A Cost Effectiveness Analysis of Community Water Fluoridation in New Zealand

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New Zealand was one of the first countries to adopt Community Water Fluoridation (CWF) as a dental health intervention to lower rates of dental cavities. The Ministry of Health currently recommends a water fluoride concentration of 0.7-1.0mg/l to improve oral health, however responsibility for implementing CWF has remained with local authorities since the 1950's.[2] Approximately 56% of New Zealander's have access to fluoridated water.[1]

AIM

The last economic analysis of CWF in New Zealand, conducted in 2001 by Wright et. al., found it was a cost effective public health intervention in communities of over 1000 people.[2] The aim of this study was to use a similar methodology, with more recent data, to determine whether community water fluoridation remained a cost effective public health intervention in New Zealand in the 21st century.

METHOD

A Cost Effectiveness Analysis (CEA) was conducted from a societal perspective. CWF (at a level of 0.7-1.0mg/l) with treatment for reducing dental caries, was evaluated against treatment only. The CEA measured the cost of preventing one newly decayed tooth.

In line with Wright et. al. (2001),[2] the CEA examined the relationship between cost effectiveness and community size. CEA was conducted separately for children and total population. Fluoride was considered to be effective for all individuals that were dentate.[4]

Data Collection

Fluoridation status of water supplies was identified using data from the National Fluoridation Information Service (NFIS), Environmental Scan: 2011-2012.[3] A questionnaire was emailed to the organisations identified as responsible for CWF in fluoridated communities.

Data on mean difference in decayed missing and filled teeth (dmft /DMFT) between fluoridated and non-fluoridated communities was taken from the New Zealand Oral Health Survey (NZOHS).[4] This data represented a mean for the total New Zealand population adjusted for age, gender, ethnicity and socioeconomic deprivation.

Assumptions:

- All carious teeth were treated with a two surface amalgam filling.[9-11]
- Cost of adverse side effects (dental fluorosis) was assumed to be negligible and not attributed a value.[2, 7, 9]
- Cost was based on the reimbursement rate under the CDA base agreement.[12]
- One hour's productivity was lost per dmft/ DMFT treated.[7]
- The population profile reflected the New Zealand population described in the NZOHS.[4]

Data Analysis

Data on costs of CWF received from local authorities supplying fluoridated water was adjusted to the 2011/2012 financial year.[5] Average annual equivalised cost (AEC) of capital was calculated at a base discount rate of 3.5%,[6] and a base life span for plant and equipment of 15 years.[2,7] Salvage value (FV) of capital was set at zero.

AEC of capital was added to annual costs for the chemical, maintenance and testing. The sum was divided by the population of the community served, (AEC per capita).

Annual equivalised saving (AES) – the present value of cost averted by CWF - was calculated using the mean difference in dmft/DMFT between communities with CWF and those without. Cost of treatment was divided by the lifespan of the treatment (12.8 years),[8] and discounted at a rate of 3.5% p.a.. AES was divided by the percentage of the population who were dentate (AES per capita).

Cost effectiveness was calculated by subtracting AES per capita from AEC per capita.

RESULTS

Data was received from eleven of the twenty suppliers of fluoridated water, twelve out of twenty-eight fluoridated communities (43%) and a population of 420,616, (20% of those receiving fluoridated water).

Cost of CWF

At base rate the total annual equivalised per capita cost of community water fluoridation per dmft /DMFT averted ranged from $0.37 to $5.63; A strong relationship was evident between community size and cost, *see table 1.*

Size of community served	Average AEC per capita of CWF
Small (< 5000) range: 744-3240	$4.38
Medium (5-10,000) range: 7542-9710	$1.23
Large 1 (10-50,000) range: 19000-34300	$0.66
Large 2 (>50,000) range: 74953-343900	$0.53

Table 1: AEC of CWF by community size

Costs Averted

The annual equivalised per capita costs averted resulting from CWF was $4.82 for total population and $5.21 for children.

Costs averted, adjusted to 2011 prices, were $82.33 for a two surface amalgam filling and $20.64 for one hour's loss of productivity based on the average wage in 2011[13].

The difference in mean dmft /DMFT between communities with and without CWF was 1.0 dmft /DMFT ($p<0.05$) for children (<18 years) and 0.8 dmft /DMFT ($p<0.05$), for total population[4].

Cost Effectiveness of Community Water Fluoridation

CWF represented a cost saving of between $0.55 and $6.09 per dmft /DMFT averted at base rate for total population and children in all four communities. This indicated that CWF with treatment was a more cost effective oral health intervention than treatment alone for those groups - *see table 2*.

Population	Community Size			
	Small (<5000)	Medium (5-10,000)	Large 1 (10-50,000)	Large 2 (>50,000)
Child	-$2.23	-$5.38	-$5.95	-$6.09
Total (all ages)	-$0.55	-$4.49	-$5.20	-$5.38

Table 2: Average annual per capita net cost of CWF per dmft/DMFT averted

Sensitivity Analysis

A univariant sensitivity analysis was conducted and showed:

A negative net cost (cost saving) for CWF under all scenarios in communities with populations over 5,000.

For populations under 5,000 CWF with treatment was less cost effective than treatment alone for:

- Total population: at a discount rate of $\geq$ 0% when lifespan of plant and machinery was less than eight years. Under all scenarios at a discount rate of $\geq$5%.
- Children: at a discount rate of $\geq$3.5% when an amalgam filling was assumed to last 15 years or more. Under all scenarios when the discount rate increased to $\geq$ 6.4%.

Limitations.

Cost effectiveness could have been:

- over-estimated through the non-inclusion of adverse effects.
- under estimated through non-inclusion of: pain and suffering averted and dental treatments beyond a two surface amalgam filling.

Data only covered 20% of people receiving fluoridated water..

Lack of data on the length of exposure to fluoride at an individual level.

CONCLUSION

This cost effectiveness analysis supports an earlier economic analysis of community water fluoridation in New Zealand by Wright et. al. (2001)[3]. CWF remained a cost effective public health intervention in New Zealand despite an overall reduction in dental caries. This finding also agrees with a number of economic analyses of CWF conducted in countries similar to New Zealand, [7, 9-11].

It should be noted however, that for smaller communities cost effectiveness was more marginal. Wright et. al. (2001) identified a 'break even' community size for CWF of 700-900 people[3]. In smaller communities cost effectiveness was more dependent on the risk profile of the population. CWF would be more cost effective in communities with a higher risk of dental caries.

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