



FLUORIDATION - NATURE THOUGHT OF IT FIRST

The Australian Dental Association (ADA) and many dental academics and researchers around Australia have for a considerable time been confounded by occasional opposition to the adjustment of natural fluoride levels in drinking water supplies through the addition of fluoride to optimum decay-fighting levels.

There is universal agreement between all the major public health bodies throughout the world regarding the benefits of water fluoridation. However we are still seeing campaigns that oppose the measure and seek to influence decision-making at the local level, thereby denying communities vital decay protection.

It is with this in mind that the ADA has committed some resources to commemorate the 50-year anniversary of the first community water fluoridation in Australia and remind key community members that water fluoridation is:

- **SAFE** to be used in the fight against dental infection (decay)
- **EFFECTIVE** in that it delivers proven decay reduction
- **EFFICIENT** in that it reaches a high proportion of targets
- **COST-EFFECTIVE** in that its benefits far outweigh the costs
- **EQUITABLE** in that it transcends socio-economic barriers that might prevent the use of other decay-preventing, fluoride-containing products

In these papers, the ADA strives to put the entire issue into perspective - that fluoridation offers a net benefit to a community without raising the risks.

As the ADA is an observer in these matters, this paper draws on the experience of other peak public health bodies, for example:

- The Australian National Health and Medical Research Council (NHMRC)
- The Australian Institute of Health and Welfare (AIHW)
- The US Centers for Disease Control (CDC)
- The British National Health Service (BNHS)
- Health Canada
- World Health Organisation (WHO)

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THE BEACONSFIELD STORY

The first inclusion of fluoride into a water supply occurred in Beaconsfield, near Launceston, Tasmania in 1953. The Tasmanian Branch of the ADA and, in particular, Dr Wayne Ottaway has access to many of the original documents regarding this initiative.

The planning started in 1949 and was instigated by a chemist at the local council named Frank Grey who read about the benefits of fluoride in the United States. This US experience is a story in itself.

It appears that in the early 20th century, several instances of dental fluorosis or mottling had been noticed on the teeth of children in the US. One of these occurred in 1909 when a local dentist in Bauxite, Arkansas decided that mottling on children's teeth must be associated with the new town water supply that had been sourced from a new and very deep well. The well was abandoned as a water source, and in 1927 an industrial chemist used new analysis equipment to determine that the fluoride content of water in that well was 13.7 parts per million (ppm). We now aim at about 1 ppm.

As a result, US dentist and epidemiologist H. Trendley Dean was given the task of researching this effect and his extensive epidemiological work, which demonstrated the beneficial effect of an ideal fluoride content in water, was well-documented by 1942. It is likely that this research was the talk of health authorities and water boards, and Frank Grey would have been alert to the findings.

Frank Grey happened to have the infrastructure to make water fluoridation possible as the local water supply at Beaconsfield was so poor in quality that sophisticated filtration and reticulation had been installed. It was just a matter of purchasing the fluoridation equipment and placing it in the line so a metered dose was added to the only drinking water supply in the town.

Frank Grey became internationally renowned for his efforts and received much correspondence and enquiries from Canada and the US regarding the fluoridation of water supplies. His daughter, Jeanette Grant, wrote recently "... I think it was really due to Dad's concern about my teeth (I was 13 at the time) that Dad became interested in the fact that our water supply could be fluoridated..."

The Tasmanian Branch of the ADA will be celebrating the 50-year anniversary of this event by placing a commemorative plaque in a prominent place in Beaconsfield and by recording the history of the first fluoridation of a public water supply in Australia.

It was because of the observations of this naturally occurring phenomenon by keen scientists like H. Trendley Dean and Frank Grey that the ADA has chosen ***Nature Thought of it First*** as the theme for this campaign.

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www.ada.org.au PO Box 520, St Leonards NSW 1590 Tel (02) 9906 4412 Fax (02) 9906 4676



FLUORIDATION IS SAFE

When local communities or State Governments decide whether fluoride adjustment of the water supply will occur, the most serious concern of local communities is safety. Apart from consideration of dental fluorosis (see later), we should ask:

- Is fluoridation safe?
- Are there any side effects?
- Are there any adverse consequences?

THE SCIENTIFIC OPINION

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| US CDC Oct 1999 ¹ | <i>"The safety and effectiveness of water fluoridation have been re-evaluated frequently, and no credible evidence supports an association between any of these conditions"...cancer, Down Syndrome, heart disease, osteoporosis and bone fracture, AIDS, low intelligence, Alzheimer disease, allergic reactions, and other health conditions."</i> |
| Commentary on the UK Government commissioned research by the York NHS Centre for Reviews and Dissemination 2000 ² | <i>"Worldwide, 39 million people consume naturally fluoridated water and a further 317 million consume water with added fluoride, many for 40 years or more. Any adverse health effects would by this time have emerged in the general population and have been reported and incorporated into the York review. The review can therefore be added to those others published over the past fifteen years that provide reassurance on the safety and efficacy of fluoridation programmes."</i> |
| US National Cancer Institute Oct 2000 quoting research from 1991 ³ | <i>"...scientists at the National Cancer Institute evaluated the relationship between the fluoridation of drinking water and the number of deaths due to cancer in the US during a 36 year period, and the relationship between water fluoridation and the number of new cases of cancer during a 15 year period. After examining more than 2.2 million cancer deaths records and 125,000 cancer case records in countries using fluoridated water, the researchers concluded that there was no indication of increased cancer risk associated with fluoridated drinking water."</i> |
| Australian NHMRC (1999) ⁴ | <i>"There is insufficient evidence to establish a link between fluoridated drinking water and increased risk of bone or other cancers." "There is no evidence for either an osteoporosis risk or benefit from water fluoridation."</i> |
| Health Canada ⁵ | <i>"Health Canada endorses the fluoridation of drinking water to prevent tooth decay and has no warnings of any adverse effects other than skeletal fluorosis which it acknowledges may only occur at levels (which) are much higher than those to which the average Canadian is exposed daily, even with fluoridated drinking water."</i> |

¹ MMWR Weekly October 22nd 1999 / 48(41);933-940 Accessed on 26.7.01 at www.cdc.gov/epo/mmwr/preview/mmwrhtml/mm4841

² Lennon, M.A. (2000) Guest Leader: A systematic review of public water fluoridation – a commentary. Community Dental Health 17: No 3. p130-2

³ National Cancer Institute (2000) Accessed on 8.6.03 at http://cis.nci.nih.gov/fact/3_15.htm

⁴ National Health and Medical Research Council (1999) Review of Water Fluoridation and Fluoride Intake from Discretionary Fluoride Supplements. Melbourne.

⁵ Health Canada: Fluorides and Human Health Accessed on 8.6.03 at <http://www.hc-sc.gc.ca/english/iyh/environment/fluorides.html>

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FLUORIDATION IS EFFECTIVE

The key questions to be asked by anyone who is determining public health policy for a country or a local community are:

- What are the expected benefits?
- Does it deliver the expected benefits?

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| <p>UK Government-commissioned research 2000⁶</p> | <p><i>"The best available evidence suggests that fluoridation of drinking water supplies does reduce caries prevalence, both as measured by the proportion of children who are caries (decay) free and by the mean change in dmft/DMFT score (a measure of the number of decayed, missing or filled teeth – DMFT)</i></p> <p><i>"The best available evidence from studies following withdrawal of water fluoridation indicates that caries prevalence increases..."</i></p> |
| <p>Australian NHMRC 1999⁷</p> | <p><i>"Fluoridation of water at optimal levels (levels given)... remains the most effective and socially equitable means of achieving community-wide exposure to the caries-preventive effects of fluoride."</i></p> <p><i>"Communities that have ceased water fluoridation have demonstrated an increase in caries (decay) experience."</i></p> |
| <p>US CDC Oct 1999⁸</p> | <p><i>"Although early studies focussed mostly on children, water fluoridation also is effective in preventing dental caries amongst adults. Fluoridation reduces enamel caries in adults by 20-40% and prevents caries on the exposed root surfaces of teeth, a condition that particularly affects older adults."</i></p> |

⁶ A systematic Review of Public Water Fluoridation. NHS Centre for Reviews and Dissemination. University of York. 2000
 Accessed on 28.8.03 at <http://www.york.ac.uk/inst/crd/fluorid.pdf>

⁷ National Health and Medical Research Council (1999) Review of Water Fluoridation and Fluoride Intake from Discretionary Fluoride Supplements.

⁸ MMWR Weekly October 22nd 1999 / 48(41);933-940 Accessed on 26.7.01 at www.cdc.gov/epo/mmwr/preview/mmwrhtml/mm4841



FLUORIDATION IS EFFICIENT

The assertion here is that water fluoridation is the most efficient way of delivering fluoride as opposed to other forms such as adding it to salt, tablets, drops, toothpaste, mouthwash etc. It also addresses the question – if we are exposed to a wide variety of fluoride sources, does water fluoridation still have an effect?

This question is dealt with in the comprehensive paper by Spencer et al.⁹ in which the researchers challenge claims made by Diesendorf et al. that the reductions of dental decay incidence in Australia has been similar in fluoridated and non-fluoridated areas and so this reduction could not be explained by water fluoridation.

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| <p>Spencer et al. Water Fluoridation in Australia 1996¹</p> | <p>The paper reports on a study in which researchers looked at Queensland (approx. 5% of population with water fluoridation) and South Australia (70%).</p> <p>In Queensland it compared children in Townsville (fluoridated since 1964) with those in Brisbane (never fluoridated). In South Australia it compared Adelaide (fluoridated since 1971) and regional centres (mainly not fluoridated).</p> <p>The study concluded that in comparing the two regions (with or without fluoride):</p> <ul style="list-style-type: none"> • water fluoridation alone had a strong effect on the primary dentition (first teeth) • in Queensland, water fluoridation was responsible for 0.3 less decayed surfaces per child. <p>Spencer points out the public health importance of these figures – that: <i>“...a difference of only 0.12 DMF surfaces per child would translate to 300,000 permanent tooth surfaces for the approximately 2.5 million children in Australia aged 5-15 years.”</i></p> |
| <p>Australian NHMRC 1999¹⁰</p> | <p><i>“Communities that have ceased water fluoridation have demonstrated an increase in caries (decay) experience.”</i></p> |
| <p>UK Government-commissioned research by the York NHS Centre for Reviews and Dissemination 2000</p> | <p><i>“In those studies completed after 1974, a beneficial effect of water fluoridation was still evident in spite of the assumed exposure to non-water fluoride in the populations studied.”</i></p> |
| <p>UK York Health Economics Review¹¹</p> | <p><i>“One of the greatest strengths of water fluoridation is that it does not require any behavioural changes from its recipients, unlike other possible strategies (eg campaigns encouraging people to improve their oral hygiene and/or visit their dentist regularly).”</i></p> |

⁹ Spencer A.J., Slade, G.D. and Davies, M. (1996) Water Fluoridation in Australia. Community Dental Health, **13**, supplement 2, 27-37.

¹⁰ National Health and Medical Research Council (1999) Review of Water Fluoridation and Fluoride Intake from Discretionary Fluoride Supplements.

¹¹ University of York. York Health Economics Forum. Water Fluoridation - An Economics Perspective. Accessed on 28.8.03 at: <http://www.liv.ac.uk/bfs/cost%20york.html>



FLUORIDATION IS COST-EFFECTIVE

The argument here is that the addition of fluoride to water supplies to boost the ambient fluoride levels to optimum levels, is the most cost-effective way of preventing dental decay.

The cost saving in the private dental sector is assumed to be not as significant as the saving to be made in the public care sector, the latter essentially representing Government expenditure.

This is so because it has been shown that lower socio-economic status (SES) children have higher decay rates than higher SES children and that fluoridation conveys a greater reduction to the lower SES group¹².

Access to Government-funded public sector care is largely available only to lower SES children.

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| <p>US CDC Oct 1999¹³</p> | <p><i>"Water fluoridation costs range from a mean of 31 cents per person per year in US communities of greater than 50,000 persons to a mean of \$2.12 per person in communities of less than 10,000."</i></p> <p><i>"One economic analysis estimated that prevention of dental caries (decay), largely attributed to fluoridation and fluoride-containing products, saved \$39 billion in dental care expenditures in the United States during 1979-1989."</i></p> |
| <p>New Zealand research 2001.¹⁴</p> | <p><i>"Fluoridation remains very cost-effective, and is particularly so for communities with higher proportions of children, Maori, or people of low socio-economic status."</i></p> <p><i>"Fluoridation was cost-saving (dental cost saving exceeded fluoridation costs) for communities above 1,000 people. The true break-even community size may be lower."</i></p> |
| <p>World Health Organisation¹⁵</p> | <p><i>"Community water fluoridation is safe and cost effective and should be introduced and maintained wherever socially acceptable and feasible."</i></p> |
| <p>UK York Health Economics Review¹⁶</p> | <p><i>"Studies comparing the cost-effectiveness of water fluoridation compared with other strategies for reducing caries always conclude that water fluoridation is the most cost-effective approach."</i></p> |

¹² Spencer A.J., Slade, G.D. and Davies, M. (1996) Water Fluoridation in Australia. *Community Dental Health*, **13**, supplement 2, 27-37.

¹³ MMWR Weekly October 22nd 1999 / 48(41);933-940 Accessed on 26.7.01 at www.cdc.gov/epo/mmwr/preview/mmwrhtml/mm4841

¹⁴ Wright, J.C., Bates, M.N., Cutress, T. and Lee M. (2001) The cost-effectiveness of fluoridating water supplies in New Zealand. *Aust N Z J Public Health*. 25: 170-177

¹⁵ World Health Organisation Environmental Information – Fluoride Accessed on 8.6.03 at: http://www.who.int/environmental_information/Information_resources/htmldocs/Fluoride/fluoride.html

¹⁶ University of York. York Health Economics Forum. Water Fluoridation - An Economics Perspective. Accessed on 28.8.03 at: <http://www.liv.ac.uk/bfs/cost%20york.html>



FLUORIDATION IS EQUITABLE

The assertion here is that the addition of fluoride to water supplies to boost the ambient fluoride levels to optimum levels is the most efficient way of conveying the benefit to a wide variety of socio-economic groups.

If the only access to fluoride is by choice, say, in toothpaste, tablets, drops or mouthwash (all requiring a financial commitment), then certain groups of children in the community who do not have that level of care at their disposal will miss out. This is a logical and reasonable assumption in that the most underprivileged children in the community would still drink tap water when thirsty but are unlikely to be given a fluoride tablet.

Some groups have tested this assumption and, of relevance to Australian conditions, Spencer et al. found that lower socio-economic status children had higher decay rates than higher socio-economic children and this gap was reduced by water fluoridation.

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| Spencer et al. Water Fluoridation in Australia 1996 ¹⁷ | <i>“Water fluoridation reduces socio-economic inequalities in caries experienced in children and is therefore a socially equitable strategy for caries (decay) prevention.”</i> |
| Australian NHMRC 1999 ¹⁸ | <i>“Fluoridation of water at optimal levels (levels given)... remains the most effective and socially equitable means of achieving community-wide exposure to the caries-preventive effects of fluoride.”</i> |
| US CDC Oct 1999 ¹⁹ | <i>“Water fluoridation is especially beneficial for communities of low socio-economic status. These communities have a disproportionate burden of dental caries (decay) and have less access than higher income communities to dental-care services and other sources of fluoride. Water fluoridation may help reduce such dental health disparities.”</i> |
| UK Government- commissioned research by the York NHS Centre for Reviews and Dissemination 2000 ²⁰ | <i>“There appears to be some evidence that water fluoridation reduces the inequalities in dental health across social classes in 5 and 12 year-olds, using the dmft/DMFT measure...”</i> |
| New Zealand research 2001. ²¹ | <i>“ Our data show that the effectiveness of (water) fluoridation is higher for lower socio-economic groups. This confirms results found elsewhere.</i> |

¹⁷ Spencer A.J., Slade, G.D. and Davies, M. (1996) Water Fluoridation in Australia. *Community Dental Health*, **13**, supplement 2, 27-37.

¹⁸ National Health and Medical Research Council (1999) Review of Water Fluoridation and Fluoride Intake from Discretionary Fluoride Supplements.

¹⁹ MMWR Weekly October 22nd 1999 / 48(41);933-940 Accessed on 26.7.01 at www.cdc.gov/epo/mmwr/preview/mmwrhtml/mm4841a1.htm

²⁰ University of York. York Health Economics Forum. Water Fluoridation - An Economics Perspective. Accessed on 28.8.03 at: <http://www.liv.ac.uk/bfs/cost%20york.html>

²¹ Wright, J.C., Bates, M.N., Cutress, T. and Lee M. (2001) The cost-effectiveness of fluoridating water supplies in New Zealand. *Aust N Z J Public Health*. 25: 170-177

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DENTAL FLUOROSIS

WHAT IS IT?²²

The term 'Dental fluorosis' or 'mottling' refers to the effects of fluoride on the hard, crystalline dental enamel that covers the exposed surfaces of the teeth. It occurs when enamel is being 'grown' during the formation of the tooth.

It has been seen in ancient skulls and was not examined closely until the 1930's when US dentist and epidemiologist, H. Trendley Dean, made the association between fluoride and this mottling. The source of the fluoride was found to be occurring naturally in local water supplies in areas where the dental effects were seen in the local population.

At the same time as identifying fluoride as the culprit, Dean also noticed that decay rates were significantly lower when fluoride was present in sufficient concentration. The question was asked, at what concentration of fluoride would there be maximum decay prevention with minimal or no fluorosis? It seemed that minimal fluorosis was noticed at levels of 1 milligram per litre of water (1 part per million or ppm).

Other methods of delivering fluoride were investigated, including adding it to salt, as a tablet, as a constituent of drops or by painting it in the mouth. However it was seen that the best decay prevention over a large population could be achieved with water fluoridation, and reductions of up to 50% were seen.

Dean also set out to examine and classify the degrees of fluorosis. He found that they varied from:

1. Very thin, almost invisible white patches or lines over the tooth surface, which pose a mild to moderate cosmetic problem to,
2. Significant areas of brown staining with pitted enamel defects or large areas of enamel missing which are toxic effects on developing dental enamel caused by very high fluoride exposure

Dental fluorosis continues to be the single harmful effect on teeth if a child is exposed to high levels of fluoride when the teeth are forming. However, cases of severe dental fluorosis are now rare in Australia.

HOW HAS IT BEEN MINIMISED?

There have been some areas in the world where the natural water fluoride concentration has been over 10 times the recommended dose and attempts have been made to de-fluoridate the water.

However, in Australia, most, if not all natural water supplies have lower than optimal fluoride levels, so need adjusting by the addition of more fluoride.

Therefore the answer is the same as that posed by Dean in the 1930's – to make sure that the fluoride exposure of children is optimal for the best decay prevention and the least (or no) fluorosis. Dean had little epidemiological data to work on, but today we have 50 years of experience to factor in all fluoride sources (toothpaste etc).

There was a relatively high incidence of low-grade fluorosis in some child populations in the late 1970's due to the exposure to fluoride from other sources. Spencer et al.²³ point to the need to control those discretionary fluoride sources (by reducing fluoride content in toothpastes, infant formula powder etc,) as a far better strategy to reduce the incidence of dental fluorosis as opposed to reducing the fluoride level in drinking water. This is the strategy favoured and followed by the dental profession.

²² Fejerskov, O., Baelum, V., Manji, F. and Moller, I.J. (1988) Dental Fluorosis – a handbook for health workers. Munksgaard, Copenhagen.

²³ Spencer A.J., Slade, G.D. and Davies, M. (1996) Water Fluoridation in Australia. Community Dental Health, **13**, supplement 2, 27-37.