The benefits and costs of water fluoridation - a summary for DHBs

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1. Summary

1.1 Introduction and purpose

The Ministry of Health commissioned us to provide an evaluation of the benefits and costs of water fluoridation in New Zealand in 2015. Since that analysis was concluded the Minister of Health has proposed transferring decision making powers for fluoridating public water supplies away from District Councils to District Health Boards (DHBs).

District Health Boards under the New Zealand Public Health and Disability Act 2000 are required to "improve, promote, and protect the health of people and communities"[1] and as such they are responsible for their population's oral health. The evidence has shown that children with access to fluoridated water experience 40 per cent reduction in dental decay[2], while adults experience 20-30 per cent reduction in dental decay[3]. There has been little increase in the population coverage of water fluoridation in the last 15 years.

The decision to keep or start water fluoridation is equally important; there are significant health gains from both continuing and starting water fluoridation. Dental decay accounts for approximately one per cent of all health loss in New Zealand due to early death, illness or disability[4]. The 'burden' of the disease from dental decay is a similar magnitude to other diseases that attract significant public interest.

District Health Boards are also already responsible for ensuring the public has access to safe drinking water. Transferring responsibility for the fluoridation of water to them aligns with this responsibility, allows them to consider the health related evidence for their districts, and aligns responsibility for the positive or negative effects of fluoride into their overall responsibility for their population. The cost of maintaining public water supplies including fluoridation remains with Councils, however the decision and any associated costs with making the decision will sit with the DHBs.

The purpose of this document is to provide a DHB-level analysis of the results of our report – 'Review of the benefits and costs of water fluoridation in New Zealand' (2015). That report was a national level analysis. This report applies our results to aggregated Council data to provide indicative DHB-level results. We recommend the analysis be further refined at the DHB level before being used in decision making.

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1 http://www.legislation.govt.nz/act/public/2000/0091/latest/DLM80807.html

2 P.13 (Moore & Poynton, 2015).

3 P.19 (Moore & Poynton, 2015).

4 Ministry of Health. 2013. Health loss in New Zealand: a report from the New Zealand burden of diseases, injuries and risk factors study, 2006–2016. Wellington: Ministry of Health.

1.2 Context

1.2.1 Fluoridation in New Zealand

Water fluoridation involves the controlled addition of fluoride to a public drinking supply in order to improve oral health.[5] Fluoride occurs naturally in water but at a rate of 0.2 parts per million, New Zealand's naturally occurring levels of fluoride are low compared to other countries. The optimum level of fluoridation is between 0.7 and 1.0 parts per million according to Ministry of Health recommendations.

Fluoridation began in New Zealand in 1954 and expanded rapidly in the 1960s. Currently, public supply of drinking water covers 3.8 million New Zealanders, or approximately 85 per cent of the current population. Approximately 56 per cent of people on public drinking water supply receive fluoridated water. This contrasts with Australia where currently over 90 per cent of the population receives fluoridated drinking water.

The cities of Auckland, Wellington and Dunedin comprise the greatest population coverage of water fluoridation. Currently, 39[6] of 66 councils do not adjust the fluoride level in their water supplies. As a means of promoting the practice, the Ministry of Health had a subsidy to assist Councils with the capital costs associated with setting up fluoridation infrastructure.

1.2.2 Oral health in New Zealand

Oral disease is more important than generally realised. Millions of school and work hours are lost to it globally.[7] The World Health Organization states that it is the fourth most expensive disease category.[8]

The New Zealand Oral Health Survey 2009 (NZOHS) found a considerable improvement over the past 20-30 years.[9] However, it also found that New Zealand continues to have a comparatively high rate of tooth decay.

Additionally, oral disease is a significant issue of health equity. The 2009 NZOHS found that although oral health in adults has continued to improve over the last three decades, Maori, Pacific peoples and people living in high deprivation areas experience worse oral health outcomes.

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5 Fluoride promotes oral health by decreasing de-mineralisation; increasing re-mineralisation in early cavities and inhibiting the process that metabolises sugar to produce acid (the cause of dental decay).

6 We include three district councils fluoridating less than 10 per cent of their supply.

7 Kandelman D, Petersen PE, Ueda H. Oral health, general health, and quality of life in older people. Special Care in Dentistry. 2008;28(6):224–36; and Hyde S, Satariano WA, Weintraub JA. Welfare dental intervention improves employment and quality of life. J Dent Res. 2006;85(1):79–84.

8 Petersen PE. World Health Organisation global policy for improvement of oral health – World Health Assembly 2007. International Dental Journal. 2008;58:115–21.

9 Ministry of Health. Our Oral Health – Key Findings of the 2009 New Zealand Oral Health Survey. Wellington (New Zealand): Ministry of Health; 2010.

1.2.3 Drinking water regulation

DHBs through their public health units are already responsible for ensuring that the public have access to safe drinking water. This is through surveillance monitoring of public water supplies, and assessing compliance with the Health (Drinking Water) Amendment Act 2007 and the New Zealand Drinking Water Standards.

1.3 Headline results of the national level cost benefit analysis of fluoridation

1.3.1 There is strong evidence for the health benefits of water fluoridation

A large body of epidemiological evidence accumulated over 60 years, including thorough systematic reviews, confirms water fluoridation prevents and reduces dental decay across the lifespan. The evidence for this benefit is found in numerous New Zealand and international studies and reports. However, the precise amount that dental decay is reduced by is difficult to estimate.

Our estimates for the health benefits of water fluoridation are as follows:

- In children and adolescents, a 40 per cent lower lifetime incidence of dental decay (on average) for those living in areas with water fluoridation. This estimate is based on the New Zealand Oral Health Survey (NZOHS).
- For adults, a 21 per cent reduction in dental decay for those aged 18 to 44 years and a 30 per cent reduction for those aged 45+ (as measured by tooth surfaces affected). This estimate is based on the Australian National Survey of Adult Oral Health (NSAOH).[10]
- 48 per cent reduction in hospital admissions for treatment of tooth decay, for children up the age of four years. This estimate is based on the findings of the Public Health England Monitoring Report 2014.

1.3.2 Significant reduction in dental decay

In our analysis, the benefits of fluoridation are represented by an estimate of the dental treatment costs averted as a result of reduced decay. Dental care benefits are made up of a combination of reduced fillings (initial and replacements), fewer tooth extractions, and a reduction in childhood hospitalisations for treatment of dental decay. We estimate water fluoridation results in 8 million fewer teeth affected by decay, which is an average of 2 per person over 20 years. This represents a 22 per cent reduction in the number of teeth affected by decay, combined across the total population. We also assumed a 30 per cent reduction in decayed tooth surfaces. Our estimates of dental care costs are conservative meaning that the benefits are likely larger than estimated.

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[10] We selected this study rather than the 2009 NZOHS findings for adults because, unlike the 2009 NZOHS, the Australian study took into account lifetime exposure to water fluoridation.

1.3.3 Fluoridation is materially cost-saving

We estimate that fluoridation results in a net saving of over $1.4 billion over 20 years (discounted at a rate of 3.5 per cent p.a.). This estimate is made up of a cost of fluoridation of $177 million and cost offsets of $1,578 million from reduced dental decay. This net saving is based on providing water fluoridation to plants supplying populations over 500. At an individual level, the net saving of water fluoridation is $334 per person, made up of $42 for the cost of fluoridation and $376 savings in reduced dental care.

Our results demonstrate that fluoridation is a health intervention which provides improved health outcomes for a net saving. This is a rare result among health interventions which generally require a net increase in spending in order to achieve improved health outcomes. This positive result is robust to significant changes in assumptions.

The investment in fluoridation made by district councils ($177m) results in savings at a rate of $9 dollars per dollar invested. The majority of the savings ($1,428m) are from reduced dental costs for adults; these savings represent the avoided costs of fillings and extractions. There are also savings to the health budget ($149m) from reduced dental care costs for children; these savings represent avoided dental procedures and some reduction in hospital admissions. Table 1 below shows where the costs and savings fall.

Table 1 Net costs by provider: 20-year time horizon

Stakeholder	Cost*	Saving*	Net cost
Health budget		-$149m	-$149m
District council	$177m		$177m
Private		-$1,428m	-$1,428m
Total	$177m	-$1,578m	-$1,401m

*Over 20 years, discounted at a rate of 3.5 per cent p.a.

1.3.4 Fluoridation provides material quality of life benefits

We estimate provision of fluoridated water to all of New Zealand reticulated water supplies over 20 years would result in between 8,800 and 13,700 quality adjusted life years (QALYs) gained. At an individual level, the average health benefit per person due to a reduction in dental decay is expected to be between 0.002 and 0.003 QALYs (discounted, i.e. approximately equivalent to an additional 1 to 1.5 days of life at full quality of life). In comparison to almost all other health spending, these quality benefits are from a cost-saving intervention rather than being paid for.

1.3.5 Fluoridation is likely to have a positive effect on disparities in oral health

Equally important in health interventions to overall efficiency of the intervention are the distributional effects. There is strong evidence water fluoridation reduces dental decay regardless of ethnicity, socioeconomic status and age. We expect the relative impact of water fluoridation is the same across ethnic groups and deprivation. Because of the greater prevalence of dental decay among Maori and those who are most deprived, we expect these groups to have a greater absolute benefit from water fluoridation.

2. DHB level analysis of the benefits and costs of fluoridation

In response to the transfer of decision making powers away from District Councils to DHBs, we have extended our original analysis to provide indicative benefit and costs estimates of water fluoridation at a DHB level.

The DHB level results are derived from aggregated Council data. The method used to aggregate Councils to DHB level is outlined in Appendix 1. We did not look at the overall costs and benefits of treating water, but rather the incremental costs and benefits of adding fluoride to existing water treatment plants. We recommend the analysis is further refined at the DHB level before being used in any decision making.

We limited our analysis to water treatment plants serving populations of 500 or more as our analysis demonstrates that this is the plant size at which water fluoridation becomes cost-effective.[11]

2.1 Current status of water fluoridation at the DHB level

14 out of 20 DHBs currently add fluoride to their water supplies at varying levels. Public water supply covers approximately 3.8 million New Zealanders, of which 56 per cent receive fluoridated water.

Figure 1 maps the current water fluoridation status for each DHB. The map is colour coded by the proportion of the population with fluoride added to their reticulated water supply. DHBs shaded green are those with less than 10 per cent of their population supplied fluoridated water; yellow depicts DHBs with more than 70 per cent of their population supplied fluoridated water, and DHBs with between 10 per cent and 70 per cent water fluoridation coverage are shaded orange.

Note: several DHBs share a similar water supply system, restricting their ability to make autonomous decisions regarding water fluoridation. For the purpose of this analysis, we combined the data for the following DHBs:

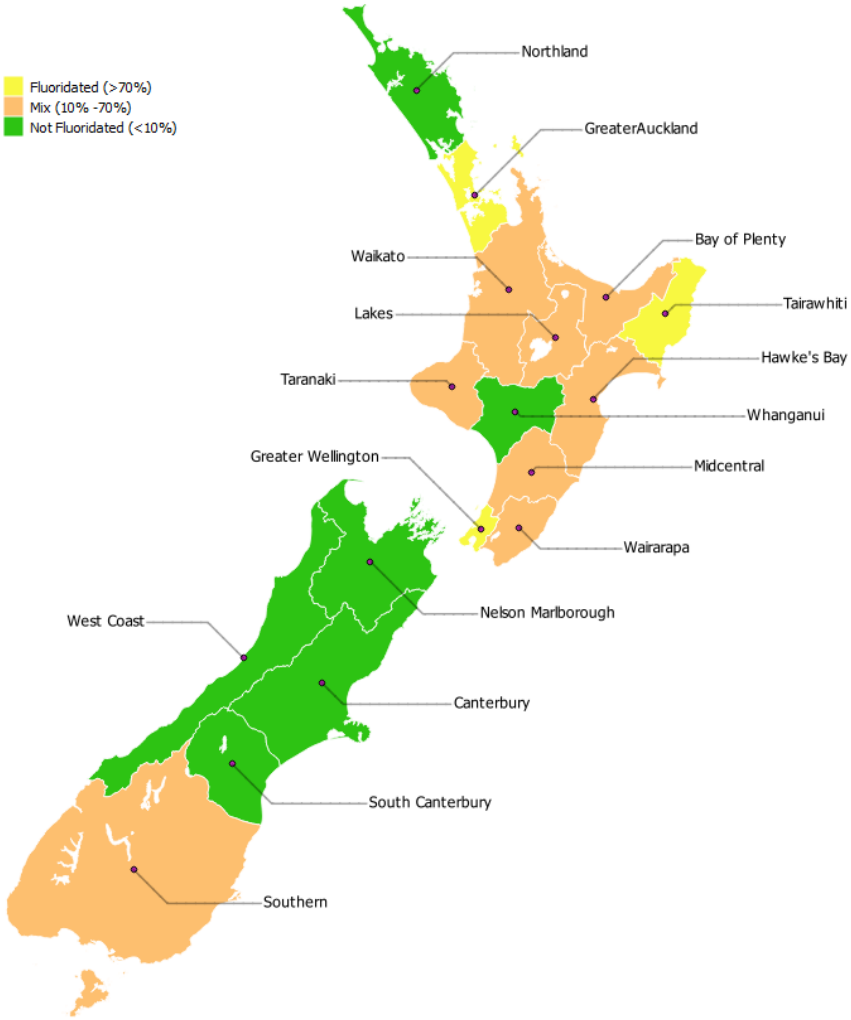
- Greater Auckland:
    - (i) Auckland DHB.
    - (ii) Waitemata DHB.
    - (iii) Counties Manukau DHB.

[11] Only a very small proportion of New Zealand's population are supplied water through these small plants, and as such, the loss of potential gains from adding fluoride to those supplies is limited due to the small number of people they serve. However, there would be a significant additional cost of adding fluoride to these water treatment plants due to the small volume of water supplied.

- Greater Wellington
    (i) Capital and Coast DHB.
    (ii) Hutt Valley DHB.

This aggregation is reflected in Figure 1 below.

Figure 1 Water fluoridation status at DHB level, as of January 2014



Source: Data supplied by the Institute of Environmental Science and Research; figure created by Sapere

2.2 Methods for estimating the impacts at a DHB level

Below are the key assumptions used when we estimated the DHB estimates from our national level analysis. Further details are in Appendix 1.

The DHB estimates were adjusted for the following:

- Number of water plants and plant size (including type of fluoride used and amount of water used).
- Population with reticulated water.

DHB estimates were not adjusted (i.e. they use the national average) for:

- Population growth (assumes national growth rate of 1 per cent and same age distribution).
- Amount of dental decay with and without water fluoridation.
- Ethnic mix.
- Cost of dental treatment.
- Cost of fluoride (some councils may negotiate different prices, will depend on size).

Water fluoridation is likely to remain cost-saving for each and every DHB after adjusting for regional variation in these factors because of the extent of the gains.

Predicting the interplay of these factors precisely would be difficult. For instance water fluoridation is likely to be more cost-effective in DHBs with a relatively high proportion of Maori compared with the estimates in this report. Maori tend to have higher levels of dental decay which means both the health benefits and cost-savings are likely to be greater. However, the cost of dental services in these DHB's may be lower which may reduce savings.

2.3 Implications of water fluoridation for DHBs

Table 2 below illustrates DHB-level results presented for the following categories:

- **Cost of fluoridation** – this represents the costs of fluoridating all public water supplies serving population of at least 500, within the DHB boundaries. The costs are estimated over 20 years, discounted at a rate of 3.5 per cent.
- **Cost per person per annum** – this is the cost of fluoridation per person per annum.
- **Reduction in dental costs** – expected total cost savings (averted dental care costs) for people receiving fluoridated water.
- **Net savings** – costs of fluoridation minus costs averted (benefits).
- **Net QALYs** – the additional QALYs gained from fluoridation (i.e. QALYs with fluoridation minus QALYs without fluoridation.

Results are reported as a range due to the uncertainty of the DHB estimates. For the DHBs where fluoride is currently added, the QALY gains and savings represent what would be forgone if fluoridation was stopped; whereas for DHBs where fluoride is not currently added, the QALY gains and savings represent the benefit of adding fluoride (details regarding current fluoridation coverage is in Table 3 in Appendix 1).

Table 2 Benefits and costs of fluoridation by DHB: 20 year time horizon, providing water fluoridation to plants supplying populations over 500

District Health Board[12]	Cost per person p.a.	Cost of Fluoridation ($ million)	Cost saving dental decay ($ millions)	Net saving ($ millions)	Net QALYs
Greater Auckland[13]	$0.4 - $1.2	$9 - $27	$282 - $845	$254 -$8,356	1,571 - 7,336
Bay of Plenty	$1.4 - $4.2	$4 - $13	$36 - $109	$23 - $105	203 - 948
Canterbury	$1.7 - $5.0	$15 - $46	$106 - $318	$60 - $303	592 - 2,764
Greater Wellington[14]	$0.6 - $1.9	$4 - $12	$80 - $241	$68 - $237	448 - 2092
Hawkes Bay	$2.6 - $7.9	$6 - $17	$26 - $78	$9 - $72	145 - 676
Lakes	$2.0 - $5.9	$4 - $11	$21 - $62	$10 - $59	116 - 540
Mid Central	$1.8 - $5.3	$4 - $12	$28 - $84	$16 - $80	157 - 731
Nelson Marlborough	$2.8 - $8.4	$5 - $14	$20 - $61	$6 - $57	114 - 532
Northland	$2.2 - $6.5	$4 - $11	$19 - $58	$8 - $54	107 - 500
South Canterbury	$3.2 - $9.6	$3 - $9	$10 - $31	$2 - $28	57 - 268
Southern	$2.5 - $7.4	$12 -$35	$55 - $166	$20 - $154	308 - 1,436
Tairawhiti	$1.2 - $3.7	$1 - $2	$6 - $19	$5 - $18	35 - 165
Taranaki	$1.6 - $4.7	$3 - $8	$19 - $56	$11 - $54	104 - 487
Waikato	$2 - $6.0	$10 - $29	$57 - $169	$27 - $160	315 - 1,470
Wairarapa	$3.3 - $9.8	$2 - $6	$7 - $21	$1 - $19	39 - 183
West Coast	$2.9 - $8.6	$1 - $3	$4 - $13	$1 - $12	25 - 115
Whanganui	$2.5 - $7.6	$3 - $8	$13 - $38	$4 - $35	70 - 326
ALL NZ	**$2.1 - $3.1**	**$141 - $212**	**$1,264 - $1,895**	**$1,052 - $1,754**	**4,404 - 20,571**

[12] Some DHBs have been merged for the purpose of this analysis. A full explanation of the method used to construct this table of results can be found at Appendix 1.

[13] Greater Auckland includes Auckland, Waitemata and Counties Manukau District Health Boards.

[14] Greater Wellington includes Capital and Coast and Hutt Valley District Health Boards.

2.3.1 Fluoridation is cost-saving at the DHB level

Fluoridation is cost-saving in all DHBs when adding fluoridation to treatment plants serving populations of more than 500 people. Over 20 years, we estimate the range in net savings (measured at the mid-point) for all DHBs to be between $6.6m and $545m. The national average net savings is approximately between $30.9m-$134.2m.

Unlike a number of health interventions that require a net increase in spending to achieve improved health outcomes, fluoridation provides net savings while improving health outcomes.

2.3.2 Potential benefits will be greater for DHBs with low levels of fluoridation

The above results consider the benefits and costs from fluoridating all water treatment plants serving populations more than 500. As such, the status quo of water fluoridation is important to consider when interpreting the results above because it influences the extent to which the calculated benefits are already being realised and the potential marginal gains from extending fluoridation coverage.

DHBs currently with low levels of fluoridation may gain most or all of the estimated benefits from fluoridating their reticulated water supplies. Conversely, a large proportion of these benefits are already being obtained by DHBs with high levels of fluoridation, and as such, the scope for increasing the derived benefits from fluoridating is more limited. For these DHBs, it may be more useful to consider the estimated benefits as a potential cost if water fluoridation ceased.

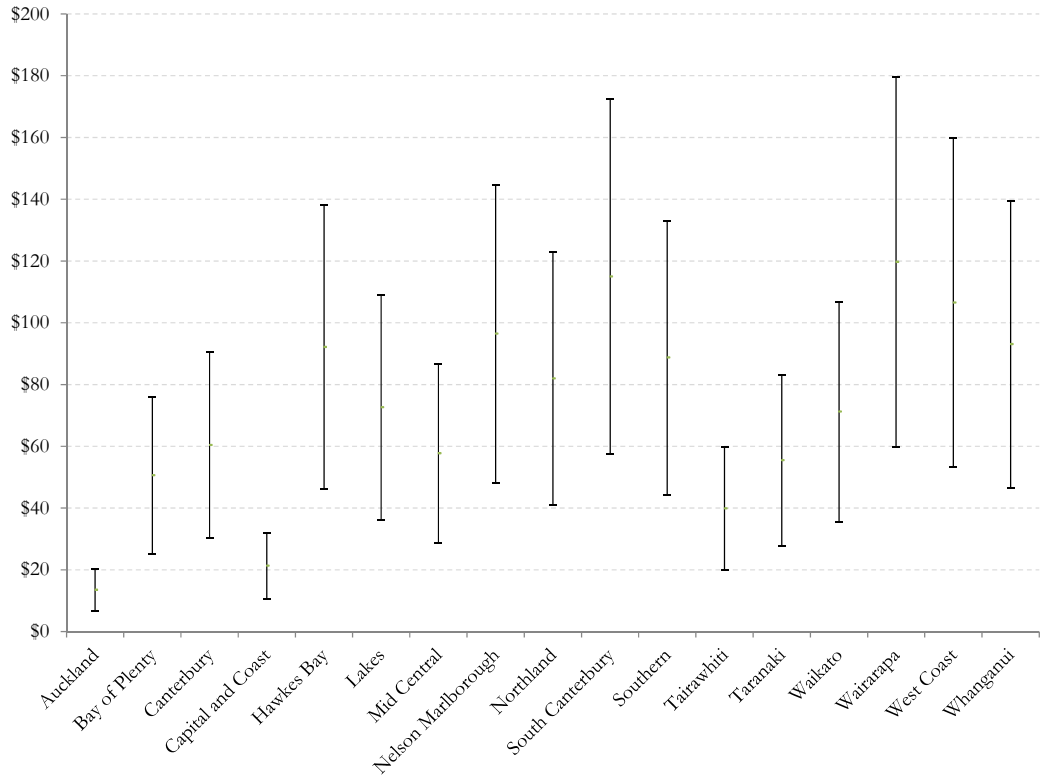
2.3.3 Costs of fluoridation per person varies significantly by DHB

Despite being a cost-saving intervention for all DHBs, the cost of fluoridating per person varies considerably between DHBs. Figure 2 plots the estimated range in costs of fluoridation per person for each DHB.

The cost of fluoridating water supplies is made up of capital, maintenance and fluoride costs. The cost structure differs by plant size, with small plants having higher capital costs relative to supply volume and using a more expensive chemical.

The average cost per person is much lower for area supplied by large water treatment plants. As shown in Figure 2 below, Auckland has the lowest estimated average cost per person which is due a number of very large water treatment plants servicing the area. Wairarapa has the highest estimated average cost per person due to a number of smaller plants servicing the area (although it does have one large treatment plant).

Figure 2 Average costs of fluoridation per person by DHB – discounted over 20 years



2.3.4 Net savings per person are largely similar for DHBs

The net savings per person are similar for each DHB. Cost savings from dental decay are estimated to be proportional to the size of population served by the water treatment plants. Further, across New Zealand the savings outweigh the costs by a factor of nine resulting in a similar net cost per person across DHB's.

However, the observed similarity in net savings is likely to be overstated in our results. The cost of treating dental decay was based on national averages, which means the DHB level variation in dental prices are not incorporated in our estimates.

2.4 Further local analysis required

The DHB level results are affected by regional variation in both the costs and benefits of water fluoridation, some of which was beyond the scope of this analysis. The factors described below should be considered in any further analysis of local populations and the potential to benefit from the addition of fluoride.

2.4.1 Regional variation of costs

Costs depend on the number of people supplied water, amount of water used per person, number of water plants, and size of water plants. These factors are highly variable by DHB:

- Population supplied reticulated water ranges from 24,000 (West Coast DHB) to 1.5 million (Greater Auckland DHB).
- Capital Coast and South Canterbury have similar number of water plants (14-15 respectively), yet the populations with public water supply varies significantly (428,000 compared to 55,000 respectively).
- Costs per person range from 40 cents to $9.84 per year (after accounting for DHB variation and cost uncertainty). The national average ranges between $2.09 to $3.14.

2.4.2 Regional variation of benefits

The benefits of water fluoridation will depend on the number of people supplied, amount of dental decay experienced, dental care provided and local costs of dental care. Of note:

- The NZ Oral Health Survey found that dental decay is associated with particular demographic features – e.g. Maori and those living in high deprivation areas had worse dental decay. DHB demographics will affect the amount of benefit from water fluoridation.
- Private dental care costs vary significantly across the country. Areas with higher dental costs will incur greater cost offsets meaning the cost-savings from fluoridation will be greater.
- The amount of naturally occurring water fluoride influences the benefits from added fluoride. Areas with lower amounts of naturally occurring water will receive relatively greater benefits.

2.4.3 Shared decision-making across DHBs

In addition to the regional variation in costs and benefits of water fluoridation, the level of autonomous decision-making will differ across DHBs. That is, individual DHBs will need to navigate varying levels of complexity in the relationship between water treatment plants, councils and other DHBs. This relationship between council water supplies and DHB jurisdictional boundaries is described further in Appendix 1.

By way of example, below we discuss at a high level the underlying decision-making relationships for the two aggregated DHBs presented in this analysis: Greater Auckland and Greater Wellington.

These are the two most complicated cases identified resulting from the transfer of decision making powers; however, each DHB will need to consider their own relationship with councils and water treatment supplies. While benefits from fluoridation can be realised at the DHB-level, costs from fluoridation will still be derived at the council-level.

Greater Auckland

The results reported for the Greater Auckland DHB are aggregated from three individual DHBs:

- Auckland DHB.
- Waitemata DHB.
- Counties Manukau DHB.

All three individual DHBs are serviced through the Auckland Council water supply system. Six large water plants supply the bulk of water across Auckland, limiting each DHB's ability to make autonomous decisions. There is also a number of smaller water plants included in the Auckland Council supply system only servicing communities within a single DHB. To some extent, water fluoridation decisions can therefore be made by each DHB; however, the cost effectiveness of micro decisions at the plant level may vary considerably from the aggregate results.

The benefits from fluoridating water supplies are shared across three DHBs and the cost is concentrated at a single council. This is in contrast to most of the country, where a single DHB will capture the health benefits from fluoridation and a number of councils will be responsible for the costs.

Greater Wellington

The results reported for Greater Wellington are aggregated from two individual DHBs:

- Capital and Coast DHB.
- Hutt Valley DHB.

Five District Councils operate within the same jurisdictional boundaries:

- Kapiti Coast District.
- Lower Hutt City.
- Porirua City.
- Upper Hutt City.
- Wellington City.

Four District Councils – Lower Hutt, Porirua, Upper Hutt, and Wellington – are supplied water from a shared water plant. Kapiti District is supplied separately through a number of smaller water plants, but still mostly shares jurisdictional boundaries with the Capital Coast DHB. Accordingly, water fluoridation decision-making will likely be collaborative and involve at least four Councils and two DHBs. "All or nothing" decisions at the DHB level will require collaboration with all five Councils.

Appendix 1 Method

Generating DHB level data

DHB level data was generated after considering:

- The compatibility of council and DHB jurisdictional boundaries, and
- Shared water supply systems between DHBs.

Council and DHB jurisdictional boundaries were mapped to identify any overlaps preventing a simple aggregation of the relevant Council data to the DHB level. Where we identified instances of overlapping Council jurisdictional boundaries across multiple DHBs, a judgement call was made as to which DHB the council should be assigned; these decisions are discussed in detail below.

We also considered how shared water supply systems may affect each DHB's ability to make autonomous decision regarding fluoridation of water. For simplicity, we combined DHB level data where individual fluoridation of water supplies isn't currently feasible – such that "all or nothing" decisions will need to be made collectively.

Establishing the compatibility of jurisdictional boundaries

Figure 3 below sets out each DHB's jurisdictional boundaries. Figure 4 then superimposed each Council's boundaries to establish the relationship between District Council and DHB jurisdictions. The red lines represent DHB boundaries and the white lines are the Council boundaries.

The combined Figures suggest Council boundaries fit almost seamlessly within the larger DHB boundaries. Further inspection into the data identified some minor overlaps between Council and DHB jurisdictional boundaries. Given Councils will keep responsibility for managing water supply systems, we apportioned the communities located within these overlapping boundaries to the DHB servicing the largest proportion the Council's communities.

Figure 3 Map of District Health Board boundaries

Figure 4 Map of combined District Council and District Health Board boundaries

Shared water supply between DHBs

A number of Councils share a similar water supply system, limiting their ability to make autonomous decisions regarding water fluoridisation. This limitation persists at the DHB level. Consequently, to calculate the cost effectiveness of water fluoridation at the DHB level we combined the data for DHBs sharing a water supply system.

For the purpose of this analysis, the following DHBs were merged into a single entity:

- Greater Auckland:
    (i) Auckland DHB.
    (ii) Waitemata DHB.
    (iii) Counties Manukau DHB.
- Greater Wellington:
    (i) Capital and Coast DHB.
    (ii) Hutt Valley DHB.

In total, we calculated the cost effectiveness of water fluoridation for 17 DHB groupings. Table 3 summaries the final aggregation of Councils to DHB level. In addition, we include the following information in Table 3 below:

- Water Data Quality (Estimated % data reported):
    - Where we estimate over 70 per cent of data regarding for the amount of water processed by the councils water plant is recorded we categorise it is high quality data. This increases our confidence in the cost of fluoridation.
- # of plants (minor, medium, large):
    - The size of the plants are categorised as:
        (i) Minor: serving populations 501-5,000.
        (ii) Medium: serving populations 5001-10,000.
        (iii) Large: serving more than 10,000.
- Currently fluoridated:
    - The percentage currently fluoridated is based on the proportion of water volume supplied to the DHB that has fluoride added. Earlier in the document, the proportion of fluoridation is based on the number of people accessing fluoridated water.
- Population (reticulated water supply):
    - The population is the estimated average population over 20 years. Assuming 1 per cent p.a. growth.

Table 3 Aggregating Councils to DHB for analysis

DHB	District Council	Water Data Quality (Estimated% data reported)	# of plants (minor, medium, large)[¤]	Population with fluoridated supply – at Jan 2014	Population (reticulated water supply)
Bay of Plenty	Tauranga City	High (94%)	22 (10, 9 ,3)	10%	194,000
	Western Bay of Plenty District				
	Kawerau District				
	Opotiki District				
	Whakatane District				
Canterbury	Ashburton District	High (73%)	81 (60, 7 ,14)	1%	565,000
	Christchurch City				
	Hurunui District				
	Kaikoura District				
	Selwyn District				
	Waimakariri District				
Greater Auckland	Auckland	Low (60%)	27 (18, 3 ,6)	95%	1,499,000
Greater Wellington	Kapiti Coast District*	High (90%)	14 (4, 4 ,6)	89%	428,000
	Lower Hutt City				
	Porirua City				
	Upper Hutt City				
	Wellington City				
Hawkes Bay	Central Hawke's Bay District	Low (67%)	24 (9, 0 ,15)	32%	138,000
	Hastings District				
	Napier City				
	Wairoa District				
Lakes	Rotorua District	High (83%)	18 (14, 0 ,4)	21%	110,000
	Taupo District				
Mid Central	Horowhenua District	High (95%)	19 (9, 2 ,8)	66%	149,000
	Manawatu District				
	Palmerston North City				
	Taraua District				
Nelson Marlborough	Marlborough District	Low (41%)	22 (13, 0 ,9)	2%	109,000
	Nelson City				
	Tasman District				
Northland	Far North District	High (97%)	20 (14, 3 ,3)	0%	102,000
	Kaipara District				
	Whangarei District				
South Canterbury	Mackenzie District	High (95%)	15 (14, 0 ,1)	0%	55,000
	Timaru District				
	Waimate District				
Southern	Central Otago District	High (86%)	62 (43, 6 ,13)	50%	294,000
	Clutha District				
	Dunedin City				

DHB	District Council	Water Data Quality (Estimated% data reported)	# of plants (minor, medium, large)[¤]	Population with fluoridated supply – at Jan 2014	Population (reticulated water supply)
	Gore District				
	Invercargill City				
	Queenstown-Lakes District				
	Southland District				
	Waitaki District				
Tairawhiti	Gisborne District	High (100%)	2 (0, 0 ,2)	100%	34,000
Taranaki	New Plymouth District	High (100%)	11 (8, 2 ,1)	19%	99,000
	South Taranaki District				
	Stratford District				
Waikato	Hamilton City	High (93%)	48 (35, 7 ,6)	11%	301,000
	Hauraki District				
	Matamata-Piako District				
	Otorohanga District				
	Ruapehu District				
	South Waikato District				
	Thames-Coromandel District				
	Waikato District[†]				
	Waipa District				
	Waitomo District				
Wairarapa	Carterton District	High (85%)	11 (10, 0 ,1)	55%	37,000
	Masterton District				
	South Wairarapa District				
West Coast	Buller District	High (76%)	6 (5, 1 ,0)	0%	24,000
	Grey District				
	Westland District				
Whanganui	Rangitikei District	High (93%)	13 (11, 0 ,2)	0%	67,000
	Ruapehu District				
	Wanganui District				
ALL NZ		**High (77%)**	**415 (277, 44 ,94)**	**50%**	**4,204,000**