

# Preventing Dental Caries: Community Water Fluoridation

## Summary Evidence Tables - Economic Review

Study Characteristics Monetary conversion	Location Population Characteristics Time Horizon	Intervention Description	Effectiveness	Program Costs	Healthcare Costs Averted Productivity Losses Averted	Economic Summary Measure
<p><b>Author (Year):</b> O'Connell et.al (2005)</p> <p><b>Study Design:</b> Comparison control</p> <p><b>Economic Method:</b> Cost-benefit analysis</p> <p><b>Monetary conversion:</b> CPI ratio of year 2013 against year 2003 is 1.266.</p> <p><b>Discount rate:</b> 3%</p>	<p><b>Location:</b> Colorado, U.S.</p> <p><b>Population Characteristics:</b> Out of 172 public water systems in Colorado that served populations of 1000 individuals or more, 61 had WF, and 111 did not. 52 of the 111 were recommended to have WF because their fluoride level was lower than the CDC recommended level. Hydrofluosilicic acid was used as fluoridation compound</p> <p><b>Time Horizon:</b> 15 years</p>	<p><b>Control group:</b> 52 communities with 769,287 population potentially served by WF</p> <p><b>Intervention group:</b> 61 communities with 2,449,674 population served by WF</p>	<p><b>Caries reduction rate:</b> 0.2</p>	<p><b>Annual cost per person:</b></p> <ul style="list-style-type: none"> <li>Population size 1000-4999: \$2.66 (or \$3.36 in 2013 dollars)</li> <li>Population size 5000-9999: \$1.44 (or \$1.82 in 2013 dollars)</li> <li>Population size 10,000-19,999: \$0.93 (or \$1.18 in 2013 dollars)</li> <li>Population size &gt;= 20,000: 0.43 (or \$0.54 in 2013 dollars)</li> </ul>	<p><b>Total annual cost averted per person:</b> \$58.05 (or \$73.50 in 2013 dollars)</p> <p>Total cost included healthcare cost and productivity loss</p>	<p><b>Benefit cost ratio:</b> 21.82 to 135, depending on the size of the water system.</p> <p><b>Net savings:</b> \$60.78 per person, or \$76.95 per person in 2013 dollars.</p> <p>CO would have additional \$46.6 million, or \$59 million in 2013 dollars, savings if the 52 water systems were installed.</p>
<p><b>Author (Year):</b> Tchouaket E et al. (2013)</p> <p><b>Study Design:</b></p>	<p><b>Location:</b> Quebec, Canada (whole province)</p>	<p><b>Intervention group:</b> 15 municipalities in Quebec</p>	<p><b>Caries reduction rate:</b> from 1% to 50% hypothetically.</p>	<p><b>Annual cost per person:</b></p> <ul style="list-style-type: none"> <li>Population size of the community was not given, but the total</li> </ul>	<p><b>Total annual savings averted per person:</b></p> <ul style="list-style-type: none"> <li>\$106.42 (or \$93.19 in 2013\$) for 20% caries reduction rate</li> </ul>	<p><b>Benefit cost ratio:</b></p> <ul style="list-style-type: none"> <li>7.32 to 8.53 for 1% caries reduction rate</li> </ul>

Study Characteristics Monetary conversion	Location Population Characteristics Time Horizon	Intervention Description	Effectiveness	Program Costs	Healthcare Costs Averted Productivity Losses Averted	Economic Summary Measure
<p>Comparison control</p> <p><b>Economic Method:</b> Cost benefit</p> <p><b>Monetary conversion:</b> PPP is 1.22 for year 2010.</p> <p>CPI ratio of year 2013 against 2010 is 1.07.</p> <p><b>Discount rate:</b> 3%</p>	<p><b>Population characteristics:</b> 15 municipalities in Quebec between 2002 and 2010.</p> <p>Only 2.7% of the population in Quebec had access to voluntarily fluoridated water in 2010.</p> <p>The population with at least one cavity ranged from 38.9% to 96%, depending on age.</p> <p><b>Time Horizon:</b> 20 years</p>	<p><b>Control group:</b> none</p>	<p>30% assumption was used by the author. 20% assumption was reported in this review.</p>	<p>population of 7,907,375 was given.</p> <ul style="list-style-type: none"> <li>The average per capita cost at 3% discount rate, given 30% effectiveness assumption was \$1.93 (\$1.69 2013 U.S dollars)</li> <li>The average per capita cost at 3% discount rate, given 20% effectiveness assumption was \$1.86 (\$1.63 2013 U.S dollars)</li> </ul>	<ul style="list-style-type: none"> <li>\$159.62 (or \$139.78 in 2013\$) for 30% caries reduction rate</li> </ul> <p><b>Treatment cost per person:</b> Per person (2010) dental expense is \$532.08, \$532.87 and \$534.05 for discount rates of 3, 5, 8%. (or \$465.93, \$466.63 and \$467.66 in 2013 U.S. dollars).</p> <p><b>Loss of productivity per person:</b> based on the min wage rate of \$9.65 (\$8.45 in 2013 U.S dollars).</p> <p><b>Transportation cost per person:</b> \$2.9 (or, \$2.54 in 2013 U.S dollars) for patients under 14; and \$5.8 (or, \$5.08 in 2013 U.S dollars) for those over 14.</p>	<ul style="list-style-type: none"> <li>115 to 134.07 for 50% caries reduction rate</li> <li>75.29 to 514.9 for 30% caries reduction rate</li> <li>57.21 to 49.07 for 20% caries reduction rate</li> </ul>
<p><b>Author (Year):</b> Wright et al. (2001)</p> <p><b>Study Design:</b> Comparison control</p> <p><b>Economic Method:</b> Cost-benefit</p>	<p><b>Location:</b> New Zealand.</p> <p><b>Population characteristics:</b> By 1999, 57% of New Zealand were Fluoridated area. The study was to check if WF is still cost saving in the</p>	<p><b>Intervention group:</b> Children living in fluoridated areas from 4 to 13 year old.</p> <p><b>Control group:</b> Children living in non-fluoridated areas from 4 to 13 year old.</p>	<p><b>Caries reduction rate:</b> 33% caries reduction rate assuming 15% Maori population</p>	<p><b>Annual cost<sup>a</sup> per person:</b></p> <ul style="list-style-type: none"> <li>Population size 1,000: \$5.2 (or \$4.92 in 2013\$)</li> <li>Population size 5,000: \$1.12 (or \$1.06 in 2013\$)</li> <li>Population size 10,000: \$0.61 (or \$0.58 in 2013\$)</li> </ul>	<p><b>Healthcare cost averted per person:</b> \$5.8<sup>b</sup> (\$5.49 in 2013 U.S dollars)</p> <p><sup>b</sup> By Dividing total healthcare cost averted by 30 years.</p>	<p><b>Benefit cost ratio:</b></p> <ul style="list-style-type: none"> <li>Population size 1,000: 1.12</li> <li>Population size 5,000: 5.18</li> <li>Population size 10,000: 9.51</li> <li>Population size 50,000: 27.88</li> </ul>

Study Characteristics Monetary conversion	Location Population Characteristics Time Horizon	Intervention Description	Effectiveness	Program Costs	Healthcare Costs Averted Productivity Losses Averted	Economic Summary Measure
<p><b>Monetary conversion:</b> PPP is 1.43 for year 1999.</p> <p>CPI ratio of year 2013 against 1999 is 1.398.</p> <p><b>Discount rate:</b> 5%</p>	<p>years of 2000 to 2030. The assumptions of the population were: No new averted decay after age 34. No dental cost savings after age 45. From 2000 to 2030 there is no mortality in the birth cohorts receiving fluoridated water. Out-migration in the cohort is exactly counterbalanced by immigration.</p> <p><b>Time Horizon:</b> 30 years</p>			<ul style="list-style-type: none"> <li>Population size 50,000: \$0.21 (or \$0.2 in 2013\$)</li> <li>Population size 100,000: \$0.154 (or \$0.15 in 2013\$)</li> <li>Population size 300,000: \$0.12 (or \$0.11 in 2013\$)</li> </ul> <p><sup>a</sup> By Dividing intervention cost by 30 years.</p>		<ul style="list-style-type: none"> <li>Population size 100,000: 37.66</li> <li>Population size 300,000: 48.79</li> </ul>
<p><b>Author (Year):</b> Cobiac et al. (2012)</p> <p><b>Study Design:</b> Comparison control</p> <p><b>Economic Method:</b> Cost effectiveness/ Cost benefit</p>	<p><b>Location:</b> Australia</p> <p><b>Sample:</b> 69% of the population in Australia was receiving the minimum recommended dose of WF. The study analyzes the possibility of extending WF to</p>	<p><b>Intervention group:</b> fluoridated area</p>	<p><b>Caries reduction rate:</b> 15%</p>	<p><b>Annual cost per person:</b></p> <ul style="list-style-type: none"> <li>Population size &gt;1,000: \$0.26 (or \$0.24 in 2013 US dollars);</li> <li>Rural area: \$26 (or \$24.38 in 2013 US dollars).</li> </ul>	<p><b>Cost effectiveness:</b> For \$13 million cost (or \$18.7 million in 2013 dollars), DALY averted was 26,000 (communities with larger than 1,000 population).</p> <p><b>Healthcare cost total per year:</b> \$490 million (or \$704.97 million in US dollars)</p>	<p><b>Benefit Cost ratio:</b> 37.69 (calculated by dividing the total benefit by total cost).</p> <p><b>Cost/DALY:</b> \$719.23</p>

Study Characteristics Monetary conversion	Location Population Characteristics Time Horizon	Intervention Description	Effectiveness	Program Costs	Healthcare Costs Averted Productivity Losses Averted	Economic Summary Measure
<p><b>Monetary Conversion:</b> the PPP for year 2003 is 1.35; the CPI ratio of year 2013 against 2003 is 1.266.</p> <p><b>Discount rate:</b> 3%</p>	<p>all communities with over 1000 people (89% of the population), also analyzed the possibility of extending it to 100% population</p> <p><b>Time Horizon:</b> 15 years</p>					
<p><b>Author (Year):</b> Griffin et al. (2001)</p> <p><b>Study Design:</b> Simulation study</p> <p><b>Economic Method:</b> Cost benefit</p> <p><b>Monetary Conversion:</b> The CPI ratio of year 2013 against 1995 is 1.529.</p> <p><b>Discount rate:</b> 4%</p>	<p><b>Location:</b> U.S</p> <p><b>Population Characteristics:</b> 18,507 respondents of National Survey of Oral Health in U.S. School Children: 1986-1987, or 47% of all children age 6-17 years who had at least one permanent tooth and for whom a complete fluoride exposure history could be created.</p> <p><b>Time Horizon:</b> 15 years</p>	<p>Simulation study, data are from publications and national surveys.</p>	<p><b>Caries reduction rate:</b> ranged from 4% to 34%, with 19% being the baseline</p>	<p><b>Annual cost per person:</b></p> <ul style="list-style-type: none"> <li>Population size &lt;5,000: \$3.17 (or \$4.85 in 2013\$)</li> <li>Population size 5,000-9,999: \$1.64 (or \$2.51 in 2013\$)</li> <li>Population size 10,000-20,000: \$1.06 (or \$1.62 in 2013\$)</li> <li>Population size &gt;20,000: \$0.5 (or \$0.76 in 2013\$)</li> </ul>	<p><b>Healthcare cost averted per person:</b></p> <ul style="list-style-type: none"> <li>Worst-case of 4% caries reduction and 8% discount rate: \$2.99 (or \$4.57 in 2013 dollars)</li> <li>Best-case of 34% caries reduction and 0% discount rate: \$56.07 (or \$85.71 in 2013 dollars)</li> <li>Best-case of 19% caries reduction and 4% discount rate: \$19.12 (or \$29.23 in 2013 dollars)</li> </ul>	<p><b>Benefit Cost ratio:</b></p> <p>For baseline case:</p> <ul style="list-style-type: none"> <li>Population size &lt;5,000: 6.03</li> <li>Population size 5,000-9,999: 11.66</li> <li>Population size 10,000-20,000: 18.04</li> <li>Population size &gt;20,000: 38.24</li> </ul>
<p><b>Author (Year):</b> Ciketic et al. (2010)</p>	<p><b>Location:</b> Brisbane and South East</p>	<p><b>Intervention group:</b> fluoridated town of Townsville</p>	<p><b>Caries reduction</b></p>	<p><b>Total intervention cost:</b> \$35.97 million with</p>	<p><b>Total intervention benefit:</b></p>	<p><b>Benefit-Cost ratio:</b> 17.51 (calculated from total)</p>

Study Characteristics Monetary conversion	Location Population Characteristics Time Horizon	Intervention Description	Effectiveness	Program Costs	Healthcare Costs Averted Productivity Losses Averted	Economic Summary Measure
<p><b>Study Design:</b> Comparison control</p> <p><b>Economic Method:</b> Cost effectiveness /benefit</p> <p><b>Monetary Conversion:</b> The PPP for year 2002 is 1.34. The CPI ratio of year 2013 against 2002 is 1.29.</p> <p><b>Discount rate:</b> 3%</p>	<p>Queensland, Australia;</p> <p><b>Population characteristics:</b> The population of South East Queensland region was 2.86 million.</p> <p>Brisbane was until the paper was written the only capital in Australia with a large population that was experiencing the highest rate of tooth decay in the whole nation due to non-fluoridated water supplies.</p> <p><b>Time Horizon:</b> 15 years</p>	<p><b>Control group:</b> non-fluoridated town of Brisbane</p>	<p><b>rate:</b> not available</p>	<p>(or \$34.76 million in 2013 U.S dollars)</p> <p>Per capita annual cost: \$0.84 (or \$0.81 in 2013 U.S dollars), assuming population size of 2.86 million</p>	<p>\$630 million (or \$608.81 million in 2013 U.S dollars)</p> <p>Per capita annual benefit: \$14.68 (or \$14.19 in 2013 U.S dollars), assuming population size of 2.86 million</p> <p>The DALY saved is 10,437</p>	<p>benefit divided by total cost)</p> <p><b>ICER (incremental cost-effectiveness ratio):</b> \$3608/DALY (\$3486.63/DALY in 2013 U.S dollars) without cost offsets.</p>
<p><b>Author (Year):</b> Maupome et al. (2007)</p> <p><b>Study Design:</b> cross-sectional</p>	<p><b>Location:</b> U.S.</p> <p><b>Sample:</b> HMO members with continuous dental eligibility (Jan 1, 1990 to Dec 31, 1995) who</p>	<p>Three models were run with three dependent variables: cost, proportions of members with one or more restorative procedures, counts</p>	<p>NA</p>	<p><b>Per capita annual cost:</b> \$0.67 in 1989 (or \$1.024 in 2013 U.S dollars) and ranged from \$0.15 to \$1.53 in 1995 dollars (or \$0.23 to \$2.34 in 2013 dollars).</p>	<p>“Taking into consideration the varying impact of age and locale, it seems reasonable to conclude that, as a general rule, costs were lower in the fluoride areas.”</p>	<p>“In conclusion, we found evidence that WF was associated with reduced total and restorative cost among members with one or more dental visits, particularly in older adults. The effect we observed was generally small, likely</p>

Study Characteristics Monetary conversion	Location Population Characteristics Time Horizon	Intervention Description	Effectiveness	Program Costs	Healthcare Costs Averted Productivity Losses Averted	Economic Summary Measure
<p><b>Economic Method:</b> Multi-linear regression, Analysis of covariance</p> <p><b>Monetary conversion:</b> The CPI ratio of year 2013 against 1995 is 1.529.</p>	<p>resided in Oregon and Washington.</p> <p><b>Population Characteristics:</b> 85% of eligible members (n=51683) were classified as residing either in a fluoridated (n=12194) or non-fluoridated (n=39489) area.</p> <p>Mean age was 40; 52.3% were women.</p>	<p>of number of procedures or visits.</p>				<p>because of this insured population’s access to care and the higher use of preventive procedures, in particular supplemental fluorides, in the NF areas.”</p>
<p><b>Author (Year):</b> TX health department (2000)</p> <p><b>Study Design:</b> Cross-sectional</p> <p><b>Economic Method:</b> Regression</p> <p><b>Monetary conversion:</b> The CPI ratio of year 2013 against 1999 is 1.398.</p>	<p><b>Location:</b> Texas, U.S.</p> <p><b>Sample:</b> 254 TX counties:</p> <ul style="list-style-type: none"> <li>• 253 had incurred Medicaid dental costs and were used in the analysis</li> <li>• 86 had optimal public WF level</li> <li>• 167 had &lt;= 0.8 ppm</li> </ul>	<p>The study assessed the impact of one public program for prevention of tooth decay, WF, on another program, Medicaid, which provides publicly funded dental care for a group known to be at greater risk for disease.</p>	<p>NA</p>	<p>The estimated cost of installing water fluoridation system in four counties ranges from \$.71 (\$0.99 in 2013 dollar) to \$1.9 (\$2.66 in 2013 dollar) per person for one year and would cost under \$.35 (\$0.49 in 2013 dollar) per person to maintain.</p>	<p>Using regression analysis by regressing cost on the log of WF level and the squared term of it.</p> <p>For a unit rise of 1 ppm Fluoride, the average TX dental treatment cost per child across the entire state falls by \$24 (\$33.56 in 2013 dollar)</p>	<p>Adjustment from a very low natural level to .8 ppm F will lower the average cost of dental treatment by \$19 (or \$26.57 in 2013 dollar) per child.</p> <p>Conclusion: about 70% of the TX population can benefit from adjusted WF.</p>

Study Characteristics Monetary conversion	Location Population Characteristics Time Horizon	Intervention Description	Effectiveness	Program Costs	Healthcare Costs Averted Productivity Losses Averted	Economic Summary Measure
<p><b>Author (Year):</b> CDC (1999)</p> <p><b>Study Design:</b> Cross-sectional</p> <p><b>Economic Method:</b> Linear regression</p> <p><b>Monetary conversion:</b> The CPI ratio for year 2013 against 1995 is 1.529</p>	<p><b>Location:</b> Louisiana; 19 parishes out of 64</p> <p><b>Sample:</b> 5 fluoridated parishes with 38,162 Medicaid-eligible preschoolers and 14 non-fluoridated parishes with 16,444 Medicaid-eligible preschoolers</p> <p><b>Time Horizon:</b> 1995-1996</p>	<p>Linear regression was used to regress parish average caries-related cost per Medicaid-eligible child on fluoridation status of the parish, per capita income, population, and dentist per 1000 residents.</p>	<p>NA</p>	<p>NA</p>	<p>The difference in treatment costs per Medical-eligible child in Fluoridated parishes compared to those residing in Non-fluoridated parishes ranged from \$14.68 (or \$22.44 in 2013 dollar) for 1-year-old to \$58.91 (or \$90.05 in 2013 dollar) for 3-year-old. The mean difference regardless of age is \$36.28, (or \$55.46 in 2013 dollars).</p>	<p>In 1998, at least 39,000 preschoolers could potentially benefit from water fluoridation, with the expected annual reduction in dental costs of \$1.4 million (or \$2.14 million in 2013 dollar).</p>
<p><b>Author (Year):</b> Kumar et al. (2010)</p> <p><b>Study Design:</b> Cross-sectional</p> <p><b>Economic Method:</b> Scatterplots, linear regression</p> <p><b>Monetary Conversion:</b> The CPI ratio of year 2013 against 2006 is 1.16</p>	<p><b>Location:</b> New York; 57 counties and NYC</p> <p><b>Sample:</b> 606,125 children under 21 years old who had at least one claim for a dental procedure.</p>	<p>WF is measured as the percentage of people receiving fluoridated water in each county determined by dividing the number of residents on fluoridated water by the total population from the 2007 U.S census data. Three strata: less fluoridated (&lt;=30%), partially</p>	<p>NA</p>	<p>NA</p>	<p>The regression analysis shows that for every 10% increase in the fluoridation status of the county, the number of claims per child for caries-related services declined by 0.06.</p>	<p>A single claim for a simple restoration costs \$55 (\$63.55 in 2013 dollar). So the difference between less fluoridated county and predominantly fluoridated counties as for per recipient costs on simple restoration is <math>(1.66 - 1.23) * \\$55 = \\$23.63</math> (\$27.31 in 2013 dollar).</p>

Study Characteristics Monetary conversion	Location Population Characteristics Time Horizon	Intervention Description	Effectiveness	Program Costs	Healthcare Costs Averted Productivity Losses Averted	Economic Summary Measure
		fluoridated (31% - 69%), and predominantly fluoridated (>=70%).				

**Abbreviations:**

CPI, Consumer Price Index  
 DALY, Disability-Adjusted Life Year  
 NA, Not applicable  
 PPP, Purchasing Power Parity  
 WF, Water fluoridation