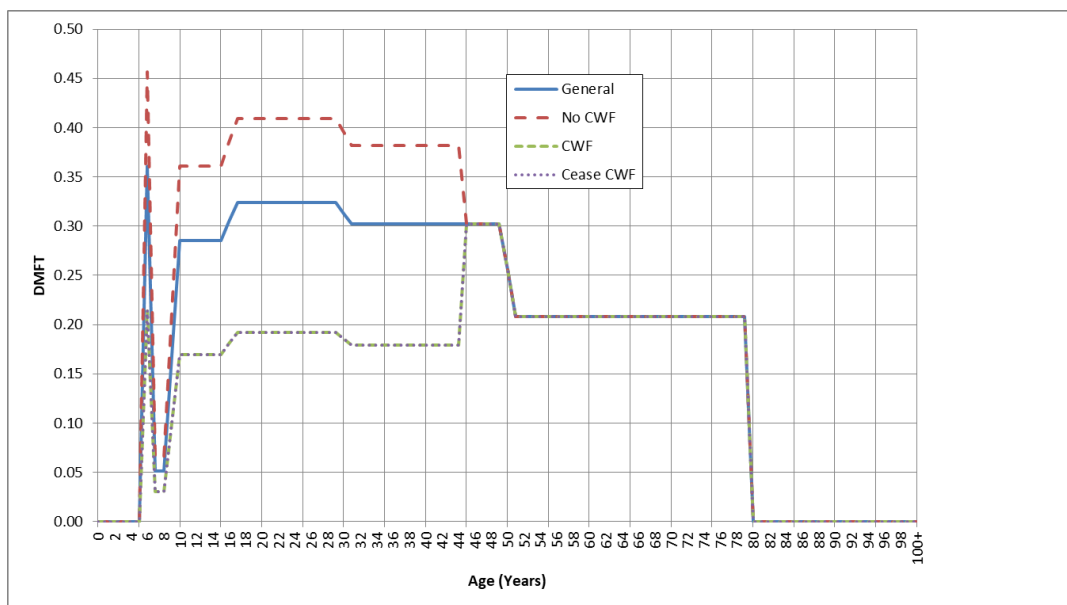
Figure 6: Age-Specific Incidence Rate of Decayed, Missing, and Filled Deciduous Teeth in the General Population and by Community Water Fluoridation Exposure Status^a



CWF = community water fluoridation; dmft = decayed, missing, and filled deciduous teeth.

^a Incidence of caries in deciduous teeth is estimated to be different based on exposure to CWF. These rates are also assumed to be consistent across age. Incidence is estimated to be highest for those who have never been exposed to CWF, while the estimated incidence in those previously exposed to CWF and in those who are currently exposed to CWF are assumed to be equivalent.

Figure 7: Age-Specific Incidence Rate of Decayed, Missing, and Filled Deciduous Permanent Teeth in the General Population and by Community Water Fluoridation Exposure Status^a



CWF = community water fluoridation; DMFT = decayed, missing, and filled permanent teeth.

^a Incidence of caries in permanent teeth is estimated to change based on age and exposure to CWF. Incidence rate is estimated to peak with the appearance of permanent teeth at the age of six, before falling and rebounding to another peak between ages 17 and 29. Incidence is estimated to be highest for those who have never been exposed to CWF, while the estimated incidence in those previously exposed to CWF and in those who are currently exposed to CWF are assumed to be equivalent. Incidence rates are also assumed to be equivalent across CWF exposure groups after 45 years of age, and to be reduced to zero after age 79.

Cost Inputs

Three different categories of costs were considered for each of the strategies in the BIAs: direct medical costs, indirect costs, and CWF implementation costs. These costing components and associated input parameters are detailed later on in this report. Generally, latest available costs and resource use information were incorporated and, as necessary, were inflated to 2018 costs using the relevant consumer price indices (CPIs). Dental service-specific costs were inflated using dental care services CPI from Statistics Canada,^{82,83} other medical service costs were inflated using the general CPI,^{82,83} and costs extracted from American sources were inflated using urban CPI from the United States Department of Labor's Bureau of Labor statistics⁸⁴ before being converted to Canadian dollars (exchange rate: US1 dollar = C1.2586 dollars).⁸⁵

Inflation was not accounted for in the base-case analyses and, per guidelines for the conduct of BIA, discounting was not applied.⁸⁶ Therefore, the reported costs are not presented in 2018 present value but instead reflect currency with identical purchasing power to 2018 Canadian dollars.

Direct Medical Costs

In this report, medical costs refer to dental costs. The development of caries would incur a medical care visit (whether to a dentist for a timely treatment or to a hospital for delayed caries treatment). The proportion of dmfts and DMFTs covered by each respective stakeholder (federal, provincial and territorial, municipal, and private [i.e., private dental insurance and individual's out-of-pocket]) were informed by the Canadian Institute for Health Information's (CIHI) national health expenditure trends (Table 3).⁸⁷ As these proportions are calculated from CIHI's 2017 per capita expenditure forecasts for the "other professionals" expenditure category, these are broadly representative of health expenditures for a mix of allied health professions and are not solely attributable to dental services. An additional limitation incurred by incorporating this data was that an assumption would be introduced that equates the proportion of health expenditure billed by a stakeholder to the proportion of caries treated by the stakeholder's plan. This may not hold in practice considering that different dental fees exist between federal, provincial and territorial, and private insurance plans.⁸⁸⁻⁹⁰ However, given the dearth of information to inform the proportion of caries treated by each plan, this data were incorporated into the base-case analyses.

Table 3: Proportion of Caries Treated by Stakeholder

Federal	Provincial and Territorial	Municipal	Private (i.e., Private Dental Insurance and Individual's Out-of-Pocket Expenses)
1.6680%	9.4655%	0.0037%	88.8628%

The type of medical care resourced for each caries is in part determined by whether care was timely sought or delayed. The proportion of delayed caries treatment was informed by the proportion of Canadians who avoided seeking care due to costs (17.3%), as reported by Health Canada.²

If timely care was sought, caries would be managed at a dental office. It was assumed to entail a specific examination and a bonded composite resin tooth restoration. Restorations using composite resin rather than amalgam were assumed to reflect the observation that amalgam use had declined while composite resin use had become more popular.⁹¹ Fees were specific to deciduous or permanent teeth and came from federal, provincial, and

private dental fee guides.⁸⁸⁻⁹⁰ As municipal dental service fees were not available, these were assumed to be identical to private fee codes. To estimate the procedure cost for a restoration, the fees corresponding to a two- or three-surfaces restoration for anterior and posterior teeth were averaged, as these are the most common codes utilized in Canadian practice, and the incidence of caries were assumed to be equally distributed by tooth location.⁹¹ A summary of the cost parameters related to timely dental care is presented in Table 4.

Table 4: Timely Dental Care Treatment Costs

Stakeholder	Deciduous Teeth	Permanent Teeth
Federal ⁸⁹	Specific examination: \$58.96 + Average of the following tooth-coloured restorations, bonded: <ul style="list-style-type: none"> • Anterior, 2 surfaces: \$152.39 • Anterior, 3 surfaces: \$171.30 • Posterior, 2 surfaces: \$171.30 • Posterior, 3 surfaces: \$171.30 <hr/> Average 2018 total cost: \$226.82	Specific examination: \$58.96 + Average of the following tooth-coloured restorations, bonded: <ul style="list-style-type: none"> • Anterior, 2 surfaces: \$146.50 • Anterior, 3 surfaces: \$194.05 • Bicuspid, 2 surfaces: \$177.89 • Bicuspid, 3 surfaces: \$194.05 • Molars, 2 surfaces: \$194.05 • Molars, 3 surfaces: \$210.22 <hr/> Average 2018 total cost: \$246.48
Provincial or Territorial ⁹⁰	Specific examination: \$19.00 + Average of the following tooth-coloured restorations, bonded: <ul style="list-style-type: none"> • Anterior, 2 surfaces: \$63.35 • Anterior, 3 surfaces: \$87.17 • Posterior, 2 surfaces: \$87.17 • Posterior, 3 surfaces: \$95.02 <hr/> Average 2018 total cost: \$102.76	Specific examination: \$19.00 + Average of the following tooth-coloured restorations, bonded: <ul style="list-style-type: none"> • Anterior, 2 surfaces: \$63.35 • Anterior, 3 surfaces: \$95.02 • Bicuspid, 2 surfaces: \$87.17 • Bicuspid, 3 surfaces: \$95.02 • Molars, 2 surfaces: \$95.02 • Molars, 3 surfaces: \$102.88 <hr/> Average 2018 total cost: \$109.36
Municipal ⁸⁸	Assumed identical to private costs	Assumed identical to private costs
Private ⁸⁸	Specific examination: \$36.70 + Average of the following tooth-coloured restorations, bonded: <ul style="list-style-type: none"> • Anterior, 2 surfaces: \$153.00 • Anterior, 3 surfaces: \$170.00 • Posterior, 2 surfaces: \$183.00 • Posterior, 3 surfaces: \$213.00 <hr/> Average 2018 total cost: \$217.68	Specific examination: \$36.70 + Average of the following tooth-coloured restorations, bonded: <ul style="list-style-type: none"> • Anterior, 2 surfaces: \$147.00 • Anterior, 3 surfaces: \$185.00 • Bicuspid, 2 surfaces: \$195.00 • Bicuspid, 3 surfaces: \$238.00 • Molars, 2 surfaces: \$234.00 • Molars, 3 surfaces: \$282.00 <hr/> Average 2018 total cost: \$251.62

If caries treatment is delayed, the severity of the tooth decay was assumed to worsen to the point that caries would need to be managed at a hospital setting. For the treatment of early childhood caries occurring in children younger than five years of age, a day surgery at a local hospital under general anesthesia was assumed.⁹² For patients older than five years of age, a visit to the local emergency department was assumed. Table 5 summarizes the list of fee parameters associated with delayed dental care.

Table 5: Delayed Dental Care Cost Parameters

Care Type	Value
Early childhood caries day surgery with general anesthesia ⁹²	\$2,199.13
Emergency department visit ⁹³	\$573.97

Indirect Costs

Each dental care visit would also incur transportation costs and productivity loss costs.

Transportation costs were calculated as the product of the average round trip distance travelled, the fuel efficiency of cars, and the fuel consumption cost. Given the dearth of information regarding average distance travelled to a dental care provider, median distance to the nearest general practitioner, estimated by Statistics Canada,⁹⁴ was used as a proxy (0.5 km) for distances travelled to seek timely dental care. Median distance to the nearest emergency department (6.8 km) was also obtained from the same source to estimate the distance travelled for delayed dental care. These distances may represent an underestimate, especially in rural and remote settings. Fuel efficiency was used to convert these distances to litres of gasoline consumed, before applying fuel prices to determine total transportation costs. As Canada follows the same fuel efficiency improvement targets set by the Environmental Protection Agency in the US, the Environmental Protection Agency's average fuel efficiency target improvement rate from 2016 to 2025⁹⁵ were used to project fuel efficiency improvements over time. To project fuel efficiency up to 2037, the previous year's fuel efficiency was adjusted by the relative rate of improvement (i.e., ratio of new efficiency targets compared with the proceeding year's target). As these projections were calculated in miles per gallon units, they were converted to L/km based on the National Energy Board's unit conversion (0.4252 km/L).⁹⁶ Similarly, the 2018 average retail price for regular gasoline reported by Natural Resources Canada⁹⁷ was projected to 2037 using the projected changes in gasoline prices for years 2017 to 2037 estimated by Natural Resources Canada.⁹⁸

Cost to lost productivity reflected the opportunity cost from the time spent seeking dental care. Each visit for dental care, whether for children or adult, was assumed to incur a loss of time for an adult (or an accompanying adult for children) that was valued at 2018 average Canadian hourly wage rate of \$26.92 per hour.⁷² In terms of the duration of loss time, each dental care visit was assumed to consist of travel time and service time. The average commuting speed, in Canada,⁹⁹ was multiplied by round trip dental care travel distances to calculate the estimated duration of travel time required to seek care. The average duration of a dentist visit was calculated from the average dentists' working hours per week reported by the Canadian Dental Association¹⁰⁰ divided by the average number of patients seen per week. The average duration of an emergency department visit was based on CIHI length-of-stay estimates for early childhood caries day surgeries with general anesthesia and emergency department stays for oral cavity or pharynx interventions.¹⁰¹ Calculated indirect costs are summarized in Table 6.

Table 6: Estimated Indirect Costs

Cost Type	Value in 2018 Canadian Dollars
Oral care trip fuel cost	Dentist visit: 2018: \$0.11 2037: \$0.04 Emergency department visit: 2018: \$1.49 2037: \$0.61
Productivity loss, as foregone wages	Dentist visit: \$14.99 Emergency department visit: \$58.45 General anesthesia in emergency department: \$57.55

Community Water Fluoridation Implementation Costs

Direct non-medical costs associated with implementing CWF consist of a lump sum capital cost and recurring operation and maintenance costs. A hand search of the grey literature, including municipal council meeting minutes, was conducted to obtain cost estimates applicable to the base-case population size. Per capita costs were obtained and used to calculate the total capital costs related to CWF introduction, retrofitting costs for CWF continuation, and annual operation and maintenance costs (Table 7). By using a per capita costing approach, the cost of CWF implementation is variable in the BIA and would differ depending on the size of a municipality.

It was assumed that there would be no costs associated with decommissioning fluoride upon ceasing water fluoridation.

Table 7: Community Water Fluoridation Cost Parameters

Per Capita Cost	Value	Sources	Source Municipality Size	Derivation
CWF construction capital cost	\$11.432	Portland, Oregon, 2012	602,955 ¹⁰²	Average of the following three implementation costs ¹⁰³ converted and inflated to 2018 Canadian dollars: <ul style="list-style-type: none"> • CWF using fluorosilicic acid: \$4.95 million • CWF using sodium fluoride: \$5.1 million • CWF using sodium fluorosilicate: \$5.1 million.
CWF retrofit capital cost	\$1.494	Peel, Ontario, 2016	1,381,739 ¹⁰⁴	Average of the following two retrofit costs ¹⁰⁵ inflated to 2018 Canadian dollars: <ul style="list-style-type: none"> • CWF using sodium fluoride: \$2 million • CWF using sodium fluorosilicate: \$2 million.
CWF operation and maintenance cost	\$0.308	Peel, Ontario, 2016	1,381,739 ¹⁰⁴	Sum of the following costs ¹⁰⁵ inflated to 2018 Canadian dollars: <ul style="list-style-type: none"> • hydrofluorosilicic acid supply cost: \$250,000 • other operations cost estimated by the municipality as 20% of supply cost: \$50,000.

CWF = community water fluoridation.

Analyses

Base Case

The base case represents the analysis that is most widely generalizable to Canadians, in whom the majority resides in large urban municipalities. Both base case BIAs (i.e., for CWF introduction [Strategy 1b versus 1a] and CWF cessation [Strategy 2b versus 2a]) incorporated a population size and age-sex composition that reflected a large urban Canadian municipality. Medium birth, mortality, immigration, and emigration rates were assumed, and intermunicipal migration was assumed negligible to project the population growth over the next 20 years. Caries reduction due to CWF exposure was assumed to be limited to those under the age of 45 years. CWF costs and distance to a dentist and a hospital were also assumed to reflect that of a large urban Canadian municipality.

Uncertainty and Sensitivity Analysis

All parameters were modelled deterministically and uncertainties were accounted for through deterministic sensitivity analyses. The following sensitivity analyses were conducted in which a particular set of parameters or an assumption was modified from the base-case analyses:

Municipal Scenarios and Rural Municipality Threshold Analysis

Base-case analyses assumed a large urban Canadian municipality. To assess the change in the budget impact across different sizes of municipalities, scenario analyses for three additional municipality sizes — medium urban, small urban, and rural — were explored. The definition of different types of municipalities followed the definition used by Statistics Canada for large, medium, and small population centres (i.e., large urban equals a population of

100,000 or more; medium urban equals between 30,000 and 99,999 people; small urban equals between 1,000 and 29,999 people), and designated places (i.e., rural equals a population below 1,000 [with a minimum of 100], or a population density of less than 400 persons per km²).^{106,107} These scenarios differed in terms of the modelled municipality's initial population size, distribution of age-sex composition within the initial population, population growth assumptions, distances to dental care, and CWF costing approach, as described in Table 8. The modelled population sizes were the average of the 2016 Canadian census population of either large population centres, medium population centres, small population centres, or designated places, as defined by Statistics Canada.^{106,107} Due to the uncertainty regarding the cost of CWF implementation in rural settings, a threshold analysis was conducted to determine the threshold value for the total CWF implementation cost at which the 20-year budget impact of CWF introduction and the budget impact of not introducing CWF would be zero — indicating a situation where the policy-maker would be indifferent between the two strategies. The same was conducted for the CWF cessation question.

Table 8: Municipal Scenario Inputs

Parameter	Large Urban	Medium Urban	Small Urban	Rural
Municipality size (initial population)	675,429	55,777	4,857	423
Age-sex composition	2016 census subdivision profiles representing top 80th percentile of largest municipalities.	2016 census subdivision profiles representing top 80th percentile of largest municipalities.	2016 census subdivision profiles representing top 80th percentile of largest municipalities.	2016 census subdivision profiles representing bottom 20th percentile of largest municipalities.
Birth rate	High 2018: 0.0122 2037: 0.0112	Medium 2018: 0.0111 2037: 0.0099	Medium 2018: 0.0111 2037: 0.0099	Low 2018: 0.0105 2037: 0.0090
Mortality rate	Medium Male mean: 2018: 0.0404 2037: 0.0368 Female mean: 2018: 0.0321 2037: 0.0295	Medium Male mean: 2018: 0.0404 2037: 0.0368 Female mean: 2018: 0.0321 2037: 0.0295	Medium Male mean: 2018: 0.0404 2037: 0.0368 Female mean: 2018: 0.0321 2037: 0.0295	High Male mean: 2018: 0.0434 2037: 0.0403 Female mean: 2018: 0.0333 2037: 0.0317
Immigration rate	High 2018: 0.0088 2037: 0.0099	Medium 2018: 0.0083 2037: 0.0090	Medium 2018: 0.0083 2037: 0.0090	Low 2018: 0.0078 2037: 0.0076
Emigration rate	Medium 2018-2037: 0.0019	Medium 2018-2037: 0.0019	Medium 2018-2037: 0.0019	Medium 2018-2037: 0.0019
Distance to nearest dentist	0.5 km	0.5 km	0.5 km	14.5 km
Distance to nearest hospital	6.8 km	6.8 km	14.5 km	74.5 km
CWF costs	Base case (per capita approach)	Base case (per capita approach)	Base case (per capita approach)	Threshold analysis

CWF = community water fluoridation.

Population Growth

Base-case analyses assumed population growth components that reflected a large urban municipality. In order to assess the range of impact of these population growth parameters, a set of sensitivity analysis reflecting low and high population growth scenarios were conducted. Associated inputs are described in Table 9.

Table 9: Population Growth Scenarios

Parameter	Low Growth Rate Scenario	High Growth Rate Scenario
Birth rate	Low 2018: 0.0105 2037: 0.0090	High 2018: 0.0122 2037: 0.0112
Mortality rate	High Male mean: 2018: 0.0434 2037: 0.0403 Female mean: 2018: 0.0333 2037: 0.0317	Low Male mean: 2018: 0.0375 2037: 0.0328 Female mean: 2018: 0.0307 2037: 0.0269
Immigration rate	Low 2018: 0.0078 2037: 0.0076	High 2018: 0.0088 2037: 0.0099
Emigration rate	High 2018 to 2037: 0.0016	Low 2018 to 2037: 0.0021

Efficacy of Community Water Fluoridation on Caries Prevention

Base-case analyses assumed that the efficacy of CWF on caries prevention applied to both those who have yet to form and those who have already formed permanent dentition; thus, were applied to everyone under the age of 45. A scenario analysis explored a more conservative assumption in which the efficacy of CWF was focused solely on deciduous teeth in those who are younger than six years old.

Community Water Fluoridation Cost

As noted, a per capita approach was taken to calculate the implementation costs associated with CWF whereby these costs would be dependent on the size of a municipality. However, the specific CWF costs incurred by a municipality may depend on many factors, including population size, fluoridation supply type, and water treatment plant design. To explore the impact of different CWF costs on the model, the highest per capita cost reported for implementing and maintaining a CWF program was selected from the literature and tested. The CWF cost parameters that were used in this sensitivity analysis are summarized in Table 10.

Table 10: High Community Water Fluoridation Cost Scenario Parameters

Per Capita Cost	Value	Sources	Source Municipality Size	Derivation
CWF construction capital cost	\$24.593	Sudbury, ON, 2017	165,270 ¹⁰⁸	Assumed same as retrofit cost given that retrofit costs were more commonly reported than construction costs in literature, and the retrofit cost reported in this table was more costly per capita than other construction costs identified for this budget impact analysis.
CWF retrofit capital cost	\$24.593	Sudbury, ON, 2017	165,270 ¹⁰⁸	Reported cost estimate of fluoride isolation rooms across twelve sites was ¹⁰⁹ \$4 million. This cost was inflated to 2018 Canadian dollars.
CWF operation and maintenance cost	\$2.231	Hamilton, ON, 2008	728,866 ¹¹⁰	Reported cost estimate ¹¹¹ of annual water fluoridation budget for 0.7 ppm target concentration was \$1.4 million. This cost was inflated to 2018 Canadian dollars.

CWF = community water fluoridation; ppm = parts per million.

Amalgam Dental Restoration

Base-case analyses assumed that timely treated caries were treated using bonded composite resin restorations. A scenario analysis explored another assumption that caries were instead treated using non-bonded amalgam restorations, as costed in Table 11.

Declining Population Threshold Analysis

The assumption of growing municipal populations does not capture the reality of some municipalities, which experience a decreasing population over time. A threshold analysis was conducted to explore whether a specific rate of annual outmigration would alter CWF implementation or cessation decisions such that the net budget impact between the CWF strategies would be zero over a twenty-year time horizon. Furthermore, in this analysis, the municipality's demographics settings were set to low birth, high mortality, and no immigration.

Community Water Fluoridation Cost Subsidization Threshold Analysis

Subsidization of municipal CWF costs is a policy option already in practice in Quebec.⁶³ A threshold analysis explored whether a degree of subsidization of municipal CWF costs by provincial or territorial jurisdictions would alter base-case CWF implementation or cessation decisions such that the municipal net budget impact between the CWF strategies would be zero over a twenty-year time horizon.

Table 11: Amalgam Dental Restoration Costs

Stakeholder	Deciduous Teeth	Permanent Teeth
Federal ⁸⁹	Specific examination: \$58.96 + Average of the following amalgam restorations, non-bonded: <ul style="list-style-type: none"> • 2 surfaces: \$122.45 • 3 surfaces: \$137.42 <hr/> Average 2018 total cost: \$189.97	Specific examination: \$58.96 + Average of the following amalgam restorations, non-bonded: <ul style="list-style-type: none"> • Anterior, 2 surfaces: \$122.45 • Anterior, 3 surfaces: \$137.42 • Bicuspid, 2 surfaces: \$122.45 • Bicuspid, 3 surfaces: \$137.42 • Molars, 2 surfaces: \$152.39 • Molars, 3 surfaces: \$168.24 <hr/> Average 2018 total cost: \$200.15
Provincial or territorial ⁹⁰	Specific examination: \$19.00 + Average of the following amalgam restorations, non-bonded: <ul style="list-style-type: none"> • 2 surfaces: \$55.49 • 3 surfaces: \$63.35 <hr/> Average 2018 total cost: \$78.87	Specific examination: \$19.00 + Average of the following amalgam restorations, non-bonded: <ul style="list-style-type: none"> • Anterior, 2 surfaces: \$55.51 • Anterior, 3 surfaces: \$63.35 • Bicuspid, 2 surfaces: \$55.51 • Bicuspid, 3 surfaces: \$63.35 • Molars, 2 surfaces: \$63.35 • Molars, 3 surfaces: \$79.34 <hr/> Average 2018 total cost: \$82.87
Municipal ⁸⁸	Assumed identical to private costs	Assumed identical to private costs
Private ⁸⁸	Specific examination: \$36.70 + Average of the following amalgam restorations, non-bonded: <ul style="list-style-type: none"> • 2 surfaces: \$125.00 • 3 surfaces: \$135.00 <hr/> Average 2018 total cost: \$167.65	Specific examination: \$36.70 + Average of the following amalgam restorations, non-bonded: <ul style="list-style-type: none"> • Anterior, 2 surfaces: \$142.00 • Anterior, 3 surfaces: \$168.00 • Bicuspid, 2 surfaces: \$142.00 • Bicuspid, 3 surfaces: \$168.00 • Molars, 2 surfaces: \$170.00 • Molars, 3 surfaces: \$196.00 <hr/> Average 2018 total cost: \$202.18

Table 12: Summary of Key Assumptions and Sensitivity Analyses

Base-Case Assumption	Sensitivity Analyses
Time horizon analyzed was 20 years to reflect municipal asset management practices in Canada. ⁶⁶⁻⁶⁹	Cumulative year-to-date budget impact results were also presented for each of the years over the modelled time horizon.
The municipalities considered have existing water treatment infrastructure. The decision problems of introducing CWF (Question 4) or maintaining CWF (Question 5) therefore reflect an incremental cost.	
For municipalities considering CWF cessation, cost of CWF cessation is conservatively assumed to be zero.	
Parameters relating to population size, demographic profile, population growth, dental care access, and CWF costs are representative of a large urban municipality.	Scenarios that are more representative of medium urban, small urban, and rural municipalities were captured in the sensitivity analyses. Municipality size, age-sex composition, birth, mortality, immigration, emigration, and distance to dentist and hospital were customized in each municipality's scenario.
Intermunicipal migration does not occur.	Threshold analyses were conducted to find an annual outmigration rate for a municipality (i.e., shrinking population) that would make the municipality indifferent between fluoridated and non-fluoridated water from a budgetary perspective.
Municipalities fully assume the cost of CWF implementation.	Threshold analyses were conducted to find a municipal CWF cost subsidization rate that would make the municipality indifferent between fluoridated and non-fluoridated water supplies from a budgetary perspective.
CWF construction or retrofitting only occurs once in the first year of the 20-year time horizon. Both were assumed to be completed within the first year of the model.	
All of those who lived in a municipality with CWF are assumed to drink fluoridated water. Likewise, those who live in a municipality without CWF are assumed to drink unfluoridated water.	
Caries reduction benefit of CWF introduction was applied to both those who have yet to form (i.e., deciduous teeth) and those who have already formed permanent dentition, and to everyone under the age of 45 years.	A scenario analysis of the CWF introduction BIA explored limiting the caries reduction benefit of CWF introduction to only those who did not have a permanent tooth in the year of introduction (up to age five).
Risk of increased caries associated with CWF cessation was applied only to those who have never been exposed to CWF.	
It was assumed that each individual in the model was limited to developing one caries per year. This was supported by the caries incidence estimated from Health Canada ² for deciduous or permanent teeth.	
Upon developing caries, the medical and indirect costs relating to its eventual treatment are accounted for in the year in which the caries first develop, regardless if timely or delayed care is sought.	
Replacement of composite resin fillings was not considered in this analysis, representing a conservative assumption.	
Distribution of caries care across stakeholders reflects CIHI's 2017 forecast of "other professional" national expenditure trends.	

Base-Case Assumption	Sensitivity Analyses
Caries treatments funded by municipal budgets are assumed to be billed at the same rate as for the private dental sector.	

BIA = budget impact analysis; CIHI = Canadian Institute for Health Information; CWF = community water fluoridation; DMFT = decayed, missing, and filled permanent teeth.

Results

Base Case

Community Water Fluoridation Introduction

Over 20 years, for a hypothetical large urban municipality, CWF introduction was found to cost a total of \$983 million, while not implementing CWF was found to cost \$1,508 million (Table 13). This indicates that, over a 20-year time span, savings of more than \$525 million could be achieved in a municipality that currently does not adjust fluoride levels in their water supplies by introducing CWF. This represents savings of approximately \$34.46 per capita per year (Table 42), or \$43.33 per dollar invested (Table 43). Savings began in the first year and continued on an annual basis thereafter. Assuming that construction costs were incurred in the first year, the first-year savings would be lowest at \$16.6 million, they would then increase annually to at least \$24.5 million in the second year of implementation, and continue to rise to \$28.9 million by the end of the 20 years (Table 14).

Table 13: Base-Case Results for Question 4 — Estimated Total Costs Associated With Each Strategy and Overall Budget Impact at 5, 10, 15, and 20 Years

	Total Costs Across Years (2018 Canadian Dollars, in Thousands)			
	5 years	10 years	15 years	20 years
CWF introduction	231,706	469,262	719,960	982,684
No CWF	347,696	715,292	1,102,479	1,507,704
Budget impact (i.e., difference between CWF implementation and no CWF)	-115,990	-246,030	-382,518	-525,020

CWF= community water fluoridation.

Note: Negative budget impact denotes overall financial savings from implementing CWF.

Among the jurisdictional stakeholders, CWF introduction was costliest for municipalities and offered the greatest cost savings to private stakeholders (i.e., private insurance and individuals). Municipalities cover the smallest proportion of the population in terms of dental care (i.e., 0.0037%, Table 3) and were assumed to cover the entire expense related to CWF construction, operation, and maintenance. As the cost of implementing CWF is larger than the medical savings associated with reduced caries, municipal stakeholders were projected to pay a cumulative total of \$12.4 million by the end of 20 years (Table 16) for introducing CWF (compared with not implementing CWF). Private stakeholders were found to have the largest financial benefit given that the majority of dental care is covered either through private insurance plans or as an out-of-pocket expense (i.e., 88.8628%, Table 3). Furthermore, the management of caries was associated with indirect cost implications such as transportation and productivity loss. The cumulative savings associated with CWF introduction from the jurisdictional stakeholders' perspective were \$333 million by the end of 20 years (compared with not implementing CWF). Provincial and territorial stakeholders were found to absorb the second-largest financial benefit from introducing CWF as

provincial and territorial dental programs cover the second-largest proportion of the population in terms of dental care (9.4655%, Table 3), with cumulative savings associated with CWF estimated at \$199 million by the end of 20 years. Federal stakeholders were found to absorb the least financial benefit from introducing CWF because they are only responsible for medical expenses related to caries treatments and cover only a small proportion of the cost of caries treated within a population (1.6680%, Table 3). Cumulative savings associated with CWF introduction were projected to be \$5.5 million by the end of 20 years (Table 16).

Overall, the largest direct cost component in the BIA was medical costs (i.e., 98.6% in the introduction strategy, 100% in the non-implementation strategy). The CWF introduction strategy was associated with lower medical costs compared with the CWF non-implementation strategy given their differences in overall caries burden. Medical costs increased from \$40.5 million annually in the first year to \$49.5 million in the 20th year under the CWF introduction strategy, while they increased from \$63.3 million in the first year to \$76.7 million in the 20th year under the CWF non-implementation strategy. Of note, medical costs were observed to increase annually within each strategy given that a municipality's population was projected to grow over the BIA's 20-year time horizon. The findings of cost savings associated with CWF implementation compared with non-implementation were driven by the differences in projected caries burden between the two strategies. Nonetheless, caries burden was found to grow over time within each strategy, reflecting the expected overall growth in population size. In the CWF introduction strategy, the expected incidence of caries within a large urban municipality rose from ~133,000 in the first year to ~162,000 in the 20th year, while they rose from ~207,000 in the first year to ~251,000 in the 20th year in the CWF non-implementation strategy. CWF introduction prevented an increasing number of caries over time: from ~74,000 caries in the first year to ~89,000 caries in the 20th year. By the end of the 20th year, CWF was found to have prevented more than 1.6 million caries; therefore, the medical cost savings associated with CWF rose from \$22.8 million in the first year to \$27.2 million in the 20th year and accumulated to a total of \$500 million over 20 years. Although the cost of construction and maintaining fluoridation were relatively small among the direct costs, this is primarily incurred by municipalities (i.e., \$7.9 million in the initial year due to the costs of construction, followed by consistent annual costs associated with CWF operation and maintenance [~\$210,300 in the second year rising to ~\$260,900 in the last year]).

Costs associated with productivity loss constituted most of the indirect costs incurred in the analysis (99%), while transportation costs retained a small proportion (1%). Productivity loss associated with dental care was lower in the CWF introduction strategy (i.e., increasing from \$3.0 million annually in the first year to \$3.7 million in the 20th year) compared with the CWF non-implementation strategy (i.e., increasing from \$4.7 million in the first year to \$5.7 million in the 20th year). Overall, the annual savings associated with prevented productivity loss from CWF introduction rose from \$1.7 million in the first year to \$2.0 million in the 20th year, accumulating to \$36.6 million over 20 years. Annual transportation costs decreased over the analyzed 20 year time horizon due to expected improvements in fuel efficiency.⁹⁵ Transportation costs were also lower in the CWF introduction strategy and decreased from ~\$46,400 annually in the first year to ~\$22,900 in the 20th year for the CWF introduction strategy, while they decreased from ~\$72,400 annually in the first year to ~\$35,500 in the 20th year for the CWF non-implementation strategy. Overall, the annual savings from the introduction of CWF in terms of transportation costs associated with seeking medical care decreased from ~\$26,000 in the first year to ~\$12,500 in the 20th year, accumulating to ~\$384,400 over 20 years.

Table 14: Estimated Annual Costs Associated With Each Strategy, by Year and Stakeholder (Large Urban Community Water Fluoridation Introduction)

	Estimated Annual Costs (2018 Canadian Dollars)																				
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	
Total																					
1A: CWF	51,462,812	44,240,749	44,783,255	45,330,885	45,888,467	46,442,316	46,952,084	47,533,965	48,053,427	48,574,229	49,117,223	49,628,966	50,157,522	50,652,892	51,141,275	51,617,937	52,081,785	52,541,833	53,006,565	53,476,201	
1B: No CWF	68,029,697	68,722,625	69,510,744	70,313,719	71,119,277	71,927,720	72,668,817	73,573,500	74,338,425	75,087,750	75,882,411	76,667,759	77,473,424	78,216,518	78,946,164	79,653,743	80,352,713	81,052,735	81,745,535	82,420,850	
Budget impact	-16,566,885	-24,481,876	-24,727,490	-24,982,835	-25,230,811	-25,485,403	-25,716,733	-26,039,535	-26,284,999	-26,513,521	-26,765,188	-27,038,792	-27,315,902	-27,563,626	-27,804,889	-28,035,806	-28,270,928	-28,510,902	-28,738,970	-28,944,649	
Federal																					
1A: CWF	447,428	452,251	457,416	462,527	467,620	472,661	477,754	483,694	489,054	494,513	500,228	505,623	511,209	516,444	521,600	526,621	531,487	536,287	541,106	545,945	
1B: No CWF	698,245	704,865	712,310	719,738	726,994	734,262	741,658	750,924	758,838	766,725	775,124	783,447	792,004	799,899	807,643	815,136	822,506	829,846	837,060	844,036	
Budget impact	-250,817	-252,614	-254,894	-257,211	-259,375	-261,601	-263,904	-267,230	-269,785	-272,212	-274,896	-277,823	-280,795	-283,455	-286,043	-288,514	-291,019	-293,559	-295,954	-298,091	
Provincial and Territorial																					
1A: CWF	15,858,374	16,058,834	16,280,836	16,513,041	16,755,082	16,997,673	17,192,767	17,407,272	17,595,418	17,778,762	17,968,584	18,146,967	18,330,318	18,500,731	18,668,761	18,833,183	18,994,213	19,155,492	19,320,226	19,488,652	
1B: No CWF	24,847,137	25,134,012	25,464,415	25,813,564	26,174,141	26,538,626	26,827,546	27,163,732	27,444,145	27,710,767	27,991,051	28,266,773	28,548,198	28,805,680	29,058,579	29,304,588	29,549,212	29,796,679	30,044,737	30,290,178	
Budget impact	-8,988,763	-9,075,179	-9,183,579	-9,300,523	-9,419,059	-9,540,953	-9,634,779	-9,756,459	-9,848,728	-9,932,005	-10,022,468	-10,119,806	-10,217,880	-10,304,949	-10,389,818	-10,471,405	-10,554,999	-10,641,187	-10,724,511	-10,801,526	
Municipal																					
1A: CWF	7,930,164	211,273	213,932	216,667	219,491	222,357	225,225	228,096	230,963	233,825	236,681	239,528	242,367	245,196	248,018	250,834	253,648	256,463	259,282	262,110	
1B: No CWF	1,572	1,587	1,603	1,620	1,636	1,652	1,669	1,690	1,708	1,725	1,744	1,763	1,782	1,800	1,817	1,834	1,851	1,867	1,883	1,899	
Budget impact	7,928,592	209,687	212,328	215,047	217,854	220,704	223,556	226,406	229,256	232,100	234,937	237,766	240,585	243,396	246,201	249,000	251,797	254,596	257,399	260,211	
Private and Individual																					
1A: CWF	27,226,846	27,518,391	27,831,071	28,138,650	28,446,274	28,749,626	29,056,337	29,414,902	29,737,992	30,067,128	30,411,730	30,736,848	31,073,628	31,390,521	31,702,895	32,007,298	32,302,437	32,593,592	32,885,951	33,179,494	
1B: No CWF	42,482,743	42,882,161	43,332,415	43,778,797	44,216,506	44,653,179	45,097,944	45,657,154	46,133,734	46,608,533	47,114,492	47,615,776	48,131,440	48,609,140	49,078,125	49,532,185	49,979,145	50,424,343	50,861,854	51,284,737	
Budget impact	-15,255,897	-15,363,770	-15,501,345	-15,640,147	-15,770,231	-15,903,553	-16,041,606	-16,242,252	-16,395,742	-16,541,405	-16,702,762	-16,878,929	-17,057,812	-17,218,619	-17,375,230	-17,524,887	-17,676,708	-17,830,751	-17,975,904	-18,105,243	

CWF = community water fluoridation.

Note: Negative budget impact denotes overall financial savings.

Table 15: Estimated Annual Costs Associated With Each Strategy, by Year and Cost Category (Large Urban Community Water Fluoridation Introduction)

	Estimated Annual Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Direct Cost																				
1A: CWF	48,431,209	41,177,357	41,685,356	42,200,650	42,724,951	43,246,924	43,724,222	44,267,571	44,752,430	45,237,964	45,743,947	46,220,778	46,713,099	47,174,860	47,630,161	48,074,642	48,507,353	48,936,638	49,370,426	49,808,916
1B: No CWF	63,297,224	63,946,614	64,684,986	65,441,144	66,199,374	66,962,049	67,656,136	68,500,666	69,214,559	69,913,038	70,653,359	71,384,820	72,134,955	72,827,403	73,507,411	74,167,033	74,818,876	75,471,866	76,118,394	76,748,920
Budget impact	-14,866,015	-22,769,257	-22,999,630	-23,240,494	-23,474,422	-23,715,125	-23,931,914	-24,233,095	-24,462,129	-24,675,074	-24,909,412	-25,164,043	-25,421,856	-25,652,543	-25,877,250	-26,092,391	-26,311,523	-26,535,227	-26,747,968	-26,940,004
Medical and Dental Costs																				
1A: CWF	40,502,052	40,967,103	41,472,454	41,985,024	42,506,513	43,025,632	43,500,072	44,040,563	44,522,568	45,005,251	45,508,392	45,982,387	46,471,883	46,930,826	47,383,317	47,824,993	48,254,902	48,681,382	49,112,361	49,548,035
1B: No CWF	63,297,224	63,946,614	64,684,986	65,441,144	66,199,374	66,962,049	67,656,136	68,500,666	69,214,559	69,913,038	70,653,359	71,384,820	72,134,955	72,827,403	73,507,411	74,167,033	74,818,876	75,471,866	76,118,394	76,748,920
Budget impact	-22,795,172	-22,979,512	-23,212,532	-23,456,120	-23,692,860	-23,936,418	-24,156,064	-24,460,103	-24,691,992	-24,907,786	-25,144,967	-25,402,433	-25,663,073	-25,896,577	-26,124,095	-26,342,040	-26,563,974	-26,790,483	-27,006,033	-27,200,885
CWF Costs																				
1A: CWF	7,929,157	210,255	212,902	215,626	218,438	221,293	224,150	227,007	229,863	232,712	235,556	238,391	241,216	244,034	246,844	249,649	252,452	255,256	258,064	260,881
1B: No CWF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Budget impact	7,929,157	210,255	212,902	215,626	218,438	221,293	224,150	227,007	229,863	232,712	235,556	238,391	241,216	244,034	246,844	249,649	252,452	255,256	258,064	260,881
Indirect Costs																				
1A: CWF	3,031,603	3,063,392	3,097,898	3,130,235	3,163,515	3,195,392	3,227,862	3,266,394	3,300,997	3,336,265	3,373,275	3,408,188	3,444,423	3,478,032	3,511,114	3,543,295	3,574,431	3,605,195	3,636,140	3,667,286
1B: No CWF	4,732,473	4,776,011	4,825,758	4,872,575	4,919,904	4,965,671	5,012,681	5,072,833	5,123,866	5,174,713	5,229,052	5,282,938	5,338,468	5,389,115	5,438,753	5,486,710	5,533,837	5,580,870	5,627,141	5,671,931
Budget impact	-1,700,870	-1,712,619	-1,727,860	-1,742,340	-1,756,388	-1,770,278	-1,784,819	-1,806,440	-1,822,870	-1,838,448	-1,855,777	-1,874,750	-1,894,045	-1,911,083	-1,927,639	-1,943,415	-1,959,406	-1,975,675	-1,991,001	-2,004,645
Transportation																				
1A: CWF	46,356	45,791	45,660	43,726	42,875	40,955	39,239	37,933	36,536	35,129	33,757	32,384	31,074	29,783	28,537	27,333	26,156	25,041	23,968	22,949
1B: No CWF	72,365	71,392	71,127	68,065	66,680	63,646	60,936	58,912	56,713	54,487	52,329	50,198	48,162	46,148	44,205	42,324	40,494	38,765	37,092	35,495
Budget impact	-26,009	-25,601	-25,468	-24,339	-23,805	-22,690	-21,698	-20,979	-20,177	-19,359	-18,572	-17,814	-17,088	-16,365	-15,668	-14,992	-14,338	-13,723	-13,124	-12,545
Productivity Loss																				
1A: CWF	2,985,247	3,017,601	3,052,239	3,086,509	3,120,640	3,154,437	3,188,623	3,228,461	3,264,461	3,301,136	3,339,518	3,375,804	3,413,349	3,448,250	3,482,577	3,515,963	3,548,276	3,580,154	3,612,172	3,644,336
1B: No CWF	4,660,108	4,704,619	4,754,631	4,804,510	4,853,223	4,902,025	4,951,744	5,013,921	5,067,153	5,120,225	5,176,723	5,232,740	5,290,306	5,342,967	5,394,548	5,444,386	5,493,343	5,542,105	5,590,049	5,636,436
Budget impact	-1,674,861	-1,687,018	-1,702,392	-1,718,001	-1,732,583	-1,747,588	-1,763,122	-1,785,461	-1,802,693	-1,819,089	-1,837,205	-1,856,935	-1,876,957	-1,894,717	-1,911,971	-1,928,423	-1,945,067	-1,961,951	-1,977,877	-1,992,100

CWF = community water fluoridation.

Note: Negative budget impact denotes overall financial savings.

Table 16: Estimated Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Large Urban Community Water Fluoridation Introduction)

	Estimated Cumulative Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total																				
1A: CWF	51,462,812	95,703,562	140,486,816	185,817,701	231,706,168	278,148,484	325,100,568	372,634,532	420,687,959	469,262,188	518,379,411	568,008,377	618,165,899	668,818,791	719,960,066	771,578,003	823,659,788	876,201,621	929,208,186	982,684,388
1B: No CWF	68,029,697	136,752,322	206,263,067	276,576,786	347,696,063	419,623,783	492,292,600	565,866,100	640,204,525	715,292,275	791,174,686	867,842,445	945,315,868	1,023,532,387	1,102,478,551	1,182,132,294	1,262,485,007	1,343,537,742	1,425,283,277	1,507,704,128
Budget impact	-16,566,885	-41,048,761	-65,776,251	-90,759,085	-115,989,896	-141,475,299	-167,192,032	-193,231,567	-219,516,566	-246,030,087	-272,795,276	-299,834,068	-327,149,970	-354,713,596	-382,518,485	-410,554,291	-438,825,219	-467,336,121	-496,075,091	-525,019,740
Federal																				
1A: CWF	447,428	899,679	1,357,095	1,819,622	2,287,241	2,759,902	3,237,656	3,721,350	4,210,403	4,704,917	5,205,144	5,710,768	6,221,977	6,738,421	7,260,021	7,786,643	8,318,130	8,854,416	9,395,522	9,941,468
1B: No CWF	698,245	1,403,110	2,115,421	2,835,159	3,562,153	4,296,415	5,038,073	5,788,997	6,547,836	7,314,561	8,089,685	8,873,131	9,665,135	10,465,034	11,272,677	12,087,812	12,910,318	13,740,164	14,577,224	15,421,260
Budget impact	-250,817	-503,431	-758,326	-1,015,537	-1,274,912	-1,536,513	-1,800,418	-2,067,648	-2,337,433	-2,609,644	-2,884,540	-3,162,364	-3,443,159	-3,726,613	-4,012,656	-4,301,170	-4,592,188	-4,885,748	-5,181,702	-5,479,793
Provincial and Territorial																				
1A: CWF	15,858,374	31,917,208	48,198,044	64,711,085	81,466,168	98,463,841	115,656,608	133,063,881	150,659,298	168,438,060	186,406,644	204,553,611	222,883,928	241,384,660	260,053,421	278,886,604	297,880,817	317,036,309	336,356,535	355,845,187
1B: No CWF	24,847,137	49,981,150	75,445,565	101,259,129	127,433,270	153,971,896	180,799,443	207,963,175	235,407,320	263,118,087	291,109,138	319,375,911	347,924,109	376,729,789	405,788,368	435,092,956	464,642,168	494,438,847	524,483,584	554,773,761
Budget impact	-8,988,763	-18,063,942	-27,247,521	-36,548,044	-45,967,103	-55,508,056	-65,142,835	-74,899,294	-84,748,022	-94,680,027	-104,702,494	-114,822,300	-125,040,180	-135,345,129	-145,734,947	-156,206,353	-166,761,351	-177,402,538	-188,127,049	-198,928,575
Municipal																				
1A: CWF	7,930,164	8,141,437	8,355,369	8,572,036	8,791,527	9,013,883	9,239,109	9,467,205	9,698,168	9,931,994	10,168,675	10,408,204	10,650,570	10,895,766	11,143,784	11,394,618	11,648,266	11,904,729	12,164,011	12,426,121
1B: No CWF	1,572	3,158	4,762	6,382	8,018	9,670	11,339	13,029	14,737	16,462	18,206	19,969	21,750	23,550	25,367	27,201	29,051	30,919	32,802	34,701
Budget impact	7,928,592	8,138,279	8,350,607	8,565,654	8,783,509	9,004,213	9,227,769	9,454,176	9,683,431	9,915,532	10,150,469	10,388,235	10,628,820	10,872,216	11,118,417	11,367,417	11,619,215	11,873,810	12,131,209	12,391,420
Private and Individual																				
1A: CWF	27,226,846	54,745,237	82,576,308	110,714,958	139,161,232	167,910,858	196,967,195	226,382,097	256,120,090	286,187,217	316,598,947	347,335,795	378,409,423	409,799,944	441,502,840	473,510,138	505,812,575	538,406,167	571,292,118	604,471,612
1B: No CWF	42,482,743	85,364,904	128,697,319	172,476,116	216,692,622	261,345,801	306,443,744	352,100,898	398,234,633	444,843,165	491,957,658	539,573,434	587,704,874	636,314,014	685,392,139	734,924,324	784,903,469	835,327,813	886,189,667	937,474,404
Budget impact	-15,255,897	-30,619,667	-46,121,011	-61,761,159	-77,531,390	-93,434,943	-109,476,549	-125,718,801	-142,114,543	-158,655,948	-175,358,710	-192,237,639	-209,295,451	-226,514,070	-243,889,299	-261,414,186	-279,090,894	-296,921,645	-314,897,549	-333,002,792

CWF = community water fluoridation.

Note: Negative budget impact denotes overall financial savings.

Table 17: Estimated Cumulative Costs Associated With Each Strategy, by Year and Cost Category (Large Urban Community Water Fluoridation Introduction)

	Estimated Cumulative Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Direct Cost																				
1A: CWF	48,431,209	89,608,566	131,293,923	173,494,573	216,219,524	259,466,449	303,190,671	347,458,242	392,210,672	437,448,635	483,192,583	529,413,361	576,126,459	623,301,319	670,931,480	719,006,122	767,513,475	816,450,114	865,820,539	915,629,455
1B: No CWF	63,297,224	127,243,839	191,928,825	257,369,969	323,569,343	390,531,392	458,187,528	526,688,194	595,902,754	665,815,791	736,469,150	807,853,970	879,988,926	952,816,329	1,026,323,740	1,100,490,773	1,175,309,649	1,250,781,514	1,326,899,908	1,403,648,828
Budget impact	-14,866,015	-37,635,272	-60,634,902	-83,875,396	-107,349,818	-131,064,943	-154,996,858	-179,229,953	-203,692,082	-228,367,156	-253,276,567	-278,440,610	-303,862,466	-329,515,010	-355,392,260	-381,484,651	-407,796,174	-434,331,401	-461,079,369	-488,019,373
Medical Costs																				
1A: CWF	40,502,052	81,469,155	122,941,609	164,926,633	207,433,147	250,458,779	293,958,851	337,999,414	382,521,982	427,527,233	473,035,625	519,018,012	565,489,895	612,420,721	659,804,037	707,629,030	755,883,932	804,565,315	853,677,676	903,225,710
1B: No CWF	63,297,224	127,243,839	191,928,825	257,369,969	323,569,343	390,531,392	458,187,528	526,688,194	595,902,754	665,815,791	736,469,150	807,853,970	879,988,926	952,816,329	1,026,323,740	1,100,490,773	1,175,309,649	1,250,781,514	1,326,899,908	1,403,648,828
Budget impact	-22,795,172	-45,774,684	-68,987,216	-92,443,336	-116,136,196	-140,072,613	-164,228,677	-188,688,780	-213,380,772	-238,288,558	-263,433,525	-288,835,958	-314,499,031	-340,395,608	-366,519,702	-392,861,742	-419,425,717	-446,216,200	-473,222,233	-500,423,118
CWF Costs																				
1A: CWF	7,929,157	8,139,412	8,352,314	8,567,939	8,786,377	9,007,670	9,231,820	9,458,827	9,688,690	9,921,402	10,156,958	10,395,348	10,636,565	10,880,598	11,127,442	11,377,091	11,629,543	11,884,799	12,142,863	12,403,744
1B: No CWF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Budget impact	7,929,157	8,139,412	8,352,314	8,567,939	8,786,377	9,007,670	9,231,820	9,458,827	9,688,690	9,921,402	10,156,958	10,395,348	10,636,565	10,880,598	11,127,442	11,377,091	11,629,543	11,884,799	12,142,863	12,403,744
Indirect Costs																				
1A: CWF	3,031,603	6,094,995	9,192,894	12,323,128	15,486,643	18,682,036	21,909,897	25,176,291	28,477,288	31,813,552	35,186,828	38,595,016	42,039,439	45,517,472	49,028,586	52,571,881	56,146,313	59,751,508	63,387,647	67,054,933
1B: No CWF	4,732,473	9,508,484	14,334,242	19,206,817	24,126,720	29,092,391	34,105,072	39,177,905	44,301,772	49,476,484	54,705,536	59,988,474	65,326,943	70,716,058	76,154,811	81,641,521	87,175,358	92,756,228	98,383,369	104,055,300
Budget impact	-1,700,870	-3,413,489	-5,141,348	-6,883,689	-8,640,077	-10,410,355	-12,195,175	-14,001,614	-15,824,484	-17,662,932	-19,518,708	-21,393,458	-23,287,503	-25,198,586	-27,126,225	-29,069,640	-31,029,046	-33,004,720	-34,995,722	-37,000,367
Transportation																				
1A: CWF	46,356	92,147	137,807	181,533	224,408	265,363	304,602	342,535	379,071	414,200	447,957	480,341	511,415	541,198	569,735	597,068	623,223	648,265	672,232	695,181
1B: No CWF	72,365	143,757	214,884	282,949	349,630	413,275	474,212	533,124	589,837	644,324	696,653	746,852	795,014	841,162	885,367	927,691	968,185	1,006,950	1,044,042	1,079,536
Budget impact	-26,009	-51,610	-77,077	-101,417	-125,222	-147,912	-169,610	-190,589	-210,766	-230,124	-248,696	-266,511	-283,598	-299,964	-315,632	-330,624	-344,962	-358,685	-371,810	-384,355
Productivity Loss																				
1A: CWF	2,985,247	6,002,848	9,055,087	12,141,595	15,262,235	18,416,672	21,605,295	24,833,756	28,098,217	31,399,353	34,738,871	38,114,675	41,528,024	44,976,274	48,458,851	51,974,814	55,523,089	59,103,243	62,715,415	66,359,751
1B: No CWF	4,660,108	9,364,727	14,119,358	18,923,868	23,777,091	28,679,116	33,630,860	38,644,781	43,711,935	48,832,160	54,008,883	59,241,623	64,531,929	69,874,896	75,269,444	80,713,830	86,207,173	91,749,278	97,339,327	102,975,763
Budget impact	-1,674,861	-3,361,879	-5,064,271	-6,782,272	-8,514,855	-10,262,443	-12,025,565	-13,811,025	-15,613,718	-17,432,807	-19,270,012	-21,126,948	-23,003,905	-24,898,622	-26,810,593	-28,739,016	-30,684,084	-32,646,035	-34,623,912	-36,616,012

CWF = community water fluoridation.

Note: Negative budget impact denotes overall financial savings.

Table 18: Estimated Annual Number of Caries Associated With Each Strategy, by Year and Caries Type (Large Urban Community Water Fluoridation Introduction)

	Estimated Annual Caries																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Caries																				
1A: CWF	132,681	134,120	135,661	137,185	138,703	140,207	141,727	143,498	145,097	146,727	148,433	150,045	151,714	153,264	154,790	156,273	157,709	159,126	160,549	161,978
1B: No CWF	207,124	209,104	211,328	213,547	215,715	217,886	220,097	222,860	225,226	227,585	230,095	232,584	235,142	237,482	239,774	241,989	244,165	246,332	248,462	250,524
Difference	-74,443	-74,984	-75,667	-76,362	-77,011	-77,679	-78,370	-79,363	-80,129	-80,857	-81,662	-82,539	-83,429	-84,218	-84,985	-85,716	-86,455	-87,206	-87,914	-88,546
dmft																				
1A: CWF	13,622	13,874	14,142	14,408	14,667	14,930	15,202	15,499	15,795	16,096	16,408	16,727	17,046	17,186	17,297	17,382	17,443	17,505	17,574	17,652
1B: No CWF	22,068	22,476	22,910	23,341	23,760	24,187	24,628	25,108	25,587	26,075	26,581	27,098	27,615	27,841	28,021	28,158	28,257	28,359	28,470	28,596
Difference	-8,446	-8,602	-8,768	-8,933	-9,093	-9,257	-9,425	-9,609	-9,793	-9,979	-10,173	-10,371	-10,569	-10,655	-10,724	-10,777	-10,814	-10,853	-10,896	-10,944
DMFT																				
1A: CWF	119,059	120,246	121,519	122,777	124,037	125,277	126,524	127,999	129,303	130,632	132,025	133,318	134,668	136,078	137,493	138,892	140,267	141,620	142,975	144,326
1B: No CWF	185,056	186,628	188,418	190,206	191,955	193,699	195,469	197,752	199,639	201,510	203,514	205,486	207,528	209,641	211,753	213,831	215,908	217,973	219,992	221,928
Difference	-65,997	-66,382	-66,900	-67,429	-67,918	-68,422	-68,944	-69,753	-70,336	-70,878	-71,489	-72,168	-72,860	-73,563	-74,260	-74,939	-75,641	-76,352	-77,018	-77,601

CWF = community water fluoridation; dmft = decayed, missing, and filled deciduous teeth; DMFT = decayed, missing, and filled permanent teeth.

Community Water Fluoridation Cessation

Over 20 years, for a hypothetical large urban municipality, CWF cessation was found to cost a total of \$1,086 million while continuing CWF was found to cost \$976 million under a societal perspective. This indicates that, for a municipality that currently adjusts fluoride levels in its water supplies, ceasing CWF compared with continuing CWF could cost \$110 million over a 20-year time horizon, or approximately \$6.93 per capita per year (Table 19). On the other hand, continuing CWF could have saved \$20.35 per dollar invested compared with ceasing CWF (Table 43). Although ceasing CWF resulted in overall savings of ~\$792,000 in the first year (compared with continuing CWF, due to foregone CWF costs, which include retrofitting and operations costs), direct and indirect costs associated with increased caries burden continued to accumulate and exhausted the initial savings by the third year.

Table 19: Base-Case Results for Question 5 — Estimated Total Costs and Budget Impact Associated With Each Strategy at 5, 10, 15, and 20 Years

	Total Costs Across Years (2018 Canadian Dollars, in Thousands)			
	5 years	10 years	15 years	20 years
Cease CWF	229,773	485,694	771,394	1,086,107
Continue CWF	224,994	462,550	713,248	975,972
Budget impact (i.e., difference between CWF implementation and no CWF)	4,779	23,144	58,147	110,136

CWF = community water fluoridation.

The magnitude of the financial impact across stakeholders reflected that of the CWF introduction analysis; CWF cessation generated savings for municipalities at the cost of the other stakeholders. Municipalities cover the smallest proportion of the population in terms of dental care (0.0037%) and, if they ceased CWF, they would avoid paying CWF costs associated with retrofitting a facility and continued operation and maintenance. As the foregone cost of continuing CWF is larger than the cumulative cost associated with increased caries burden from a municipal perspective, municipal stakeholders were projected to save a cumulative total of \$5.7 million by the end of 20 years (Table 22) from CWF cessation (compared with CWF continuation). Private and individual stakeholders were once again found to have the largest financial impact as they covered the largest proportion of caries treatments, and the cumulative cost associated with CWF cessation was \$59.2 million by the end of 20 years (compared with CWF continuation). Provincial and territorial stakeholders were found to absorb the second-largest financial impact from CWF cessation and were projected to pay \$54.2 million by the end of 20 years. Federal stakeholders were found to absorb the least financial impact from CWF cessation and would pay a total of \$2.3 million by the end of 20 years (compared with the decision to continue CWF) (Table 22).

Similar to the CWF introduction analysis, the largest proportion of the direct cost were medical costs (100% in the cessation strategy, 99.4% in the continuation strategy). The CWF cessation strategy was associated with larger medical costs compared with the CWF continuation strategy as the strategies were associated with different caries burden. Medical costs increased from \$40.9 million annually in the first year to \$60.9 million in the 20th year under the CWF cessation strategy, while they increased from \$40.5 million in the first year to \$49.5 million in the 20th year under the CWF continuation strategy (Table 23). As noted,

these findings were driven by the differences in projected caries burden between the two strategies.

In the CWF cessation strategy, the expected incidence of caries within a large urban municipality rose from ~133,000 in the first year to ~197,000 in the 20th year, while they rose from ~133,000 in the first year to ~162,000 in the 20th year in the CWF continuation strategy (Table 24). The analysis predicts that the incidence of permanent teeth caries would jump in the seventh year in the CWF cessation strategy. This observation was due to the fact that the analysis assumed caries incidence would not change for municipal residents with previous exposure to CWF (i.e., identical incidence rate between those with previous exposure and current exposure to CWF). As such, the difference in caries between a municipality that continues CWF and one that ceases CWF is mainly driven by those newly entering into a municipal's population (e.g., birth). At year seven of the analysis, the first cohort of newborns would be six years old with emerging permanent teeth and, if born in municipalities that have ceased CWF, they would be at an increased risk of DMFTs compared with their counterparts born in municipalities that have continued CWF.

The growth in caries burden over time was also due to the expected growth in population. CWF cessation was found to increase more caries over time compared with CWF continuation, from 671 caries in the first year to ~34,800 caries in the 20th year. By the end of 20 years, CWF cessation was found to have generated more than ~303,700 additional caries than CWF continuation (Table 24). Therefore, net medical costs associated with CWF cessation rose from ~\$409,000 in the first year to \$11.4 million in the 20th year, and accumulated to a total of \$108.9 million over 20 years (Table 23). Although small compared with the total medical costs, averted CWF costs from CWF cessation were large enough to offset the increased medical cost associated with caries treatment for a municipality, as previously discussed (i.e., \$1.2 million saved in the first year due to the foregone costs of CWF facility retrofitting, followed by consistent annual savings from foregone CWF operation and maintenance [~\$210,300 in the second year, rising to ~\$260,900 in the last year]) (Table 22).

Costs associated with productivity loss constituted most of the indirect costs incurred in the analysis (99%), while transportation costs retained a small proportion (1%). Productivity loss associated with dental care was larger in the CWF cessation strategy (i.e., increasing from \$3.0 million annually in the first year to \$4.4 million in the 20th year) compared with the CWF continuation strategy (i.e., increasing from \$3.0 million in the first year to \$3.6 million in the 20th year). Overall, the annual costs associated with increased productivity loss from CWF cessation rose from ~\$15,000 in the first year to ~\$782,400 in the 20th year, accumulating to \$6.8 million over 20 years. Transportation costs were also larger in the CWF cessation strategy but decreased from ~\$46,600 annually in the first year to ~\$27,900 in the 20th year under the CWF cessation strategy, while decreasing from ~\$46,400 annually in the first year to ~\$22,900 in the 20th year for the CWF continuation strategy. Overall, the difference in transportation costs between CWF cessation and CWF introduction was \$234 in the first year and \$4,930 in the 20th year, accumulating to ~\$58,500 over 20 years (Table 23).

Table 20: Estimated Annual Costs Associated With Each Strategy, by Year and Stakeholder (Large Urban Community Water Fluoridation Cessation)

	Estimated Annual Costs (2018 Canadian Dollars)																				
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	
Total																					
2A: Cease CWF	43,958,154	44,912,367	45,925,130	46,958,784	48,018,533	48,880,531	50,251,189	51,287,380	52,197,564	53,304,286	54,666,269	56,030,138	57,207,325	58,334,688	59,462,085	60,581,672	61,727,152	62,917,244	64,128,562	65,358,381	
2B: Keep CWF	44,750,263	44,240,749	44,783,255	45,330,885	45,888,467	46,442,316	46,952,084	47,533,965	48,053,427	48,574,229	49,117,223	49,628,966	50,157,522	50,652,892	51,141,275	51,617,937	52,081,785	52,541,833	53,006,565	53,476,201	
Budget impact	-792,109	671,617	1,141,876	1,627,900	2,130,066	2,438,215	3,299,105	3,753,416	4,144,137	4,730,057	5,549,046	6,401,172	7,049,803	7,681,796	8,320,810	8,963,735	9,645,367	10,375,411	11,121,997	11,882,180	
Federal																					
2A: Cease CWF	488,874	502,169	516,294	530,889	545,964	556,705	571,935	583,452	593,477	605,446	620,104	634,757	647,397	659,498	671,606	683,647	695,997	708,865	722,013	735,414	
2B: Keep CWF	447,428	452,251	457,416	462,527	467,620	472,661	477,754	483,694	489,054	494,513	500,228	505,623	511,209	516,444	521,600	526,621	531,487	536,287	541,106	545,945	
Budget impact	41,446	49,918	58,878	68,362	78,344	84,044	94,181	99,758	104,423	110,932	119,877	129,134	136,188	143,054	150,006	157,026	164,510	172,579	180,907	189,469	
Provincial and Territorial																					
2A: Cease CWF	16,118,914	16,624,710	17,162,285	17,720,515	18,299,281	18,686,327	19,193,297	19,579,258	19,914,291	20,307,436	20,785,298	21,262,472	21,669,269	22,056,459	22,443,641	22,828,763	23,224,165	23,637,137	24,060,305	24,493,011	
2B: Keep CWF	15,858,374	16,058,834	16,280,836	16,513,041	16,755,082	16,997,673	17,192,767	17,407,272	17,595,418	17,778,762	17,968,584	18,146,967	18,330,318	18,500,731	18,668,761	18,833,183	18,994,213	19,155,492	19,320,226	19,488,652	
Budget impact	260,540	565,876	881,449	1,207,474	1,544,199	1,688,654	2,000,529	2,171,986	2,318,873	2,528,673	2,816,715	3,115,505	3,338,951	3,555,728	3,774,879	3,995,580	4,229,952	4,481,645	4,740,079	5,004,359	
Municipal																					
2A: Cease CWF	1,012	1,028	1,045	1,062	1,079	1,096	1,128	1,151	1,172	1,198	1,230	1,263	1,291	1,318	1,345	1,372	1,399	1,427	1,456	1,485	
2B: Keep CWF	1,217,615	211,273	213,932	216,667	219,491	222,357	225,225	228,096	230,963	233,825	236,681	239,528	242,367	245,196	248,018	250,834	253,648	256,463	259,282	262,110	
Budget impact	-1,216,603	-210,245	-212,887	-215,605	-218,411	-221,260	-224,097	-226,945	-229,791	-232,627	-235,451	-238,266	-241,076	-243,878	-246,673	-249,462	-252,249	-255,035	-257,826	-260,624	
Private and Individual																					
2A: Cease CWF	27,349,354	27,784,459	28,245,506	28,706,319	29,172,209	29,636,402	30,484,830	31,123,519	31,688,624	32,390,206	33,259,636	34,131,646	34,889,368	35,617,413	36,345,493	37,067,891	37,805,591	38,569,814	39,344,788	40,128,471	
2B: Keep CWF	27,226,846	27,518,391	27,831,071	28,138,650	28,446,274	28,749,626	29,056,337	29,414,902	29,737,992	30,067,128	30,411,730	30,736,848	31,073,628	31,390,521	31,702,895	32,007,298	32,302,437	32,593,592	32,885,951	33,179,494	
Budget impact	122,508	266,068	414,435	567,669	725,935	886,776	1,428,492	1,708,617	1,950,632	2,323,079	2,847,906	3,394,798	3,815,739	4,226,892	4,642,598	5,060,592	5,503,154	5,976,222	6,458,837	6,948,977	

CWF = Community water fluoridation.

Note: Negative values denotes overall financial savings.

Table 21: Estimated Annual Costs Associated With Each Strategy, by Year and Cost Category (Large Urban Community Water Fluoridation Cessation)

	Estimated Annual Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Direct Cost																				
2A: Cease CWF	40,911,328	41,815,922	42,775,757	43,758,092	44,764,949	45,575,091	46,851,491	47,816,057	48,662,720	49,690,970	50,956,065	52,222,754	53,317,297	54,366,045	55,414,931	56,456,728	57,522,843	58,630,630	59,758,433	60,903,720
2B: Keep CWF	41,718,660	41,177,357	41,685,356	42,200,650	42,724,951	43,246,924	43,724,222	44,267,571	44,752,430	45,237,964	45,743,947	46,220,778	46,713,099	47,174,860	47,630,161	48,074,642	48,507,353	48,936,638	49,370,426	49,808,916
Budget impact	-807,332	638,564	1,090,401	1,557,441	2,039,998	2,328,167	3,127,269	3,548,486	3,910,290	4,453,006	5,212,118	6,001,976	6,604,198	7,191,185	7,784,771	8,382,086	9,015,490	9,693,991	10,388,008	11,094,804
Medical Costs																				
2A: Cease CWF	40,911,328	41,815,922	42,775,757	43,758,092	44,764,949	45,575,091	46,851,491	47,816,057	48,662,720	49,690,970	50,956,065	52,222,754	53,317,297	54,366,045	55,414,931	56,456,728	57,522,843	58,630,630	59,758,433	60,903,720
2B: Keep CWF	40,502,052	40,967,103	41,472,454	41,985,024	42,506,513	43,025,632	43,500,072	44,040,563	44,522,568	45,005,251	45,508,392	45,982,387	46,471,883	46,930,826	47,383,317	47,824,993	48,254,902	48,681,382	49,112,361	49,548,035
Budget impact	409,275	848,819	1,303,303	1,773,067	2,258,436	2,549,459	3,351,419	3,775,493	4,140,153	4,685,718	5,447,673	6,240,366	6,845,414	7,435,219	8,031,615	8,631,735	9,267,941	9,949,247	10,646,072	11,355,685
CWF Costs																				
2A: Cease CWF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2B: Keep CWF	1,216,608	210,255	212,902	215,626	218,438	221,293	224,150	227,007	229,863	232,712	235,556	238,391	241,216	244,034	246,844	249,649	252,452	255,256	258,064	260,881
Budget impact	-1,216,608	-210,255	-212,902	-215,626	-218,438	-221,293	-224,150	-227,007	-229,863	-232,712	-235,556	-238,391	-241,216	-244,034	-246,844	-249,649	-252,452	-255,256	-258,064	-260,881
Indirect Costs																				
2A: Cease CWF	3,046,827	3,096,445	3,149,373	3,200,693	3,253,584	3,305,440	3,399,698	3,471,324	3,534,843	3,613,316	3,710,204	3,807,384	3,890,028	3,968,643	4,047,154	4,124,944	4,204,309	4,286,615	4,370,129	4,454,662
2B: Keep CWF	3,031,603	3,063,392	3,097,898	3,130,235	3,163,515	3,195,392	3,227,862	3,266,394	3,300,997	3,336,265	3,373,275	3,408,188	3,444,423	3,478,032	3,511,114	3,543,295	3,574,431	3,605,195	3,636,140	3,667,286
Budget impact	15,224	33,053	51,475	70,458	90,069	110,048	171,836	204,930	233,846	277,051	336,928	399,196	445,605	490,611	536,040	581,649	629,877	681,419	733,989	787,376
Transportation																				
2A: Cease CWF	46,591	46,288	46,423	44,716	44,104	42,374	41,335	40,320	39,131	38,052	37,135	36,182	35,099	33,988	32,898	31,823	30,768	29,778	28,809	27,879
2B: Keep CWF	46,356	45,791	45,660	43,726	42,875	40,955	39,239	37,933	36,536	35,129	33,757	32,384	31,074	29,783	28,537	27,333	26,156	25,041	23,968	22,949
Budget impact	234	497	764	991	1,229	1,418	2,096	2,387	2,595	2,923	3,377	3,798	4,025	4,206	4,361	4,491	4,613	4,736	4,841	4,930
Productivity Loss																				
2A: Cease CWF	3,000,236	3,050,156	3,102,950	3,155,977	3,209,480	3,263,066	3,358,363	3,431,004	3,495,712	3,575,264	3,673,069	3,771,202	3,854,929	3,934,655	4,014,256	4,093,121	4,173,541	4,256,837	4,341,320	4,426,782
2B: Keep CWF	2,985,247	3,017,601	3,052,239	3,086,509	3,120,640	3,154,437	3,188,623	3,228,461	3,264,461	3,301,136	3,339,518	3,375,804	3,413,349	3,448,250	3,482,577	3,515,963	3,548,276	3,580,154	3,612,172	3,644,336
Budget impact	14,989	32,556	50,711	69,468	88,840	108,630	169,740	202,543	231,251	274,128	333,551	395,398	441,580	486,405	531,679	577,158	625,265	676,683	729,148	782,446

CWF = Community water fluoridation.

Note: Negative values denotes overall financial savings.

Table 22: Estimated Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Large Urban Community Water Fluoridation Cessation)

	Estimated Cumulative Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total																				
2A: Cease CWF	43,958,154	88,870,521	134,795,651	181,754,436	229,772,969	278,653,500	328,904,689	380,192,069	432,389,632	485,693,918	540,360,187	596,390,325	653,597,650	711,932,338	771,394,423	831,976,095	893,703,247	956,620,491	1,020,749,054	1,086,107,435
2B: Keep CWF	44,750,263	88,991,013	133,774,267	179,105,152	224,993,619	271,435,935	318,388,019	365,921,984	413,975,410	462,549,639	511,666,862	561,295,828	611,453,350	662,106,242	713,247,517	764,865,454	816,947,239	869,489,072	922,495,638	975,971,839
Budget impact	-792,109	-120,492	1,021,384	2,649,284	4,779,350	7,217,564	10,516,670	14,270,085	18,414,222	23,144,279	28,693,325	35,094,497	42,144,300	49,826,096	58,146,906	67,110,641	76,756,008	87,131,419	98,253,416	110,135,596
Federal																				
2A: Cease CWF	488,874	991,043	1,507,337	2,038,226	2,584,190	3,140,895	3,712,830	4,296,282	4,889,759	5,495,204	6,115,309	6,750,066	7,397,463	8,056,962	8,728,568	9,412,215	10,108,211	10,817,077	11,539,090	12,274,504
2B: Keep CWF	447,428	899,679	1,357,095	1,819,622	2,287,241	2,759,902	3,237,656	3,721,350	4,210,403	4,704,917	5,205,144	5,710,768	6,221,977	6,738,421	7,260,021	7,786,643	8,318,130	8,854,416	9,395,522	9,941,468
Budget impact	41,446	91,364	150,242	218,605	296,949	380,993	475,174	574,932	679,355	790,288	910,164	1,039,298	1,175,486	1,318,541	1,468,546	1,625,572	1,790,082	1,962,660	2,143,567	2,333,036
Provincial and Territorial																				
2A: Cease CWF	16,118,914	32,743,625	49,905,910	67,626,424	85,925,705	104,612,033	123,805,329	143,384,587	163,298,878	183,606,314	204,391,612	225,654,084	247,323,353	269,379,812	291,823,453	314,652,216	337,876,380	361,513,517	385,573,823	410,066,834
2B: Keep CWF	15,858,374	31,917,208	48,198,044	64,711,085	81,466,168	98,463,841	115,656,608	133,063,881	150,659,298	168,438,060	186,406,644	204,553,611	222,883,928	241,384,660	260,053,421	278,886,604	297,880,817	317,036,309	336,356,535	355,845,187
Budget impact	260,540	826,417	1,707,865	2,915,339	4,459,538	6,148,192	8,148,721	10,320,707	12,639,580	15,168,253	17,984,968	21,100,473	24,439,425	27,995,152	31,770,032	35,765,612	39,995,564	44,477,209	49,217,288	54,221,647
Municipal																				
2A: Cease CWF	1,012	2,040	3,085	4,147	5,226	6,322	7,450	8,601	9,774	10,972	12,202	13,465	14,756	16,073	17,418	18,790	20,189	21,616	23,073	24,558
2B: Keep CWF	1,217,615	1,428,888	1,642,820	1,859,487	2,078,978	2,301,335	2,526,560	2,754,656	2,985,619	3,219,445	3,456,126	3,695,655	3,938,021	4,183,217	4,431,235	4,682,069	4,935,717	5,192,180	5,451,462	5,713,572
Budget impact	-1,216,603	-1,426,849	-1,639,735	-1,855,341	-2,073,752	-2,295,012	-2,519,110	-2,746,055	-2,975,846	-3,208,473	-3,443,924	-3,682,190	-3,923,266	-4,167,144	-4,413,817	-4,663,280	-4,915,528	-5,170,564	-5,428,390	-5,689,014
Private and Individual																				
2A: Cease CWF	27,349,354	55,133,814	83,379,320	112,085,638	141,257,847	170,894,250	201,379,080	232,502,598	264,191,222	296,581,428	329,841,064	363,972,710	398,862,078	434,479,491	470,824,984	507,892,875	545,698,466	584,268,281	623,613,068	663,741,539
2B: Keep CWF	27,226,846	54,745,237	82,576,308	110,714,958	139,161,232	167,910,858	196,967,195	226,382,097	256,120,090	286,187,217	316,598,947	347,335,795	378,409,423	409,799,944	441,502,840	473,510,138	505,812,575	538,406,167	571,292,118	604,471,612
Budget impact	122,508	388,576	803,012	1,370,680	2,096,615	2,983,392	4,411,884	6,120,501	8,071,132	10,394,211	13,242,117	16,636,915	20,452,655	24,679,546	29,322,144	34,382,737	39,885,891	45,862,113	52,320,950	59,269,927

CWF = Community water fluoridation.

Note: Negative values denotes overall financial savings.

Table 23: Estimated Cumulative Costs Associated With Each Strategy, by Year and Cost Category (Large Urban Community Water Fluoridation Cessation)

	Estimated Cumulative Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Direct Cost																				
2A: Cease CWF	40,911,328	82,727,249	125,503,007	169,261,098	214,026,047	259,601,138	306,452,629	354,268,686	402,931,406	452,622,376	503,578,441	555,801,195	609,118,491	663,484,536	718,899,468	775,356,196	832,879,039	891,509,668	951,268,102	1,012,171,822
2B: Keep CWF	41,718,660	82,896,018	124,581,374	166,782,024	209,506,975	252,753,900	296,478,122	340,745,693	385,498,123	430,736,087	476,480,034	522,700,812	569,413,911	616,588,770	664,218,931	712,293,573	760,800,926	809,737,565	859,107,990	908,916,906
Budget impact	-807,332	-168,768	921,633	2,479,074	4,519,072	6,847,239	9,974,508	13,522,993	17,433,284	21,886,289	27,098,407	33,100,383	39,704,581	46,895,766	54,680,537	63,062,623	72,078,112	81,772,104	92,160,112	103,254,916
Medical Costs																				
2A: Cease CWF	40,911,328	82,727,249	125,503,007	169,261,098	214,026,047	259,601,138	306,452,629	354,268,686	402,931,406	452,622,376	503,578,441	555,801,195	609,118,491	663,484,536	718,899,468	775,356,196	832,879,039	891,509,668	951,268,102	1,012,171,822
2B: Keep CWF	40,502,052	81,469,155	122,941,609	164,926,633	207,433,147	250,458,779	293,958,851	337,999,414	382,521,982	427,527,233	473,035,625	519,018,012	565,489,895	612,420,721	659,804,037	707,629,030	755,883,932	804,565,315	853,677,676	903,225,710
Budget impact	409,275	1,258,095	2,561,398	4,334,465	6,592,900	9,142,360	12,493,779	16,269,272	20,409,424	25,095,143	30,542,816	36,783,182	43,628,597	51,063,815	59,095,430	67,727,165	76,995,107	86,944,354	97,590,426	108,946,111
CWF Costs																				
2A: Cease CWF	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2B: Keep CWF	1,216,608	1,426,863	1,639,765	1,855,391	2,073,829	2,295,121	2,519,271	2,746,278	2,976,141	3,208,853	3,444,409	3,682,800	3,924,016	4,168,049	4,414,894	4,664,543	4,916,994	5,172,250	5,430,315	5,691,196
Budget impact	-1,216,608	-1,426,863	-1,639,765	-1,855,391	-2,073,829	-2,295,121	-2,519,271	-2,746,278	-2,976,141	-3,208,853	-3,444,409	-3,682,800	-3,924,016	-4,168,049	-4,414,894	-4,664,543	-4,916,994	-5,172,250	-5,430,315	-5,691,196
Indirect Costs																				
2A: Cease CWF	3,046,827	6,143,272	9,292,645	12,493,338	15,746,921	19,052,361	22,452,059	25,923,383	29,458,226	33,071,542	36,781,746	40,589,130	44,479,158	48,447,801	52,494,955	56,619,899	60,824,208	65,110,823	69,480,952	73,935,614
2B: Keep CWF	3,031,603	6,094,995	9,192,894	12,323,128	15,486,643	18,682,036	21,909,897	25,176,291	28,477,288	31,813,552	35,186,828	38,595,016	42,039,439	45,517,472	49,028,586	52,571,881	56,146,313	59,751,508	63,387,647	67,054,933
Budget impact	15,224	48,277	99,751	170,209	260,278	370,326	542,162	747,092	980,938	1,257,990	1,594,918	1,994,114	2,439,719	2,930,330	3,466,369	4,048,018	4,677,895	5,359,315	6,093,304	6,880,681
Transportation																				
2A: Cease CWF	46,591	92,879	139,302	184,019	228,123	270,496	311,831	352,151	391,282	429,334	466,468	502,651	537,750	571,738	604,636	636,459	667,227	697,005	725,814	753,693
2B: Keep CWF	46,356	92,147	137,807	181,533	224,408	265,363	304,602	342,535	379,071	414,200	447,957	480,341	511,415	541,198	569,735	597,068	623,223	648,265	672,232	695,181
Budget impact	234	732	1,495	2,486	3,715	5,133	7,229	9,616	12,211	15,134	18,511	22,310	26,335	30,540	34,901	39,392	44,004	48,741	53,582	58,512
Productivity Loss																				
2A: Cease CWF	3,000,236	6,050,393	9,153,342	12,309,319	15,518,799	18,781,865	22,140,228	25,571,232	29,066,944	32,642,208	36,315,277	40,086,479	43,941,408	47,876,063	51,890,319	55,983,440	60,156,981	64,413,817	68,755,138	73,181,920
2B: Keep CWF	2,985,247	6,002,848	9,055,087	12,141,595	15,262,235	18,416,672	21,605,295	24,833,756	28,098,217	31,399,353	34,738,871	38,114,675	41,528,024	44,976,274	48,458,851	51,974,814	55,523,089	59,103,243	62,715,415	66,359,751
Budget impact	14,989	47,545	98,256	167,723	256,563	365,193	534,933	737,476	968,728	1,242,856	1,576,407	1,971,804	2,413,384	2,899,789	3,431,468	4,008,626	4,633,891	5,310,574	6,039,723	6,822,169

CWF = Community water fluoridation.

Note: Negative values denotes overall financial savings.

Table 24: Estimated Annual Number of Caries Associated With Each Strategy, by Year and Caries Type (Large Urban Community Water Fluoridation Cessation)

	Estimated Annual Caries																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Caries																				
2A: Cease CWF	133,352	135,577	137,929	140,293	142,678	145,062	149,298	152,527	155,402	158,937	163,283	167,644	171,364	174,907	178,444	181,948	185,522	189,223	192,978	196,776
2B: Keep CWF	132,681	134,120	135,661	137,185	138,703	140,207	141,727	143,498	145,097	146,727	148,433	150,045	151,714	153,264	154,790	156,273	157,709	159,126	160,549	161,978
Difference	671	1,457	2,269	3,108	3,975	4,855	7,571	9,029	10,305	12,210	14,851	17,599	19,651	21,643	23,654	25,675	27,813	30,097	32,429	34,797
dmft																				
2A: Cease CWF	14,293	15,331	16,411	17,516	18,641	19,786	20,951	22,152	23,362	24,588	25,835	27,098	27,615	27,841	28,021	28,158	28,257	28,359	28,470	28,596
2B: Keep CWF	13,622	13,874	14,142	14,408	14,667	14,930	15,202	15,499	15,795	16,096	16,408	16,727	17,046	17,186	17,297	17,382	17,443	17,505	17,574	17,652
Difference	671	1,457	2,269	3,108	3,975	4,855	5,748	6,653	7,568	8,492	9,427	10,371	10,569	10,655	10,724	10,777	10,814	10,853	10,896	10,944
DMFT																				
2A: Cease CWF	119,059	120,246	121,519	122,777	124,037	125,277	128,347	130,375	132,040	134,349	137,448	140,546	143,750	147,066	150,423	153,790	157,265	160,864	164,507	168,179
2B: Keep CWF	119,059	120,246	121,519	122,777	124,037	125,277	126,524	127,999	129,303	130,632	132,025	133,318	134,668	136,078	137,493	138,892	140,267	141,620	142,975	144,326
Difference	0	0	0	0	0	0	1,823	2,377	2,737	3,718	5,424	7,228	9,082	10,987	12,930	14,899	16,998	19,244	21,533	23,853

CWF = Community water fluoridation; dmft = decayed, missing, and filled deciduous teeth; DMFT = decayed, missing, and filled permanent teeth.

Sensitivity Analyses

Overall findings of the base case were robust across the majority of sensitivity analysis tested. Sensitivity analyses conducted include medium urban municipality, small urban municipality, low population growth, high population growth, low CWF efficacy scenarios, and higher CWF implementation costs. Detailed findings can be found in Appendix 4.

Municipal Scenarios

Scenario analyses for medium urban and small urban municipalities were consistent with the base-case findings. Compared with not implementing CWF, CWF introduction was found to generate net savings annually from the first year (medium urban: average of \$34.03 per capita per year, Table 28; small urban: average of \$34.49 per capita per year, Table 30).

When compared with CWF continuation, CWF cessation in both medium urban and small communities was found to be less costly in the first year but more expensive thereafter, ultimately exhausting the initial savings from foregone facility retrofit and maintenance costs by the third year. Ceasing CWF resulted in net costs over the remainder of the time horizon (medium urban: average of \$6.29 per capita per year, Table 29; small urban: average of \$6.36 per capita per year, Table 31).

Population Growth Scenarios

Findings from low and high population growth scenario analyses were consistent with the base-case findings, and exhibited a trend where a higher population growth rate was associated with similar, albeit larger, benefits associated with CWF. In a large urban municipality, the BIA suggested that overall net savings from CWF introduction compared with CWF non-implementation would be relatively similar between a low growth and high growth scenario (low growth: average of \$33.69 per capita per year,

Table 32; high growth: average of \$34.39 per capita per year, Table 34).

Similar findings to the base case were also observed for the CWF cessation BIA. In the same hypothetical large urban municipality, the BIA suggests that overall net costs from CWF cessation compared with CWF continuation would be relatively similar between a low growth and high growth scenario (low growth: average of \$5.83 per capita per year, Table 33; high growth: average of \$6.92 per capita per year,

Table 35).

Given that the findings from municipal scenario analyses were consistent with base-case findings, the above results for population growth scenarios would be also expected to be consistent across other types of municipalities.

Low Caries Prevention Efficacy Scenario

Findings were generally consistent with the base-case findings when CWF was assumed to prevent caries only in deciduous dentition of children younger than six years old. Although CWF introduction was found to be cost saving compared with CWF non-implementation, a shift in the time to break-even occurred. CWF took more time to generate savings from caries prevention. Instead of being immediately cost savings (compared with CWF non-implementation) from the first year onward, as observed in the base case, CWF introduction was estimated to be more expensive (\$5.7 million) in the first year, followed by annual net savings of approximately \$2.0 million in the second year, and a gradual increase to \$2.6

million by the 20th year (Table 36). This allowed the initial net cost to be recouped by the fourth year of CWF. Overall, CWF introduction generated \$40.4 million in net savings compared with CWF non-implementation over twenty years, approximately \$2.59 per capita per year. Although the magnitude of net savings were smaller under this scenario compared with the base case (i.e., compared with \$525 million), this scenario reflects a conservative estimate as it assumed the impact of CWF was limited to deciduous dentition in children younger than six years of age, which represents approximately 6.5% of the initial population.

Findings for CWF cessation were also consistent with the base-case findings, and the timing of achieving budget neutrality did not shift as was observed for the analysis on CWF introduction. CWF cessation was found to produce \$792,109 of net savings in the first year when compared with CWF continuation, although this eroded by the third year due to costs associated with increased caries treatments (Table 37). The cost difference was smaller given that the health outcome effects of fluoride were reduced and, overall CWF cessation generated a \$43.5 million net cost over twenty years (if averaged, approximately \$2.81 per capita per year). As the analysis assumed that those whose teeth have been exposed to CWF retain caries-preventing properties, even after CWF cessation, the budget impact of CWF cessation may be higher if cessation of CWF would lead to increased caries incidence in those who had been previously exposed to CWF.

High Community Water Fluoridation Cost Scenario

The findings from a scenario analysis that incorporated the highest CWF implementation costs reported in the literature were still consistent with the base-case finding. CWF implementation — its introduction or continuation — was found to be cost saving.

The consistency in the findings in both scenario analyses may reflect, in part, the per capita costing approach used in the BIA. Both CWF costs and averted caries treatment costs were dependent on the population size within a municipality. Therefore, the magnitude to which averted caries treatment costs was greater than CWF costs would determine how quickly the savings from averted caries treatment would accumulate. If the accumulated savings were larger than the costs of CWF construction (in the CWF introduction BIA) or retrofitting (in the CWF cessation BIA), CWF would be a cost-saving strategy beginning in the first year. If the savings accumulated more slowly, then the break-even point would shift further into the future. The CWF cessation BIA demonstrates a version of this case in which the additional cost of caries treatment from ceasing water fluoridation in the first year — the foregone savings that would have been associated with CWF continuation — was not larger than the savings from ceasing a CWF program (i.e., avoided spending on CWF retrofit, operation, and maintenance). The difference between savings and costs in this case was large enough to shift the break-even point to the twelfth year, when the cumulative additional cost of increased caries treatments from CWF cessation matched the savings of foregone CWF costs (Table 39).

Amalgam Dental Restoration Scenario

The findings from a scenario analysis that assumed non-bonded amalgam dental restorations instead of bonded composite resin restorations were still consistent with the base-case finding. Both CWF introduction and continuation were found to be cost saving, although the savings were reduced compared with the base-case analyses. The reduction in savings is reflective of the reduced cost of caries treatment in the scenario (Table 40).

Threshold Analyses

Rural Municipality

In the BIA, the cost savings of CWF introduction were driven by the reduction in caries incidences that further reduce total treatment costs, productivity loss, and transportation costs. CWF was cost saving only if the CWF implementation cost, including construction, operation, and maintenance costs were lower than the savings from averted caries. Unfortunately, up-to-date cost information regarding CWF implementation in rural municipalities was not available at the time of this study. As such, a threshold analysis was conducted under a rural setting to determine the point whereby total CWF implementation costs (with respect to construction, operation, and maintenance) would equal the savings associated with fluoridation versus non-fluoridation. (i.e., savings associated with averted incidence of caries between fluoridated and non-fluoridated municipalities). The analysis assumed the same per capita CWF costs as those in urban municipalities and that the rural municipality would be equipped with a water treatment infrastructure that provides water for all the municipal residents to consume. In this regard, the analysis is not generalizable to remote communities. The analysis found that in a modelled rural municipality of 423 people, CWF introduction would be considered cost saving if the total implementation cost of CWF was below \$355,898 over a 20-year time horizon, or approximately \$39.53 per capita per year. If CWF implementation costs were more expensive, the introduction of CWF would be more costly than keeping with the current status quo of not adjusting the fluoride levels in a rural community's water supply. Note that these findings are from a broader societal perspective and do not account for the fact that CWF introduction is always considered a costly strategy from a municipal perspective as the full CWF costs would be assumed to be borne by the municipality.

Conversely, for CWF cessation, a threshold analysis was conducted to determine the point whereby savings from foregone CWF continuation costs would equal the costs associated with increased caries treatment due to CWF cessation. The analysis found that in a hypothetical rural municipality of 423 people, the decision to cease existing CWF program would cost \$68,702 over a 20-year time horizon, or \$7.49 per capita per year. Therefore, if the savings from foregone CWF continuation were less than \$68,702, the decision to cease CWF would always be more costly than keeping with the current status quo of adjusting fluoride levels in the community water supply. As noted previously, the municipality is assumed to bear the full cost of CWF, so from a municipality's perspective, the decision to cease CWF would always be cost saving.

Given the uncertainty regarding whether the water treatment infrastructure necessary for CWF exists in rural municipalities, the results of the rural municipality threshold analyses could also be interpreted for other fluoridation mechanisms that use wells and a hauled-in water supply and do not rely on a network of water pipes. If it can be assumed that these mechanisms could be similarly efficacious as CWF, then their introduction could also be cost saving for the mechanisms that cost up to the reported \$355,898 over 20 years to implement. Similarly, if ceasing such a CWF mechanism would save the municipality less than \$68,702 over 20 years, then ceasing CWF would be more costly than continuing CWF.

Declining Municipal Population

As the base-case BIAs reflect a municipality with an expected population growth in the next 20 years, a threshold analysis was conducted to explore whether the base-case findings were sensitive to a population decline.

For CWF introduction, the analysis attempted to determine the rate of annual population decline at which the total CWF introduction costs would equal the cost savings associated with averted caries due to fluoridation. The threshold analysis for CWF introduction found that even at a 100% annual population decline rate, whereby a municipal population drops from 675,429 in the first year to zero in the second year, CWF introduction still generated net savings compared with CWF non-implementation. This finding reflects the fact that the benefit of CWF introduction from averted caries treatment is larger than the cost of CWF construction, operation, and maintenance in the first year.

Conversely, the threshold analysis for CWF cessation attempted to determine a rate of annual population decline at which the total foregone CWF continuation costs (i.e., savings) would equal the total costs of additional caries due to increased caries incidence from CWF cessation. The analysis found that CWF cessation was no longer more costly compared with CWF continuation if a municipality's population declines more than 56.33% annually, a rate at which a municipality of 675,429 people would be effectively reduced to zero by 2036.

As noted, these findings were expected given that CWF costs were calculated based on a per capita costing approach. Specifically, the costs of construction or retrofitting were variable and were dependent on the number of individuals within a municipality. Different results may be obtained if a different approach was taken to estimate CWF implementation costs; however, given challenges in obtaining real-world estimates of CWF implementation costs for different sizes of municipalities, caution is required in interpreting the findings from this sensitivity analysis.

Community Water Fluoridation Cost Subsidization

The base-case BIAs assumed that municipalities bear the full cost of CWF programs, which contributed to the finding that CWF implementation, whether its introduction or continuation, is always costly from a municipality's perspective. However, in some jurisdictions, a model of CWF financing exists in which the provincial government subsidizes the CWF costs that would be incurred by municipalities.⁶³ A threshold analysis of municipal subsidization rate by provincial or territorial governments was thus conducted to determine the specific subsidization rate at which the municipal budget impact would be neutral. The threshold analysis for CWF introduction found that CWF costs would need to be subsidized by more than 99.90% before introducing water fluoridation to community water supplies is cost saving for the municipality.

Similarly, the threshold analysis for CWF cessation found that the costs of CWF continuation would need to be subsidized by more than 99.96% before CWF continuation would be cost saving for a large urban municipality.

The finding that the costs of CWF implementation would necessarily have to be fully subsidized before either CWF introduction or continuation is a cost-saving strategy for municipalities may be due to the fact that a relatively small proportion of savings are generated by municipalities from CWF. As noted, the primary savings from CWF in the BIAs were from averted caries incidences and their associated treatment costs. Since the proportion of caries treatment funded by municipal budgets is very small (0.0037%), any associated savings from CWF would be correspondingly small from a municipal perspective,

rendering any form of CWF implementation, whether its introduction or continuation, a costlier strategy.

Of note, even with this level of municipal subsidization by provincial and territorial stakeholders, CWF introduction was still cost saving compared with CWF non-implementation, and CWF cessation was still more costly than CWF continuation from a provincial and territorial perspective. As the base-case findings were not sensitive to different municipality scenarios, these findings may also extend to municipalities that are smaller than the large urban municipality modelled for this threshold analysis.

Summary of Findings

The BIAs found that, in communities that have not already implemented CWF, CWF introduction was cost saving compared with not implementing CWF under a broad societal perspective, with the costs associated with CWF introduction recovered within the first year of full implementation. For a large urban municipality, the budget impact of CWF introduction compared with CWF non-implementation was found to generate net savings of more than \$525 million over twenty years. In communities that are currently deciding whether to continue CWF, CWF cessation was found to be more costly under a societal perspective compared with CWF continuation, even if this requires retrofitting existing CWF facilities. Specifically, any cost savings from CWF cessation were found to be exhausted by the third year as medical, productivity loss, and transportation costs associated with increased caries incidence accumulated. For a large urban municipality, CWF cessation would cost more than \$110 million than continuing the status quo of fluoridating municipal waters. As the analysis assumed that there are no costs associated with decommissioning fluoride upon ceasing water fluoridation, if such costs exist, the total cost of CWF cessation would be expected to be higher; increasing the budgetary impact of CWF cessation.

The analysis was conducted at the municipal level and reflects an average population. Subpopulations (e.g., by socio-economic status or oral hygiene status) were not separately modelled given the lack of subgroup data regarding the epidemiology of caries and the effects of fluoride on subpopulations. However, if subpopulations exist in which CWF is expected to have a larger absolute effect on caries reduction or in which treatment is delayed, resulting in the need for more costly downstream care, the overall budgetary savings may be larger with introduction or continuation of fluoridation.

In both decision problems, the savings related to CWF arose from reduced medical, productivity loss, and transportation costs associated with reduced caries incidence. Overall, implementing CWF resulted in cost savings for federal, provincial, territorial, and private stakeholders but at the expenses of municipalities. Municipalities were found to absorb the largest burden from implementing or continuing CWF but also benefit the least financially given that, for the most part, they cover the smallest proportion of individuals for dental care. Private insurance and individuals would benefit the most as CWF would reduce caries incidence and thereby reduce medical and patient's costs (i.e., productivity loss and transportation costs) associated with the treatment of caries. Provincial and territorial governments would experience the next largest financial benefit, followed by the federal government. The magnitude of potential cost savings from CWF was dependent on the proportion of the population in which dental care would be covered by each stakeholder. Threshold analyses found that if provincial and territorial governments were to fully subsidize CWF introduction costs (i.e., for construction, operation, and maintenance) or CWF continuation costs (i.e., for retrofitting, operation, and maintenance), the decision to

introduce or continue CWF would be cost saving for all stakeholders in the analysis, including municipalities.

Sensitivity analyses were conducted to address a number of uncertainties in the analyses. The findings of the BIA were robust and applicable to a range of urban municipality sizes and population growth projections, and were particularly salient in the results of the threshold analyses on the minimum annual population decline rate for budget neutrality. It found that CWF introduction would always produce savings compared with not fluoridating community water, regardless of changes in the rate of decline in a municipality's population. CWF cessation would be less costly compared with CWF continuation only if a municipality's population declined at a rate of at least 56.33% per year.

The findings were more sensitive to uncertainties regarding the efficacy of CWF exposure in reducing caries incidence, the cost of CWF, and CWF in rural settings. If CWF was assumed to only prevent caries in the deciduous dentition of children younger than six, fewer people would be impacted by CWF. Therefore, it would take a longer time for the implementation of CWF to manifest as cost savings (i.e., from immediate savings to four years for Question 4, unchanged for Question 5). Over a 20-year time horizon, net savings from CWF introduction compared with CWF non-implementation would be reduced to \$40.4 million, and the net cost of CWF cessation compared with CWF continuation was estimated to reduce to \$43.5 million. Higher CWF implementation costs were found not to shift the break-even point for CWF introduction, although its counterpart for CWF cessation (the budget-neutral point) was shifted from three years to 12 years.

For a rural municipality of initially 423 people, CWF introduction would remain a cost-saving option if the total cost of CWF implementation over 20 years was lower than \$355,898 (\$39.53 per capita per year), and CWF cessation would remain more expensive if the total cost of CWF continuation over 20 years was less than \$68,702 (\$7.49 per capita per year). It is important to recognize that the analysis from a rural municipality had greater uncertainty given the lack of data specific to such a setting, and extensive sensitivity and threshold analyses were therefore conducted. For instance, the base-case analysis is predicated on the assumption that an existing water treatment infrastructure exist. Of note, the implementation review⁵⁷ noted that some rural municipalities may not have access to such infrastructure and may be reliant on private wells or hauled-in water supply. Although the budget impact from such a setting was not explicitly considered, the findings from threshold analysis may be extrapolated. If introducing any form of CWF to a rural municipality costs more than \$355,898 over 20 years, the overall societal budget impact would be positive (i.e., more costly to introduce CWF than to not implement CWF); otherwise, CWF would be cost saving. Similarly, ceasing any form of CWF would be cost saving if the cost of continuing CWF in a rural municipality is more than \$68,702 over 20 years.

Although further primary research within a Canadian context on the health outcomes and financial impact of CWF introduction and cessation in deciduous and permanent dentition across various municipality sizes may help further reduce uncertainties in this report, the finding that CWF implementation was cost saving compared with not fluoridating community water was generally robust across different municipal, population growth, and health outcome efficacy scenarios.

Conclusion

This report describes the budget impact of two different municipalities: one without existing CWF practices and one with existing CWF practices given different decision problems faced by these municipalities. As noted, separate reports on the assessment of effectiveness and safety,⁵⁵ implementation issues,⁵⁷ environmental impact,⁵⁸ and ethical considerations⁵⁹ for CWF are available as part of the full HTA review on this topic.

In conclusion, the BIAs provide a Canadian context and support the findings in existing international literature that the savings from averted caries treatment generally outweigh the costs of implementing CWF. In a Canadian municipality that currently does not have CWF, CWF introduction was found to be cheaper than continuing without CWF under a societal perspective, with savings introduced within the early years of implementation. In a municipality that currently has CWF, CWF cessation was found to be more costly compared with continuing CWF, even if this would necessitate renovating existing facilities. These findings are applicable to urban municipalities and may be extended to rural municipalities, but with greater uncertainty given the approach by which the costs of CWF implementation were calculated. Of note, the current analysis was unable to address the potential budget impact in remote communities. In all sensitivity analyses conducted, the findings remained consistent as, despite the initial increased construction costs associated with CWF, savings would be achieved through the lowering of caries incidence in the municipality's population. However, the distribution of costs and benefits associated with CWF across different stakeholders were uneven as costs are borne by municipalities, with benefits transferred to other stakeholders. A threshold analysis suggests that there may be value in other stakeholders (e.g., provincial or federal governments) to fully subsidize the implementation of CWF to better align the interest of all stakeholders.

References

1. Behrman RE, Kliegman RM, Arvin AM, editors. *Nelson textbook of pediatrics*. 15th ed. Philadelphia (PA): W.B. Saunders Co.; 1996.
2. Health Canada. Report on the findings of the oral health component of the Canadian Health Measures Survey 2007-2009. Ottawa (ON): Government of Canada; 2010: http://publications.gc.ca/collections/collection_2010/sc-hc/H34-221-2010-eng.pdf. Accessed 2018 Aug 2.
3. Ripa LW. A half-century of community water fluoridation in the United States: review and commentary. *J Public Health Dent*. 1993;53(1):17-44.
4. Locker D, Matear D. *Oral disorders, systemic health, well-being and the quality of life: a summary of recent research evidence*. Toronto (ON): University of Toronto; 2000.
5. Low W, Tan S, Schwartz S. The effect of severe caries on the quality of life in young children. *Pediatr Dent*. 1999;21(6):325-326.
6. Ayhan H, Suskan E, Yildirim S. The effect of nursing or rampant caries on height, body weight and head circumference. *J Clin Pediatr Dent*. 1996;20(3):209-212.
7. Jackson SL, Vann WF, Jr., Kotch JB, Pahel BT, Lee JY. Impact of poor oral health on children's school attendance and performance. *Am J Public Health*. 2011;101(10):1900-1906. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3222359>. Accessed 2017 Oct 31.
8. Gift HC, Reisine ST, Larach DC. The social impact of dental problems and visits. *Am J Public Health*. 1992;82(12):1663-1668. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1694558>. Accessed 2017 Oct 31.
9. Clarke M, Locker D, Berall G, Pencharz P, Kenny DJ, Judd P. Malnourishment in a population of young children with severe early childhood caries. *Pediatr Dent*. 2006;28(3):254-259.
10. Offenbacher S, Katz V, Fertik G, et al. Periodontal infection as a possible risk factor for preterm low birth weight. *J Periodontol*. 1996;67(10 Suppl):1103-1113.
11. Dasanayake AP. Poor periodontal health of the pregnant woman as a risk factor for low birth weight. *Ann Periodontol*. 1998;3(1):206-212.
12. National health expenditure trends, 1975 to 2018. Ottawa (ON): Canadian Institute for Health Information; 2018: <https://www.cihi.ca/sites/default/files/document/nhex-trends-narrative-report-2018-en-web.pdf>. Accessed 2019 Jan 15.
13. The state of oral health in Canada. Ottawa (ON): Canadian Dental Association; 2017: <https://www.cda-adc.ca/stateoforalhealth/files/TheStateofOralHealthinCanada.pdf>. Accessed 2018 Mar 3.
14. Water fluoridation: questions & answers. Toronto (ON): University of Toronto, Faculty of Dentistry, Dental Public Health program; 2012: <http://www.caphd.ca/sites/default/files/WaterFluoridationQA.pdf>. Accessed 2017 Oct 31.
15. Health Canada. Guidelines for Canadian drinking water quality: guideline technical document -- fluoride. Ottawa (ON): Health Canada, Healthy Environments and Consumer Safety Branch, Water, Air and Climate Change Bureau; 2010: <https://www.canada.ca/content/dam/canada/health-canada/migration/healthy-canadians/publications/healthy-living-vie-saine/water-fluoride-fluorure-eau/alt/water-fluoride-fluorure-eau-eng.pdf>. Accessed 2017 Oct 31.
16. Hutton WL, Linscott BW, Williams DB. The Brantford fluorine experiment. Interim report after five years of water fluoridation. *Can J Public Health*. 1951;42(3):81-87.
17. Connor RA. Editorial. Twenty-fifth anniversary of fluoridation. A public health success story. *Can J Public Health*. 1970;61(4):283-284.
18. Dunton EA. Two fluoridation health surveys in Ontario. *Can J Public Health*. 1967;58(7):319-323.
19. Smith AG. The Brantford fluorine experiment. *J Can Dent Assoc*. 1946;12:11-14.
20. Featherstone JD. Prevention and reversal of dental caries: role of low level fluoride. *Community Dent Oral Epidemiol*. 1999;27(1):31-40.
21. Singh KA, Spencer AJ, Armfield JM. Relative effects of pre- and post-eruption water fluoride on caries experience of permanent first molars. *J Public Health Dent*. 2003;63(1):11-19.
22. Singh KA, Spencer AJ. Relative effects of pre- and post-eruption water fluoride on caries experience by surface type of permanent first molars. *Community Dent Oral Epidemiol*. 2004;32(6):435-446.
23. Singh KA, Spencer AJ, Brennan DS. Effects of water fluoride exposure at crown completion and maturation on caries of permanent first molars. *Caries Res*. 2007;41(1):34-42.
24. Newbrun E, editor. *Fluorides and dental caries*. Springfield (IL): Charles C. Thomas; 1986.
25. Groeneveld A, Van Eck AA, Backer DO. Fluoride in caries prevention: is the effect pre- or post-eruptive? *J Dent Res*. 1990;69 Spec No:751-755.
26. Hamilton IR. Biochemical effects of fluoride on oral bacteria. *J Dent Res*. 1990;69 Spec No:660-667.
27. Lambrou D, Larsen MJ, Fejerskov O, Tachos B. The effect of fluoride in saliva on remineralization of dental enamel in humans. *Caries Res*. 1981;15(5):341-345.
28. Kamel MS, Thomson WM, Drummond BK. Fluoridation and dental caries severity in young children treated under general anaesthesia: an analysis of treatment records in a 10-year case series. *Community Dent Health*. 2013;30(1):15-18.

29. Centers for Disease Control and Prevention (CDC). Water fluoridation and costs of Medicaid treatment for dental decay--Louisiana, 1995-1996. *MMWR Morb Mortal Wkly Rep.* 1999;48(34):753-757. <https://www.cdc.gov/mmwr/preview/mmwrhtml/mm4834a2.htm>. Accessed 2017 Oct 31.
30. Seaman S, Thomas FD, Walker WA. Differences between caries levels in 5-year-old children from fluoridated Anglesey and non-fluoridated mainland Gwynedd in 1987. *Community Dent Health.* 1989;6(3):215-221.
31. Evans DJ, Rugg-Gunn AJ, Tabari ED. The effect of 25 years of water fluoridation in Newcastle assessed in four surveys of 5-year-old children over an 18-year period. *Br Dent J.* 1995;178(2):60-64.
32. Rugg-Gunn AJ, Carmichael CL, Ferrell RS. Effect of fluoridation and secular trend in caries in 5-year-old children living in Newcastle and Northumberland. *Br Dent J.* 1988;165(10):359-364.
33. Downer MC, Blinkhorn AS, Attwood D. Effect of fluoridation on the cost of dental treatment among urban Scottish schoolchildren. *Community Dent Oral Epidemiol.* 1981;9(3):112-116.
34. Chippendale I, Storey E. Declining attendances for general anaesthesia and tooth extractions in children following the fluoridation of Melbourne. *Aust Dent J.* 1988;33(5):415-419.
35. Whitford GM. The metabolism and toxicity of fluoride. *Monographs in oral science, vol. 16 (book 16)*. Basel (CH): S. Karger; 1996.
36. Whitford GM. Fluoride metabolism and excretion in children. *J Public Health Dent.* 1999;59(4):224-228.
37. Fluoride. *Nutrient reference values for Australia and New Zealand*. Version 1.1 ed. Canberra (AU): Australian Government, National Health and Medical Research Council; 2017.
38. Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Dietary reference intakes for calcium, phosphorus, magnesium, vitamin D and fluoride. Washington (DC): National Academy Press; 1997: https://www.ncbi.nlm.nih.gov/books/NBK109825/pdf/Bookshelf_NBK109825.pdf. Accessed 2017 Oct 31.
39. Public Health Agency of Canada. The state of community water fluoridation across Canada: 2017 report. Ottawa (ON): Government of Canada; 2017: <https://www.canada.ca/content/dam/hc-sc/documents/services/publications/healthy-living/community-water-fluoridation-across-canada-2017/community-water-fluoridation-across-canada-2017-eng.pdf>. Accessed 2018 Mar 29.
40. Perrella AM, Kiss SJ. Risk perception, psychological heuristics and the water fluoridation controversy. *Can J Public Health.* 2015;106(4):e197-e203.
41. Podgorny PC, McLaren L. Public perceptions and scientific evidence for perceived harms/risks of community water fluoridation: an examination of online comments pertaining to fluoridation cessation in Calgary in 2011. *Can J Public Health.* 2015;106(6):e413-e425.
42. Quinonez CR, Locker D. Public opinions on community water fluoridation. *Can J Public Health.* 2009;100(2):96-100.
43. Peckham S, Awofeso N. Water fluoridation: a critical review of the physiological effects of ingested fluoride as a public health intervention. *ScientificWorldJournal.* 2014;2014:293019. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3956646>. Accessed 2017 Sep 20.
44. Mork N, Griffin S. Perceived safety and benefit of community water fluoridation: 2009 HealthStyles survey. *J Public Health Dent.* 2015;75(4):327-336. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4813797/>. Accessed 2017 Nov 22.
45. School dental health - Calgary zone. Edmonton (AB): Alberta Health Services; 2018: <https://www.albertahealthservices.ca/services/page13173.aspx>. Accessed 2018 Jul 10.
46. Dental oral health. Regina (SK): Government of Saskatchewan; 2018: <https://www.saskatchewan.ca/residents/health/wellness-and-prevention/dental-oral-health>. Accessed 2018 Jul 10.
47. Resolution on fluoride varnish programs for children at risk for dental caries. Fergus (ON): Wellington-Dufferin-Guelph Public Health; 2017: https://wdgpublichealth.ca/sites/default/files/bh.01.may0317.r12_resolution_on_fluoride_varnish_programs_for_children_at_risk_for_dental_caries_accs.pdf. Accessed 2017 Oct 31.
48. McLaren L, McIntyre L. Drinking water fluoridation in Canada: review and synthesis of published literature. Calgary (AB): University of Calgary, Department of Health Sciences; 2011: <http://www.albertahealthservices.ca/poph/hi-poph-surv-phids-drinking-water-fluoridation.pdf>. Accessed 2018 Aug 2.
49. Cheng KK, Chalmers I, Sheldon TA. Adding fluoride to water supplies. *BMJ.* 2007;335(7622):699-702.
50. Cohen H, Locker D. The science and ethics of water fluoridation. *J Can Dent Assoc.* 2001;67(10):578-580. <http://www.cda-adc.ca/jcda/vol-67/issue-10/578.html>. Accessed 2018 Jan 29.
51. McNally M, Downie J. The ethics of water fluoridation. *J Can Dent Assoc.* 2000;66(11):592-593. <http://www.cda-adc.ca/jcda/vol-66/issue-11/592.html>. Accessed 2017 Nov 24.
52. McLaren L, Singhal S. Does cessation of community water fluoridation lead to an increase in tooth decay? A systematic review of published studies. *J Epidemiol Community Health.* 2016;70(9):934-940. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC5013153>. Accessed 2017 Oct 31.
53. Moncton to debate return of fluoride in drinking water. Moncton (NB): CBC News; 2016: <http://www.cbc.ca/news/canada/new-brunswick/moncton-fluoride-water-meeting-1.3900235>. Accessed 2017 Oct 31.
54. Cromwell A. Saint John councillor says province should pay for water fluoridation. Saint John (NB): Global News; 2016: <https://globalnews.ca/news/2980007/saint-john-councillor-says-province-should-pay-for-water-fluoridation/>. Accessed 2017 Oct 31.

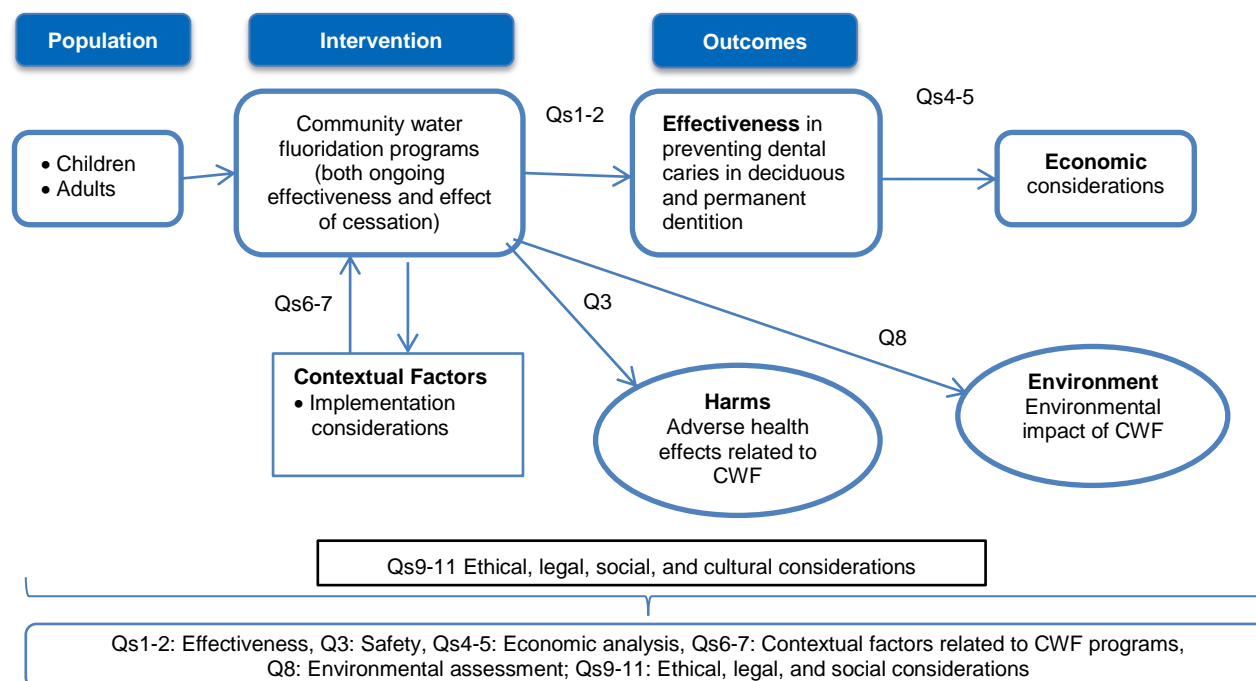
55. Community water fluoridation programs: a health technology assessment — review of dental caries and other health outcomes. (*CADTH Technology review no. 12*). Ottawa (ON): CADTH; 2019.
56. Community water fluoridation programs: a health technology assessment — budget impact analysis. (*CADTH Technology review no. 13*). Ottawa (ON): CADTH; 2019.
57. Community water fluoridation programs: a health technology assessment — implementation issues analysis. (*CADTH Technology review no. 15*). Ottawa (ON): CADTH; 2019.
58. Community water fluoridation programs: a health technology assessment — environmental assessment. (*CADTH Technology review no. 14*). Ottawa (ON): CADTH; 2019.
59. Community water fluoridation programs: a health technology assessment — ethical considerations. (*CADTH Technology review no. 16*). Ottawa (ON): CADTH; 2019.
60. Fyfe C, Borman B, Scott G, Birks S. A cost effectiveness analysis of community water fluoridation in New Zealand. *N Z Med J*. 2015;128(1427):38-46.
61. Griffin SO, Jones K, Tomar SL. An economic evaluation of community water fluoridation. *J Public Health Dent*. 2001;61(2):78-86.
62. O'Connell J, Rockell J, Ouellet J, Tomar SL, Maas W. Costs and savings associated with community water fluoridation in the United States. *Health Aff (Millwood)*. 2016;35(12):2224-2232.
63. Tchouaket E, Brousselle A, Fansi A, Dionne PA, Bertrand E, Fortin C. The economic value of Quebec's water fluoridation program. *Z Gesundh Wiss*. 2013;21(6):523-533. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3837190>. Accessed 2017 Dec 8.
64. Wright JC, Bates MN, Cutress T, Lee M. The cost-effectiveness of fluoridating water supplies in New Zealand. *Aust N Z J Public Health*. 2001;25(2):170-178.
65. Community water fluoridation programs: a health technology assessment protocol. (*CADTH Health technology assessment*). Ottawa (ON): CADTH; 2018 Feb: https://cadth.ca/sites/default/files/pdf/HT0022-Community%20Water%20Fluoridation_Protocol.pdf. Accessed 2018 Aug 2.
66. Water and wastewater policy and level of services standards (corporate manual system). *Volume 1 - capital facilities and maintenance - potable water and wastewater systems*. Ottawa (ON): Indigenous and Northern Affairs Canada; 2011: <http://www.aadnc-aandc.gc.ca/eng/1312228309105/1312228630065> Accessed 2017 Oct 19.
67. Building community resilience through asset management. Edmonton (AB): Alberta Government; 2015: http://www.municipalaffairs.alberta.ca/documents/ms/2015-11-17_Handbook_-_FINAL.pdf. Accessed 2017 Oct 6.
68. Asset management for sustainable service delivery: a BC framework. Victoria (BC): Asset Management BC; 2015: https://www.assetmanagementbc.ca/wp-content/uploads/Asset_Management_for_Sustainable_Service_Delivery_-_A_BC_Framework_-_Asset_Management_BC-September_16_2015.pdf. Accessed 2017 Oct 6.
69. Building together - guide for municipal asset management plans. Toronto (ON): Government of Ontario; 2016: <https://www.ontario.ca/page/building-together-guide-municipal-asset-management-plans>. Accessed 2017 Oct 6.
70. Statistics Canada. Canada goes urban. Ottawa (ON): Government of Canada; 2015: <http://www.statcan.gc.ca/pub/11-630-x/11-630-x2015004-eng.htm>. Accessed 2018 Aug 2.
71. Statistics Canada. Population and dwelling count highlight tables, 2016 census. Population and dwelling counts, for Canada, provinces and territories, and population centres, 2016 and 2011 censuses – 100% data. Ottawa (ON): Government of Canada; 2017: <http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hltfst/pd-pl/Table.cfm?Lang=Eng&T=801> Accessed 2018 Aug 2.
72. Statistics Canada. Population projections for Canada (2013 to 2063), provinces and territories (2013 to 2038): technical report on methodology and assumptions (Table 91-620-X). Ottawa (ON): Government of Canada; 2015: <https://www150.statcan.gc.ca/n1/pub/91-620-x/91-620-x2014001-eng.htm> Accessed 2018 Aug 2.
73. Statistics Canada. Components of projected population growth, by projection scenario (x 1,000) (Table 17-10-0058-01). Ottawa (ON): Government of Canada; 2018: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710005801>. Accessed 2018 Aug 2.
74. Statistics Canada. Estimates of non-permanent residents, quarterly (Table 17-10-0023-01). Ottawa (ON): Government of Canada; 2018: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710002301> Accessed 2018 Aug 2.
75. Statistics Canada. Selected population characteristics, Canada, ecozones and ecoregions (Table 38-10-0047-01). Ottawa (ON): Government of Canada; 2018: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3810004701>. Accessed 2018 Aug 2.
76. Statistics Canada. Age (in single years) and average age (127) and sex (3) for the population of Canada, provinces and territories, census divisions and census subdivisions, 2016 census - 100% data, 2016004. Ottawa (ON): Government of Canada; 2017: <http://www5.statcan.gc.ca/olc-cel/olc.action?objId=98-400-X2016004&objType=46&lang=en&limit=0> Accessed 2018 Aug 2.
77. Statistics Canada. Life tables, Canada, provinces and territories. 2013 to 2015. Ottawa (ON): Government of Canada; 2018: <http://www.statcan.gc.ca/pub/84-537-x/84-537-x2018001-eng.htm>. Accessed 2018 Aug 2.
78. Immigration Refugees and Citizenship Canada. Notice - supplementary information 2018-2020 immigration levels plan. 2017; <https://www.canada.ca/en/immigration-refugees-citizenship/news/notices/supplementary-immigration-levels-2018.html>. Accessed 2018 Aug 2.
79. Statistics Canada. Estimates of the components of international migration, by age and sex, annual (Table 051-0011). Ottawa (ON): Government of Canada; 2018: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710001401> Accessed 2018 Aug 2.

80. Arrow P. Oral health of schoolchildren in Western Australia. *Aust Dent J*. 2016;61(3):333-341.
81. Do L, Ha D, Peres MA, Skinner J, Byun R, Spencer AJ. Effectiveness of water fluoridation in the prevention of dental caries across adult age groups. *Community Dent Oral Epidemiol*. 2017;45(3):225-232.
82. Statistics Canada. Consumer Price Index (CPI), monthly, not seasonally adjusted (Table 18-10-0004-01). Ottawa (ON): Government of Canada; 2018: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000401>. Accessed 2018 Aug 2.
83. Statistics Canada. Consumer Price Index (CPI), annual average, not seasonally adjusted (Table 18-10-0005-01). Ottawa (ON): Government of Canada; 2018: <https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1810000501>. Accessed 2018 Aug 2.
84. Bureau of Labor Statistics. All items in U.S. city average, all urban consumers, not seasonally adjusted. CUUR0000SA0. 2018; <https://data.bls.gov/timeseries/CUUR0000SA0> Accessed 2018 Mar 25.
85. Bank of Canada. Monthly exchange rates. US Dollar. 2018; <https://www.bankofcanada.ca/rates/exchange/monthly-exchange-rates/> Accessed 2018 Mar 25.
86. Sullivan SD, Mauskopf JA, Augustovski F, et al. Budget impact analysis-principles of good practice: report of the ISPOR 2012 Budget Impact Analysis Good Practice II Task Force. *Value Health*. 2014;17(1):5-14. <https://www.sciencedirect.com/science/article/pii/S1098301513042356?via%3Dihub>. Accessed 2017 Oct 5.
87. National health expenditure trends, 1975 to 2017: data tables - series C. Ottawa (ON): Canadian Institute for Health Information; 2017: <https://www.cihi.ca/en/national-health-expenditure-trends> Accessed 2018 Aug 2.
88. *2017 abbreviated general practitioner's suggested fee guide, effective February 1, 2017*. Vancouver (BC): British Columbia Dental Association; 2017.
89. Ontario NIHB regional dental benefit grid: general practitioners and specialists. Ottawa (ON): Health Canada; 2017: http://provider.express-scripts.ca/documents/Dental/Dental%20Benefit%20Grids/2017/Ontario/Ontario_GPSP-NIHB_Regional_Dental_Benefit_Grid_April_1-2017_rev_Apr_1_2017.pdf. Accessed 2018 Mar 22.
90. Healthy smiles Ontario schedule of dental services and fees for dentist providers: Ministry of Health and Long-Term Care effective January 1, 2016. Toronto (ON): Ontario Ministry of Health and Long-Term Care; 2017 Jan 1: http://www.health.gov.on.ca/en/pro/programs/dental/docs/hso_services_fees_dentist.pdf. Accessed 2018 Mar 22.
91. Composite resin versus amalgam for dental restorations: a health technology assessment. (*CADTH Health technology assessment*). Ottawa (ON): CADTH; 2018 Mar: https://cadth.ca/sites/default/files/pdf/ht0021_dental_amalgam_report_final.pdf. Accessed 2018 Aug 2.
92. Treatment of preventable dental cavities in preschoolers: a focus on day surgery under general anesthesia. Ottawa (ON): Canadian Institute for Health Information; 2013: https://secure.cihi.ca/free_products/Dental_Caries_Report_en_web.pdf. Accessed 2018 Aug 2.
93. Association of Ontario Health Centres. Information on hospital emergency room visits for dental problems in Ontario. Toronto (ON): Alliance for Healthier Communities; 2013: <https://www.aohc.org/news/Information-Hospital-Emergency-Room-Visits-Dental-Problems-Ontario>. Accessed 2018 Aug 2.
94. Ng E, Wilkins R, Pole J, Adams OB. How far to the nearest physician? *Health Rep*. 1997;8(4):19-31. <http://www.statcan.gc.ca/pub/82-003-x/1996004/article/3022-eng.pdf>. Accessed 2018 Aug 2.
95. EPA and NHTSA set standards to reduce greenhouse gases and improve fuel economy for model years 2017-2025 cars and light trucks. *Regulatory announcement*. EPA-420-F-12-051. Washington (DC): United States Environmental Protection Agency; 2012: <https://nepis.epa.gov/Exe/ZyPDF.cgi/P100EZ7C.PDF?Dockey=P100EZ7C.PDF>. Accessed 2018 Aug 2.
96. National Energy Board. Petroleum products. *Energy conversion tables* 2016; <https://apps.neb-one.gc.ca/Conversion/conversion-tables.aspx?GoCTemplateCulture=en-CA#2-5>. Accessed 2018 Aug 2.
97. Natural Resources Canada. Energy sources: average retail prices for regular gasoline in 2018. 2018; http://www2.nrcan.gc.ca/eneene/sources/pripri/prices_bycity_e.cfm. Accessed 2018 Mar 12.
98. Natural Resources Canada. Canada's energy future 2017: energy supply and demand projections to 2040. 2017; <https://apps.neb-one.gc.ca/frppndc/dflft.aspx>. Accessed 2018 Aug 2.
99. Statistics Canada. Journey to work: key results from the 2016 census. Ottawa (ON): Government of Canada; 2017: <http://www.statcan.gc.ca/daily-quotidien/171129/dq171129c-eng.htm>. Accessed 2018 Aug 2.
100. Dental health services in Canada: facts and figures. Ottawa (ON): Canadian Dental Association; 2010: http://www.medicine.uottawa.ca/sim/data/Dental/Dental_Health_Services_in_Canada_June_2010.pdf Accessed 2018 Aug 2.
101. Patient cost estimator. Estimated average costs by CMG and age group, Canada, 2014-2015. *18-59 years average acute LOS, oral cavity/pharynx intervention* Ottawa (ON): Canadian Institute for Health Information; 2015: <https://www.cihi.ca/en/patient-cost-estimator>. Accessed 2018 Aug 2.
102. QuickFacts: Portland City, Oregon. *Population estimates base, April 1, 2010 (v2017)*. Washington (DC): United States Census Bureau; 2017: <https://www.census.gov/quickfacts/geo/chart/portlandcityoregon/PST040217>. Accessed 2018 July 30.
103. Cost to implement fluoridation. Portland (OR): City of Portland; 2012: <http://media.oregonlive.com/portlandcityhall/other/City%20of%20Portland%20Fluoride%20Table%20Final%20June2012.doc>. Accessed 2018 Aug 2.
104. Statistics Canada. Census profile, 2016 census. Peel, regional municipality [census division], Ontario and Canada [country]. Ottawa (ON): Government of Canada; 2017: <http://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/Page.cfm?Lang=E&Geo1=CD&Code1=3521>. Accessed 2018 Aug 2.

105. The Regional Municipality of Peel. Community Water Fluoridation Committee: agenda. Brampton (ON): Regional Municipality of Peel; 2016: <http://www.peelregion.ca/council/agendas/2016/2016-06-09-cwfc-agenda.pdf>. Accessed 2018 Aug 2.
106. Statistics Canada. Dictionary, census of population, 2016. Population centre (POPCTR). Ottawa (ON): Government of Canada; 2017: <http://www12.statcan.gc.ca/census-recensement/2016/ref/dict/geo049a-eng.cfm>. Accessed 2018 Aug 2.
107. Statistics Canada. Dictionary, census of population, 2016. Designated place (DPL). Ottawa (ON): Government of Canada; 2017: <http://www12.statcan.gc.ca/census-recensement/2016/ref/dict/geo018-eng.cfm>. Accessed 2018 Aug 2.
108. Statistics Canada. Canada's population estimates: subprovincial areas, July 1, 2017. *The Daily*. Ottawa (ON): Government of Canada; 2018: <https://www150.statcan.gc.ca/n1/daily-quotidien/180213/dq180213a-eng.htm>. Accessed 2018 Aug 2.
109. Fluoridation of greater Sudbury municipal water supplies - information update. Sudbury (ON): City of Greater Sudbury; 2017: <http://agendasonline.greatersudbury.ca/index.cfm?pg=feed&action=file&agenda=report&itemid=1&id=1148>. Accessed 2018 Aug 2.
110. Statistics Canada. Archived - estimates of population by census metropolitan area, sex and age group for July 1, based on the Standard Geographical Classification (SGC) 2006 (Table 17-10-0046-01). Ottawa (ON): Government of Canada; 2018: [https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710004601&pickMembers\[0\]=1.17&pickMembers\[1\]=2.1](https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=1710004601&pickMembers[0]=1.17&pickMembers[1]=2.1). Accessed 2018 Aug 2.
111. Assessment of fluoridation of water and other methods of delivering fluoride - BOH08024 (a) - (city wide). Hamilton (ON): City of Hamilton; 2008: <http://www2.hamilton.ca/NR/rdonlyres/7223C607-74F4-42E1-98CC-DCAD18F1B6D4/0/Nov24BOH08024aAssessmentofFluoridationofWater.pdf>. Accessed 2018 Aug 2.

Appendix 1: Analytical Framework

Policy Question: Should community water fluoridation be encouraged and maintained in Canada?



Research Questions	Methods
Q1. What is the effectiveness of community water fluoridation compared with non-fluoridated drinking water in the prevention of dental caries in children and adults?	Update of two published systematic reviews
Q2. What are the effects of community water fluoridation cessation compared with continued community water fluoridation, the period before cessation of water fluoridation, or non-fluoridated communities on dental caries in children and adults?	
Q3. What are the negative effects of community water fluoridation (at a given fluoride level) compared with non-fluoridated drinking water (fluoride level < 0.4 parts per million) or fluoridation at different levels on human health outcomes?	
Q4. What is the budget impact of introducing water fluoridation in a Canadian municipality without an existing community water fluoridation program from a societal perspective?	Budget impact analyses
Q5. What is the budget impact of ceasing water fluoridation in a Canadian municipality that presently has a community water fluoridation program from a societal perspective?	
Q6. What are the main challenges, considerations, and enablers to implementing or maintaining community water fluoridation programs in Canada?	Consultations with targeted experts and stakeholders
Q7. What are the main challenges, considerations and enablers to the cessation of community water fluoridation programs in Canada?	Narrative summary of the published and grey literature
	Survey on implementation issues related to community water fluoridation

Research Questions	Methods
Q8. What are the potential environmental (toxicological) risks associated with community water fluoridation?	Narrative summary of the published and grey literature Qualitative risk assessment
Q9. What are the major ethical issues raised by the implementation of community water fluoridation?	Review of the bioethics literature and analysis of ethical issues raised by reports answering Qs1-8
Q10. What are the broader legal, social, and cultural considerations to consider for implementation and cessation?	
Q11. What are the major ethical issues raised by the cessation of community water fluoridation?	

Appendix 2: Characteristics of the Community Water Fluoridation Economic Studies Identified From Economic Literature Review

Table 25: Characteristics of Community Water Fluoridation Economic Studies

First Author, Year	Country, Perspective	Community Population Size	Dentition, Age Group	Comparison	Approach	Time Frame	Findings
Griffin, 2001	USA, Societal (Productivity losses considered)	< 5,000 to > 20,000	Permanent teeth — ages 6 years to 65 years old	Water fluoridation vs. no fluoridation	Annual per person cost of fluoridation compared with cost of averted disease and productivity losses	Lifetime (up to 65 years; CWF equipment costs up to 15 years)	Water fluoridation offers significant cost savings
Wright, 2001	New Zealand, Societal (“non-monetized benefits, such as ... improved social interactions, are represented by the proxy of averted decayed surfaces”)	1,000 to 300,000	Permanent surfaces — ages 4 years to 45 years old	Water fluoridation vs. no fluoridation	Net cost of fluoridating the water supply compared with the averted dental costs; cost per newly decayed tooth surface in a permanent tooth	30 years, CWF equipment replaced halfway through	Fluoridation was cost saving for communities with more than 1,000 people. Break-even point occurs for a population between 800 people and 900 people
Tchouaket, 2013	Canada, Societal (transportation costs and productivity losses considered)	Unreported, based on 13 average Quebec municipalities	Deciduous teeth — ages 5 years to 8 years old Permanent teeth — ages 11 years to 44 years old	Water fluoridation vs. no fluoridation	Cost of the water fluoridation program compared with benefits of the water fluoridation program, including averted transportation costs and productivity losses; benefit-cost ratio	Annual results reported for year 2010	Drinking water fluoridation program produced substantial savings
Fyfe, 2015	New Zealand, Societal (productivity losses considered)	< 5,000 to > 50,000	Deciduous and permanent teeth — ages 2 years to 17 years old	Water fluoridation vs. no fluoridation	Average annual per capita net cost of CWF per dmft/DMFT averted; accounts for productivity	Annual results reported in 2011 to 2012 financial year	Net negative per capita cost of CWF (i.e., savings) per dmft/DMFT averted was generally

First Author, Year	Country, Perspective	Community Population Size	Dentition, Age Group	Comparison	Approach	Time Frame	Findings
					loss		reported
O'Connell, 2016	USA, Societal (productivity losses considered)	1,000 to > 100,000	Deciduous and permanent teeth — ages 1 year to 65 years old	Water fluoridation vs. no fluoridation	Annual costs compared with annual savings	Annual results reported for 2013	Program savings are likely to exceed costs

CWF = Community water fluoridation; dmft = decayed, missing, and filled deciduous teeth; DMFT = decayed, missing, and filled permanent teeth; vs. = versus.

Appendix 3: Initial Municipal Population Demographic Profiles

Table 26: Initial Population Composition (Base Case)

Age	Male		Female	
	Count	%	Count	%
0	153,390	0.54%	146,730	0.51%
1	154,470	0.54%	146,915	0.51%
2	156,375	0.55%	149,400	0.52%
3	160,320	0.56%	151,220	0.53%
4	161,695	0.57%	153,795	0.54%
5	162,570	0.57%	154,645	0.54%
6	166,870	0.58%	158,625	0.56%
7	168,675	0.59%	160,135	0.56%
8	168,850	0.59%	161,040	0.56%
9	164,490	0.58%	156,315	0.55%
10	160,565	0.56%	152,850	0.54%
11	158,760	0.56%	150,885	0.53%
12	159,350	0.56%	152,090	0.53%
13	156,820	0.55%	149,050	0.52%
14	157,915	0.55%	150,240	0.53%
15	160,845	0.56%	152,380	0.53%
16	166,130	0.58%	157,675	0.55%
17	165,855	0.58%	158,065	0.55%
18	171,595	0.60%	165,220	0.58%
19	181,585	0.64%	172,930	0.61%
20	188,900	0.66%	182,530	0.64%
21	193,525	0.68%	185,415	0.65%
22	192,850	0.68%	186,085	0.65%
23	195,600	0.69%	189,715	0.66%
24	198,180	0.69%	194,040	0.68%
25	201,930	0.71%	197,780	0.69%
26	201,210	0.71%	199,465	0.70%
27	194,265	0.68%	194,025	0.68%
28	188,695	0.66%	192,200	0.67%
29	190,975	0.67%	194,135	0.68%
30	195,535	0.69%	198,935	0.70%

Age	Male		Female	
	Count	%	Count	%
31	194,690	0.68%	200,035	0.70%
32	194,400	0.68%	200,360	0.70%
33	193,150	0.68%	200,515	0.70%
34	191,745	0.67%	200,805	0.70%
35	192,095	0.67%	200,550	0.70%
36	189,230	0.66%	199,195	0.70%
37	184,140	0.65%	195,795	0.69%
38	182,525	0.64%	192,300	0.67%
39	182,430	0.64%	193,460	0.68%
40	183,655	0.64%	193,755	0.68%
41	183,720	0.64%	193,690	0.68%
42	179,665	0.63%	190,295	0.67%
43	181,490	0.64%	190,195	0.67%
44	185,270	0.65%	193,410	0.68%
45	192,960	0.68%	201,445	0.71%
46	191,740	0.67%	200,065	0.70%
47	188,665	0.66%	198,750	0.70%
48	187,440	0.66%	196,405	0.69%
49	189,310	0.66%	198,180	0.69%
50	201,400	0.71%	207,905	0.73%
51	212,485	0.74%	220,670	0.77%
52	217,730	0.76%	224,990	0.79%
53	217,440	0.76%	225,075	0.79%
54	209,885	0.74%	218,360	0.77%
55	210,865	0.74%	220,500	0.77%
56	205,815	0.72%	215,710	0.76%
57	200,030	0.70%	210,045	0.74%
58	197,225	0.69%	206,615	0.72%
59	190,185	0.67%	201,510	0.71%
60	183,590	0.64%	194,835	0.68%
61	179,520	0.63%	192,405	0.67%
62	169,340	0.59%	184,070	0.65%
63	161,490	0.57%	175,315	0.61%
64	154,855	0.54%	167,925	0.59%
65	150,880	0.53%	164,405	0.58%

Age	Male		Female	
	Count	%	Count	%
66	145,705	0.51%	160,150	0.56%
67	141,315	0.50%	156,740	0.55%
68	140,820	0.49%	156,625	0.55%
69	138,835	0.49%	154,540	0.54%
70	113,935	0.40%	128,185	0.45%
71	107,205	0.38%	120,905	0.42%
72	103,490	0.36%	117,480	0.41%
73	97,630	0.34%	111,610	0.39%
74	88,030	0.31%	103,210	0.36%
75	82,750	0.29%	99,075	0.35%
76	76,235	0.27%	92,240	0.32%
77	71,875	0.25%	88,160	0.31%
78	67,280	0.24%	83,400	0.29%
79	62,260	0.22%	78,415	0.27%
80	59,760	0.21%	76,455	0.27%
81	54,640	0.19%	72,120	0.25%
82	50,630	0.18%	67,915	0.24%
83	48,130	0.17%	66,005	0.23%
84	43,955	0.15%	62,435	0.22%
85	39,640	0.14%	59,455	0.21%
86	34,665	0.12%	53,620	0.19%
87	29,105	0.10%	48,140	0.17%
88	25,120	0.09%	44,240	0.16%
89	20,785	0.07%	39,140	0.14%
90	17,300	0.06%	34,920	0.12%
91	13,400	0.05%	29,880	0.10%
92	10,580	0.04%	25,395	0.09%
93	8,010	0.03%	20,900	0.07%
94	6,205	0.02%	17,130	0.06%
95	4,435	0.02%	12,885	0.05%
96	2,905	0.01%	9,365	0.03%
97	1,700	0.01%	6,010	0.02%
98	1,115	0.00%	4,310	0.02%
99	690	0.00%	2,970	0.01%
100+	1,010	0.00%	5,750	0.02%

Table 27: Initial Population Composition (Rural Threshold Analysis)

Age	Male		Female	
	Count	%	Count	%
0	35,325	0.54%	33,540	0.51%
1	36,215	0.55%	34,590	0.53%
2	37,410	0.57%	35,355	0.54%
3	38,010	0.58%	36,140	0.55%
4	38,495	0.59%	36,640	0.56%
5	39,500	0.60%	36,965	0.56%
6	41,020	0.62%	38,670	0.59%
7	40,715	0.62%	38,765	0.59%
8	40,565	0.62%	38,775	0.59%
9	39,555	0.60%	37,585	0.57%
10	38,560	0.59%	36,520	0.56%
11	37,950	0.58%	35,645	0.54%
12	38,555	0.59%	36,715	0.56%
13	37,605	0.57%	35,935	0.55%
14	37,860	0.58%	35,835	0.54%
15	38,410	0.58%	36,330	0.55%
16	39,565	0.60%	37,605	0.57%
17	39,010	0.59%	36,520	0.56%
18	38,220	0.58%	35,505	0.54%
19	37,340	0.57%	33,540	0.51%
20	36,440	0.55%	33,180	0.50%
21	35,520	0.54%	31,920	0.49%
22	34,625	0.53%	30,810	0.47%
23	34,175	0.52%	31,190	0.47%
24	34,025	0.52%	31,625	0.48%
25	33,880	0.52%	32,170	0.49%
26	33,890	0.52%	32,880	0.50%
27	32,880	0.50%	31,910	0.49%
28	32,565	0.50%	32,350	0.49%
29	33,150	0.50%	33,375	0.51%
30	34,775	0.53%	34,750	0.53%
31	35,395	0.54%	34,915	0.53%
32	35,530	0.54%	36,050	0.55%
33	35,360	0.54%	36,410	0.55%

Age	Male		Female	
	Count	%	Count	%
34	36,125	0.55%	36,900	0.56%
35	37,395	0.57%	37,795	0.57%
36	37,635	0.57%	37,245	0.57%
37	37,020	0.56%	36,985	0.56%
38	36,800	0.56%	36,995	0.56%
39	37,155	0.56%	37,195	0.57%
40	37,325	0.57%	37,545	0.57%
41	37,500	0.57%	37,600	0.57%
42	37,145	0.56%	36,865	0.56%
43	37,865	0.58%	37,520	0.57%
44	38,720	0.59%	38,610	0.59%
45	40,470	0.62%	40,445	0.61%
46	40,705	0.62%	40,840	0.62%
47	40,750	0.62%	40,110	0.61%
48	41,075	0.62%	41,360	0.63%
49	42,945	0.65%	43,040	0.65%
50	46,290	0.70%	46,795	0.71%
51	51,045	0.78%	51,605	0.78%
52	52,840	0.80%	53,390	0.81%
53	54,060	0.82%	54,525	0.83%
54	54,295	0.83%	54,655	0.83%
55	56,135	0.85%	56,145	0.85%
56	56,020	0.85%	56,180	0.85%
57	55,320	0.84%	56,125	0.85%
58	56,655	0.86%	56,000	0.85%
59	55,700	0.85%	55,355	0.84%
60	55,270	0.84%	54,335	0.83%
61	55,200	0.84%	54,045	0.82%
62	53,695	0.82%	52,590	0.80%
63	51,470	0.78%	50,240	0.76%
64	49,910	0.76%	48,890	0.74%
65	48,880	0.74%	46,865	0.71%
66	47,670	0.72%	45,760	0.70%
67	47,130	0.72%	45,170	0.69%
68	46,295	0.70%	44,500	0.68%

Age	Male		Female	
	Count	%	Count	%
69	44,865	0.68%	43,695	0.66%
70	37,865	0.58%	36,425	0.55%
71	35,295	0.54%	33,675	0.51%
72	33,850	0.51%	32,635	0.50%
73	31,830	0.48%	30,515	0.46%
74	28,415	0.43%	27,655	0.42%
75	25,855	0.39%	26,150	0.40%
76	23,335	0.35%	23,100	0.35%
77	21,870	0.33%	21,995	0.33%
78	19,875	0.30%	20,560	0.31%
79	17,875	0.27%	18,885	0.29%
80	16,800	0.26%	18,300	0.28%
81	14,745	0.22%	16,710	0.25%
82	13,245	0.20%	15,520	0.24%
83	12,420	0.19%	14,880	0.23%
84	11,305	0.17%	14,170	0.22%
85	9,780	0.15%	12,575	0.19%
86	8,345	0.13%	11,755	0.18%
87	7,000	0.11%	10,200	0.16%
88	6,150	0.09%	9,760	0.15%
89	4,965	0.08%	8,135	0.12%
90	3,965	0.06%	7,120	0.11%
91	3,255	0.05%	6,355	0.10%
92	2,490	0.04%	5,210	0.08%
93	1,950	0.03%	4,290	0.07%
94	1,305	0.02%	3,585	0.05%
95	970	0.01%	2,725	0.04%
96	485	0.01%	2,100	0.03%
97	465	0.01%	1,350	0.02%
98	340	0.01%	1,105	0.02%
99	175	0.00%	650	0.01%
100+	285	0.00%	1,115	0.02%

Appendix 4: Sensitivity Analysis Results

Table 28: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Medium Urban Community Water Fluoridation Introduction)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
1A: CWF	4,249,805	3,646,185	3,682,863	3,718,996	3,754,314	3,788,465	3,821,260	3,856,095	3,888,795	3,921,702	3,954,844	3,984,205	4,014,331	4,043,746	4,072,560	4,100,630	4,127,790	4,154,160	4,180,389	4,206,659
1B: No CWF	5,617,900	5,663,032	5,714,580	5,765,797	5,814,445	5,861,807	5,907,316	5,957,923	6,003,339	6,047,592	6,092,313	6,133,839	6,175,854	6,215,822	6,254,582	6,291,948	6,328,903	6,365,141	6,399,888	6,432,652
Budget impact	-1,368,095	-2,016,847	-2,031,717	-2,046,801	-2,060,130	-2,073,342	-2,086,056	-2,101,828	-2,114,545	-2,125,890	-2,137,468	-2,149,634	-2,161,523	-2,172,075	-2,182,022	-2,191,318	-2,201,113	-2,210,981	-2,219,499	-2,225,993
Total Cumulative																				
1A: CWF	4,249,805	7,895,990	11,578,853	15,297,849	19,052,164	22,840,629	26,661,889	30,517,983	34,406,778	38,328,480	42,283,324	46,267,529	50,281,860	54,325,607	58,398,167	62,498,798	66,626,587	70,780,747	74,961,136	79,167,795
1B: No CWF	5,617,900	11,280,932	16,995,513	22,761,310	28,575,754	34,437,561	40,344,877	46,302,800	52,306,140	58,353,732	64,446,045	70,579,884	76,755,738	82,971,559	89,226,142	95,518,090	101,846,993	108,212,134	114,612,022	121,044,674
Budget impact	-1,368,095	-3,384,942	-5,416,659	-7,463,460	-9,523,591	-11,596,932	-13,682,989	-15,784,817	-17,899,362	-20,025,252	-22,162,721	-24,312,355	-26,473,878	-28,645,953	-30,827,975	-33,019,292	-35,220,406	-37,431,386	-39,650,886	-41,876,879

CWF = community water fluoridation.

Note: Negative values denote overall financial savings.

Table 29: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Medium Urban Community Water Fluoridation Cessation)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
2A: Cease CWF	3,630,069	3,698,279	3,769,835	3,841,531	3,913,089	3,967,357	4,067,206	4,131,243	4,191,248	4,267,483	4,361,311	4,452,781	4,527,769	4,601,698	4,675,463	4,748,917	4,824,668	4,903,146	4,982,353	5,062,414
2B: Keep CWF	3,695,482	3,646,185	3,682,863	3,718,996	3,754,314	3,788,465	3,821,260	3,856,095	3,888,795	3,921,702	3,954,844	3,984,205	4,014,331	4,043,746	4,072,560	4,100,630	4,127,790	4,154,160	4,180,389	4,206,659
Budget impact	-65,412	52,094	86,972	122,535	158,775	178,892	245,946	275,148	302,454	345,781	406,466	468,576	513,438	557,951	602,903	648,286	696,878	748,986	801,964	855,756
Total Cumulative																				
2A: Cease CWF	3,630,069	7,328,349	11,098,184	14,939,715	18,852,804	22,820,161	26,887,367	31,018,610	35,209,859	39,477,342	43,838,652	48,291,433	52,819,202	57,420,900	62,096,363	66,845,279	71,669,947	76,573,094	81,555,447	86,617,861
2B: Keep CWF	3,695,482	7,341,667	11,024,530	14,743,526	18,497,841	22,286,306	26,107,566	29,963,660	33,852,455	37,774,157	41,729,001	45,713,206	49,727,537	53,771,284	57,843,844	61,944,475	66,072,264	70,226,424	74,406,813	78,613,472
Budget impact	-65,412	-13,318	73,654	196,188	354,963	533,856	779,801	1,054,950	1,357,404	1,703,185	2,109,651	2,578,227	3,091,665	3,649,616	4,252,519	4,900,805	5,597,683	6,346,669	7,148,633	8,004,389

CWF = community water fluoridation.

Note: Negative values denotes overall financial savings.

Table 30: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Small Urban Community Water Fluoridation Introduction)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
1A: CWF	374,228	321,699	324,931	328,103	331,209	334,206	337,087	340,150	343,024	345,918	348,832	351,413	354,061	356,647	359,181	361,649	364,037	366,355	368,661	370,970
1B: No CWF	495,694	499,667	504,208	508,703	512,980	517,134	521,129	525,578	529,569	533,458	537,388	541,037	544,730	548,243	551,649	554,933	558,181	561,366	564,419	567,298
Budget impact	-121,466	-177,968	-179,278	-180,600	-181,771	-182,927	-184,042	-185,428	-186,545	-187,540	-188,556	-189,625	-190,669	-191,595	-192,469	-193,284	-194,144	-195,011	-195,758	-196,327
Total Cumulative																				
1A: CWF	374,228	695,927	1,020,857	1,348,960	1,680,170	2,014,376	2,351,463	2,691,613	3,034,637	3,380,555	3,729,387	4,080,799	4,434,861	4,791,508	5,150,689	5,512,338	5,876,374	6,242,729	6,611,390	6,982,361
1B: No CWF	495,694	995,361	1,499,570	2,008,273	2,521,253	3,038,386	3,559,516	4,085,093	4,614,662	5,148,120	5,685,508	6,226,546	6,771,276	7,319,519	7,871,169	8,426,102	8,984,283	9,545,648	10,110,068	10,677,365
Budget impact	-121,466	-299,434	-478,712	-659,312	-841,083	-1,024,010	-1,208,052	-1,393,480	-1,580,025	-1,767,565	-1,956,122	-2,145,746	-2,336,416	-2,528,011	-2,720,480	-2,913,764	-3,107,908	-3,302,919	-3,498,677	-3,695,004

CWF = community water fluoridation.

Note: Negative values denote overall financial savings.

Table 31: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Small Urban Community Water Fluoridation Cessation)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
2A: Cease CWF	320,283	326,278	332,570	338,862	345,148	349,920	358,719	364,360	369,646	376,364	384,634	392,697	399,303	405,816	412,315	418,786	425,460	432,374	439,353	446,406
2B: Keep CWF	325,958	321,699	324,931	328,103	331,209	334,206	337,087	340,150	343,024	345,918	348,832	351,413	354,061	356,647	359,181	361,649	364,037	366,355	368,661	370,970
Budget impact	-5,675	4,580	7,640	10,759	13,939	15,714	21,632	24,211	26,621	30,446	35,802	41,284	45,242	49,169	53,134	57,137	61,423	66,019	70,692	75,436
Total Cumulative																				
2A: Cease CWF	320,283	646,562	979,132	1,317,994	1,663,142	2,013,063	2,371,782	2,736,143	3,105,789	3,482,152	3,866,786	4,259,483	4,658,787	5,064,603	5,476,918	5,895,704	6,321,164	6,753,538	7,192,891	7,639,297
2B: Keep CWF	325,958	647,657	972,588	1,300,691	1,631,900	1,966,107	2,303,193	2,643,343	2,986,368	3,332,285	3,681,117	4,032,529	4,386,591	4,743,238	5,102,419	5,464,068	5,828,105	6,194,460	6,563,120	6,934,091
Budget impact	-5,675	-1,095	6,544	17,304	31,242	46,956	68,589	92,799	119,421	149,867	185,670	226,954	272,196	321,365	374,499	431,636	493,059	559,079	629,771	705,206

CWF = community water fluoridation.

Note: Negative values denotes overall financial savings.

Table 32: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Low Population Growth Community Water Fluoridation Introduction)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
1A: CWF	51,462,812	44,074,725	44,420,260	44,750,234	45,047,098	45,311,521	45,574,031	45,830,065	46,079,883	46,330,744	46,570,762	46,754,471	46,941,195	47,132,444	47,314,994	47,488,528	47,651,005	47,800,012	47,942,483	48,081,681
1B: No CWF	68,029,697	68,446,292	68,906,027	69,347,786	69,718,329	70,041,223	70,365,784	70,686,765	70,987,860	71,272,930	71,537,028	71,742,012	71,942,384	72,138,850	72,318,939	72,483,520	72,644,691	72,791,872	72,914,057	73,007,650
Budget impact	-16,566,885	-24,371,567	-24,485,767	-24,597,552	-24,671,231	-24,729,702	-24,791,754	-24,856,700	-24,907,976	-24,942,186	-24,966,266	-24,987,541	-25,001,189	-25,006,406	-25,003,945	-24,994,992	-24,993,686	-24,991,859	-24,971,574	-24,925,969
Total Cumulative																				
1A: CWF	51,462,812	95,537,537	139,957,797	184,708,031	229,755,128	275,066,650	320,640,680	366,470,746	412,550,629	458,881,372	505,452,134	552,206,605	599,147,800	646,280,245	693,595,239	741,083,767	788,734,772	836,534,784	884,477,268	932,558,949
1B: No CWF	68,029,697	136,475,989	205,382,016	274,729,802	344,448,131	414,489,354	484,855,139	555,541,904	626,529,763	697,802,693	769,339,721	841,081,733	913,024,117	985,162,967	1,057,481,907	1,129,965,427	1,202,610,118	1,275,401,990	1,348,316,047	1,421,323,696
Budget impact	-16,566,885	-40,938,452	-65,424,219	-90,021,772	-114,693,003	-139,422,705	-164,214,458	-189,071,158	-213,979,134	-238,921,321	-263,887,587	-288,875,128	-313,876,317	-338,882,723	-363,886,668	-388,881,660	-413,875,346	-438,867,206	-463,838,779	-488,764,748

CWF = community water fluoridation.
 Note: Negative values denote overall financial savings.

Table 33: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Low Population Growth Community Water Fluoridation Cessation)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
2A: Cease CWF	43,958,154	44,679,976	45,416,473	46,139,730	46,831,211	47,292,725	48,325,122	48,862,253	49,393,382	50,115,549	51,019,068	51,871,105	52,515,252	53,165,533	53,810,011	54,449,959	55,116,087	55,806,315	56,495,515	57,187,467
2B: Keep CWF	44,750,263	44,074,725	44,420,260	44,750,234	45,047,098	45,311,521	45,574,031	45,830,065	46,079,883	46,330,744	46,570,762	46,754,471	46,941,195	47,132,444	47,314,994	47,488,528	47,651,005	47,800,012	47,942,483	48,081,681
Budget impact	-792,109	605,251	996,213	1,389,496	1,784,113	1,981,204	2,751,091	3,032,187	3,313,499	3,784,806	4,448,306	5,116,634	5,574,057	6,033,089	6,495,016	6,961,431	7,465,082	8,006,303	8,553,032	9,105,787
Total Cumulative																				
2A: Cease CWF	43,958,154	88,638,131	134,054,603	180,194,333	227,025,544	274,318,270	322,643,391	371,505,644	420,899,026	471,014,575	522,033,643	573,904,748	626,419,999	679,585,532	733,395,543	787,845,503	842,961,590	898,767,906	955,263,421	1,012,450,889
2B: Keep CWF	44,750,263	88,824,988	133,245,248	177,995,482	223,042,580	268,354,101	313,928,131	359,758,197	405,838,080	452,168,824	498,739,586	545,494,056	592,435,251	639,567,696	686,882,690	734,371,218	782,022,223	829,822,236	877,764,719	925,846,400
Budget impact	-792,109	-186,858	809,355	2,198,851	3,982,965	5,964,169	8,715,260	11,747,447	15,060,946	18,845,751	23,294,057	28,410,691	33,984,748	40,017,837	46,512,853	53,474,284	60,939,367	68,945,670	77,498,702	86,604,489

CWF = community water fluoridation.
 Note: Negative values denotes overall financial savings.

Table 34: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (High Population Growth Community Water Fluoridation Introduction)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
1A: CWF	51,462,812	44,260,965	44,824,695	45,394,601	45,975,598	46,553,932	47,089,467	47,698,087	48,245,506	48,795,514	49,368,905	49,911,559	50,472,229	51,001,114	51,524,261	52,036,919	52,538,062	53,036,580	53,540,893	54,051,149
1B: No CWF	68,029,697	68,753,287	69,573,374	70,409,663	71,249,996	72,094,573	72,873,539	73,817,269	74,622,877	75,414,499	76,253,027	77,083,102	77,935,051	78,726,229	79,505,575	80,264,456	81,016,450	81,771,121	82,520,134	83,253,188
Budget impact	-16,566,885	-24,492,323	-24,748,679	-25,015,063	-25,274,397	-25,540,641	-25,784,071	-26,119,182	-26,377,371	-26,618,986	-26,884,122	-27,171,543	-27,462,822	-27,725,115	-27,981,314	-28,227,537	-28,478,388	-28,734,541	-28,979,242	-29,202,039
Total Cumulative																				
1A: CWF	51,462,812	95,723,777	140,548,472	185,943,073	231,918,671	278,472,603	325,562,070	373,260,157	421,505,664	470,301,177	519,670,083	569,581,641	620,053,871	671,054,985	722,579,245	774,616,164	827,154,226	880,190,806	933,731,699	987,782,848
1B: No CWF	68,029,697	136,782,985	206,356,359	276,766,023	348,016,018	420,110,592	492,984,130	566,801,399	641,424,276	716,838,776	793,091,803	870,174,905	948,109,956	1,026,836,186	1,106,341,761	1,186,606,217	1,267,622,667	1,349,393,788	1,431,913,922	1,515,167,110
Budget impact	-16,566,885	-41,059,208	-65,807,887	-90,822,950	-116,097,348	-141,637,989	-167,422,060	-193,541,242	-219,918,612	-246,537,598	-273,421,720	-300,593,264	-328,056,086	-355,781,201	-383,762,516	-411,990,053	-440,468,440	-469,202,981	-498,182,223	-527,384,262

CWF = community water fluoridation.
 Note: Negative values denote overall financial savings.

Table 35: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (High Population Growth Community Water Fluoridation Cessation)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
2A: Cease CWF	43,958,154	44,932,906	45,967,701	47,024,935	48,109,927	48,998,241	50,398,600	51,464,594	52,406,298	53,547,022	54,945,700	56,347,575	57,563,693	58,732,050	59,902,311	61,066,602	62,258,891	63,497,850	64,759,932	66,042,411
2B: Keep CWF	44,750,263	44,260,965	44,824,695	45,394,601	45,975,598	46,553,932	47,089,467	47,698,087	48,245,506	48,795,514	49,368,905	49,911,559	50,472,229	51,001,114	51,524,261	52,036,919	52,538,062	53,036,580	53,540,893	54,051,149
Budget impact	-792,109	671,941	1,143,006	1,630,335	2,134,329	2,444,309	3,309,133	3,766,507	4,160,792	4,751,509	5,576,795	6,436,016	7,091,463	7,730,937	8,378,051	9,029,682	9,720,829	10,461,270	11,219,039	11,991,261
Total Cumulative																				
2A: Cease CWF	43,958,154	88,891,060	134,858,761	181,883,696	229,993,624	278,991,865	329,390,465	380,855,059	433,261,357	486,808,379	541,754,079	598,101,654	655,665,347	714,397,397	774,299,708	835,366,310	897,625,201	961,123,051	1,025,882,983	1,091,925,394
2B: Keep CWF	44,750,263	89,011,228	133,835,923	179,230,524	225,206,122	271,760,054	318,849,521	366,547,609	414,793,115	463,588,628	512,957,534	562,869,092	613,341,322	664,342,436	715,866,696	767,903,616	820,441,677	873,478,257	927,019,150	981,070,300
Budget impact	-792,109	-120,168	1,022,838	2,653,172	4,787,502	7,231,810	10,540,943	14,307,450	18,468,242	23,219,750	28,796,546	35,232,562	42,324,025	50,054,962	58,433,012	67,462,695	77,183,524	87,644,794	98,863,833	110,855,094

CWF = community water fluoridation.
 Note: Negative values denote overall financial savings.

Table 36: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Low Community Water Fluoridation Efficacy Community Water Fluoridation Introduction)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
1A: CWF	64,988,199	57,849,658	58,499,949	59,152,918	59,802,812	60,450,638	61,058,246	61,815,676	62,469,979	63,121,596	63,813,260	64,488,202	65,183,011	65,827,277	66,460,488	67,075,079	67,678,133	68,278,535	68,874,183	69,458,722
1B: No CWF	59,235,964	59,874,589	60,592,629	61,327,117	62,072,657	62,819,999	63,497,484	64,288,031	64,965,287	65,629,561	66,327,562	67,006,803	67,704,376	68,350,664	68,986,148	69,604,050	70,212,513	70,821,282	71,428,965	72,029,574
Budget impact	5,752,235	-2,024,932	-2,092,680	-2,174,199	-2,269,845	-2,369,362	-2,439,237	-2,472,355	-2,495,308	-2,507,965	-2,514,302	-2,518,602	-2,521,365	-2,523,387	-2,525,660	-2,528,971	-2,534,380	-2,542,747	-2,554,782	-2,570,852
Total Cumulative																				
1A: CWF	64,988,199	122,837,857	181,337,806	240,490,724	300,293,536	360,744,173	421,802,420	483,618,096	546,088,075	609,209,671	673,022,931	737,511,133	802,694,144	868,521,421	934,981,909	1,002,056,988	1,069,735,121	1,138,013,656	1,206,887,839	1,276,346,562
1B: No CWF	59,235,964	119,110,553	179,703,182	241,030,299	303,102,956	365,922,955	429,420,439	493,708,469	558,673,757	624,303,317	690,630,879	757,637,683	825,342,059	893,692,723	962,678,871	1,032,282,921	1,102,495,434	1,173,316,716	1,244,745,681	1,316,775,256
Budget impact	5,752,235	3,727,304	1,634,623	-539,575	-2,809,420	-5,178,782	-7,618,019	-10,090,374	-12,585,682	-15,093,646	-17,607,948	-20,126,550	-22,647,914	-25,171,302	-27,696,962	-30,225,933	-32,760,313	-35,303,060	-37,857,842	-40,428,694

CWF = community water fluoridation.
 Note: Negative values denote overall financial savings.

Table 37: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Low Community Water Fluoridation Efficacy Community Water Fluoridation Cessation)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
2A: Cease CWF	57,483,541	58,521,275	59,641,825	60,780,818	61,932,878	62,888,852	63,567,481	64,358,894	65,036,726	65,701,282	66,399,503	67,078,914	67,776,618	68,423,023	69,058,638	69,676,703	70,285,392	70,894,473	71,502,568	72,103,700
2B: Keep CWF	58,275,650	57,849,658	58,499,949	59,152,918	59,802,812	60,450,638	61,058,246	61,815,676	62,469,979	63,121,596	63,813,260	64,488,202	65,183,011	65,827,277	66,460,488	67,075,079	67,678,133	68,278,535	68,874,183	69,458,722
Budget impact	-792,109	671,617	1,141,876	1,627,900	2,130,066	2,438,215	2,509,235	2,543,218	2,566,747	2,579,685	2,586,243	2,590,712	2,593,606	2,595,746	2,598,150	2,601,624	2,607,259	2,615,938	2,628,385	2,644,977
Total Cumulative																				
2A: Cease CWF	57,483,541	116,004,816	175,646,641	236,427,459	298,360,337	361,249,189	424,816,670	489,175,565	554,212,291	619,913,572	686,313,075	753,391,990	821,168,607	889,591,631	958,650,268	1,028,326,971	1,098,612,363	1,169,506,836	1,241,009,404	1,313,113,103
2B: Keep CWF	58,275,650	116,125,308	174,625,257	233,778,175	293,580,987	354,031,624	415,089,871	476,905,547	539,375,526	602,497,122	666,310,382	730,798,584	795,981,595	861,808,872	928,269,360	995,344,439	1,063,022,572	1,131,301,107	1,200,175,290	1,269,634,013
Budget impact	-792,109	-120,492	1,021,384	2,649,284	4,779,350	7,217,564	9,726,800	12,270,018	14,836,765	17,416,450	20,002,693	22,593,406	25,187,012	27,782,758	30,380,908	32,982,532	35,589,791	38,205,728	40,834,113	43,479,091

CWF = community water fluoridation.
 Note: Negative values denote overall financial savings.

Table 38: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (High Community Water Fluoridation Cost Community Water Fluoridation Introduction)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
1A: CWF	61,650,777	45,555,311	46,114,365	46,679,027	47,254,190	47,825,888	48,353,519	48,953,267	49,490,579	50,029,199	50,589,970	51,119,438	51,665,661	52,178,645	52,684,601	53,178,799	53,660,170	54,137,750	54,620,043	55,107,288
1B: No CWF	68,029,697	68,722,625	69,510,744	70,313,719	71,119,277	71,927,720	72,668,817	73,573,500	74,338,425	75,087,750	75,882,411	76,667,759	77,473,424	78,216,518	78,946,164	79,653,743	80,352,713	81,052,735	81,745,535	82,420,850
Budget impact	-6,378,921	-23,167,314	-23,396,379	-23,634,693	-23,865,087	-24,101,832	-24,315,298	-24,620,233	-24,847,846	-25,058,551	-25,292,441	-25,548,321	-25,807,763	-26,037,873	-26,261,564	-26,474,944	-26,692,543	-26,914,985	-27,125,492	-27,313,562
Total Cumulative																				
1A: CWF	61,650,777	107,206,087	153,320,453	199,999,479	247,253,669	295,079,557	343,433,076	392,386,343	441,876,922	491,906,122	542,496,092	593,615,530	645,281,190	697,459,836	750,144,436	803,323,235	856,983,405	911,121,156	965,741,198	1,020,848,487
1B: No CWF	68,029,697	136,752,322	206,263,067	276,576,786	347,696,063	419,623,783	492,292,600	565,866,100	640,204,525	715,292,275	791,174,686	867,842,445	945,315,868	1,023,532,387	1,102,478,551	1,182,132,294	1,262,485,007	1,343,537,742	1,425,283,277	1,507,704,128
Budget impact	-6,378,921	-29,546,235	-52,942,614	-76,577,307	-100,442,394	-124,544,226	-148,859,524	-173,479,756	-198,327,603	-223,386,153	-248,678,594	-274,226,915	-300,034,678	-326,072,551	-352,334,115	-378,809,059	-405,501,602	-432,416,587	-459,542,079	-486,855,641

CWF = community water fluoridation.
 Note: Negative values denote overall financial savings.

Table 39: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (High Community Water Fluoridation Cost Community Water Fluoridation Cessation)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
2A: Cease CWF	43,958,154	44,912,367	45,925,130	46,958,784	48,018,533	48,880,531	50,251,189	51,287,380	52,197,564	53,304,286	54,666,269	56,030,138	57,207,325	58,334,688	59,462,085	60,581,672	61,727,152	62,917,244	64,128,562	65,358,381
2B: Keep CWF	61,650,777	45,555,311	46,114,365	46,679,027	47,254,190	47,825,888	48,353,519	48,953,267	49,490,579	50,029,199	50,589,970	51,119,438	51,665,661	52,178,645	52,684,601	53,178,799	53,660,170	54,137,750	54,620,043	55,107,288
Budget impact	-17,692,622	-642,944	-189,235	279,758	764,343	1,054,643	1,897,670	2,334,113	2,706,984	3,275,086	4,076,299	4,910,700	5,541,664	6,156,043	6,777,484	7,402,874	8,066,981	8,779,494	9,508,520	10,251,093
Total Cumulative																				
2A: Cease CWF	43,958,154	88,870,521	134,795,651	181,754,436	229,772,969	278,653,500	328,904,689	380,192,069	432,389,632	485,693,918	540,360,187	596,390,325	653,597,650	711,932,338	771,394,423	831,976,095	893,703,247	956,620,491	1,020,749,054	1,086,107,435
2B: Keep CWF	61,650,777	107,206,087	153,320,453	199,999,479	247,253,669	295,079,557	343,433,076	392,386,343	441,876,922	491,906,122	542,496,092	593,615,530	645,281,190	697,459,836	750,144,436	803,323,235	856,983,405	911,121,156	965,741,198	1,020,848,487
Budget impact	-17,692,622	-18,335,566	-18,524,801	-18,245,044	-17,480,701	-16,426,058	-14,528,388	-12,194,274	-9,487,290	-6,212,204	-2,135,905	2,774,795	8,316,459	14,472,502	21,249,987	28,652,860	36,719,842	45,499,335	55,007,855	65,258,949

CWF = community water fluoridation.
 Note: Negative values denote overall financial savings.

Table 40: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Amalgam Dental Restoration Community Water Fluoridation Introduction)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
1A: CWF	46,279,987	39,001,716	39,484,037	39,972,111	40,470,368	40,965,471	41,415,862	41,928,564	42,385,516	42,842,642	43,318,999	43,767,743	44,231,117	44,665,911	45,094,714	45,513,433	45,921,199	46,325,919	46,735,074	47,148,878
1B: No CWF	59,938,903	60,554,485	61,255,694	61,971,972	62,692,840	63,416,435	64,071,167	64,867,877	65,540,363	66,197,538	66,894,106	67,582,195	68,287,915	68,939,606	69,579,724	70,200,805	70,814,804	71,430,192	72,039,770	72,634,560
Budget impact	-	-	-	-	-22,222,471	-22,450,964	-22,655,305	-22,939,312	-23,154,847	-23,354,897	-23,575,107	-23,814,452	-	-	-	-24,687,372	-24,893,606	-25,104,274	-25,304,696	-25,485,683
13,658,916	21,552,769	21,771,657	21,999,861										24,056,798	24,273,695	24,485,010					
Total Cumulative																				
1A: CWF	46,279,987	85,281,703	124,765,740	164,737,851	205,208,219	246,173,690	287,589,552	329,518,116	371,903,632	414,746,274	458,065,273	501,833,016	546,064,133	590,730,043	635,824,757	681,338,190	727,259,389	773,585,308	820,320,382	867,469,260
1B: No CWF	59,938,903	120,493,388	181,749,082	243,721,054	306,413,893	369,830,329	433,901,496	498,769,373	564,309,736	630,507,274	697,401,380	764,983,575	833,271,490	902,211,096	971,790,820	1,041,991,625	1,112,806,429	1,184,236,622	1,256,276,392	1,328,910,952
Budget impact	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-360,653,435	-385,547,040	-410,651,314	-435,956,010	-461,441,692
13,658,916	35,211,685	56,983,342	78,983,203	101,205,674	123,656,639	146,311,944	169,251,256	192,406,104	215,761,000	239,336,107	263,150,559	287,207,357	311,481,052	335,966,063						

CWF = community water fluoridation.

Note: Negative values denote overall financial savings.

Table 41: Estimated Annual and Cumulative Costs Associated With Each Strategy, by Year and Stakeholder (Amalgam Dental Restoration Community Water Fluoridation Cessation)

	Estimated Costs (2018 Canadian Dollars)																			
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20
Total Annual																				
2A: Cease CWF	38,749,074	39,616,309	40,537,088	41,478,332	42,444,823	43,213,602	44,418,739	45,328,730	46,126,490	47,095,042	48,287,183	49,480,642	50,512,490	51,501,486	52,490,735	53,473,455	54,479,371	55,524,905	56,589,598	57,671,089
2B: Keep CWF	39,567,438	39,001,716	39,484,037	39,972,111	40,470,368	40,965,471	41,415,862	41,928,564	42,385,516	42,842,642	43,318,999	43,767,743	44,231,117	44,665,911	45,094,714	45,513,433	45,921,199	46,325,919	46,735,074	47,148,878
Budget impact	-818,364	614,593	1,053,051	1,506,221	1,974,455	2,248,131	3,002,877	3,400,166	3,740,974	4,252,401	4,968,185	5,712,899	6,281,373	6,835,575	7,396,022	7,960,022	8,558,172	9,198,986	9,854,524	10,522,211
Total Cumulative																				
2A: Cease CWF	38,749,074	78,365,383	118,902,471	160,380,802	202,825,625	246,039,227	290,457,966	335,786,696	381,913,186	429,008,228	477,295,412	526,776,054	577,288,544	628,790,030	681,280,765	734,754,220	789,233,592	844,758,496	901,348,094	959,019,183
2B: Keep CWF	39,567,438	78,569,154	118,053,191	158,025,302	198,495,670	239,461,141	280,877,003	322,805,567	365,191,083	408,033,725	451,352,724	495,120,467	539,351,584	584,017,495	629,112,208	674,625,641	720,546,840	766,872,759	813,607,833	860,756,711
Budget impact	-818,364	-203,771	849,280	2,355,500	4,329,955	6,578,086	9,580,963	12,981,129	16,722,103	20,974,503	25,942,688	31,655,587	37,936,960	44,772,535	52,168,557	60,128,579	68,686,752	77,885,738	87,740,261	98,262,472

CWF = community water fluoridation.

Note: Negative values denote overall financial savings.

Table 42: Comparison of Per Capita, Per Year Budget Impact Across Analyses

Analytic Setting	Budget Impact Per Capita, Per Year	
	CWF Introduction BIA	CWF Cessation BIA
Large urban municipality (base case)	-\$34.46	\$6.93
Medium urban municipality	-\$34.03	\$6.29
Small urban municipality	-\$34.49	\$6.36
Rural municipality (threshold analysis)	< \$0 if CWF cost is < \$39.53 per capita, per year	> \$0 if CWF cost is < \$7.49 per capita, per year
High population growth scenario	-\$34.39	\$6.92
Low population growth scenario	-\$33.69	\$5.83
Low CWF efficacy scenario	-\$2.59	\$2.81
High CWF cost scenario	-\$31.88	\$3.86
Amalgam dental restoration scenario	-\$30.28	\$6.19

BIA = budget impact analysis; CWF = community water fluoridation.
 Note: Negative budget impact indicates cost savings.

Table 43: Comparison of 20-Year Savings per Dollar Invested in Community Water Fluoridation Across Analyses

Analytic Setting	20-Year Savings per Dollar Invested ^a in CWF	
	CWF Introduction	CWF Continuation
Large urban municipality (base case)	\$43.33	\$20.35
Medium urban municipality	\$42.22	\$18.34
Small urban municipality	\$42.76	\$18.54
Rural municipality (threshold analysis)	> \$1 if CWF cost is < \$355,898 over 20 years	> \$1 if CWF cost is < \$68,702 over 20 years
High population growth scenario	\$43.41	\$20.37
Low population growth scenario	\$41.12	\$16.83
Low CWF efficacy scenario	\$4.26	\$8.64
High CWF cost scenario	\$10.63	\$2.29
Amalgam dental restoration scenario	\$38.20	\$18.27

CWF = community water fluoridation.
 Note: Negative value indicates cost savings.
^a Discounting have not been applied to these costs.