The Cost and Cost-effectiveness of Water Fluoridation

Key points

- The World Health Organisation states that *'Community water fluoridation is safe and cost-effective and should be introduced and maintained wherever it is socially acceptable and feasible.'* [1]
- In the parts of the UK where tooth decay remains a significant public health problem, patients and the NHS economy would benefit hugely from water fluoridation.

Who pays for fluoridation?

Water fluoridation is a public health measure to improve dental health, and, as such, it is paid for entirely by the National Health Service. (Locally, the health authority is billed by the water company for the entire cost of fluoridating supplies.) The purpose of the National Health Service is to improve the health and well-being of the population; local health bodies – health authorities and boards, and primary care trusts – have a duty to improve the health of their local populations and to reduce health inequalities [2]. However, these local health bodies also have corresponding *financial* duties and they must not spend more cash than is allocated to them [3]. Clearly, with many competing demands on fixed NHS funds, health bodies will wish to be assured that they are spending public money wisely and obtaining `value for money'.

Cost-effectiveness

The *effectiveness* of water fluoridation in reducing tooth decay has long been established (see Section 2). However, effectiveness alone is not sufficient reason to implement such a measure: cost-effectiveness must also be considered. A healthcare measure is considered to be cost-effective if it provides the greatest benefit for a given expenditure, or if the value of the benefits exceeds the value of the costs [4].

Whilst surprisingly little is known about the cost-effectiveness of many common healthcare interventions [5], the cost-effectiveness of water fluoridation has been studied extensively over many years [6-16]. Indeed, a 1994 study by the University of York Health Economics Consortium of strategies for reducing tooth decay concluded:

> *'in terms of cost, effect and the certainty of that effect, the most cost-effective policy is fluoridation of water supplies.' [14].*

In 1998 the University of York Health Economics Consortium undertook a further, detailed, examination of the costs and benefits of water fluoridation and concluded:

> *'In areas where the average number of decayed, missing or filled teeth per child (dmft) is 2.0 or more (and especially if there are districts where it is greater than 2.6), and where the local water treatment works serve populations of at least 200,000 people, the benefits of water fluoridation are likely to be significantly greater than the costs.' [15]*

The 1998 study recognised that, overall, levels of tooth decay had improved dramatically since the 1960s when fluoridation was first introduced. However, it highlighted the significant variations in dental health across Britain that had become apparent as tooth decay in the general population had fallen. (See Section 2 for a more detailed discussion of these inequalities in dental health.) Recognising these variations, the study identified *'The range of possible benefits that would be associated with extending fluoridation into certain areas under certain assumptions.'*

The York study identified four key variables to be considered in evaluating the cost-effectiveness of water fluoridation:

- The size of the population;
- The level of tooth decay in the population;
- The age and condition of the water treatment works; and,
- The type of fluoride to be used.

The report's main findings, conclusions and recommendations were:

- Studies comparing the cost-effectiveness of water fluoridation compared with other strategies for reducing tooth decay always conclude that water fluoridation is the most cost-effective approach.
- One of the greatest strengths of water fluoridation is that it does not require any behavioural changes from its recipients.
- The scale of the effect of campaigns to change behaviour cannot be predicted, and such campaigns may fail to influence those who would benefit most from them. It is, however, possible to predict the costs and benefits with water fluoridation, and to be confident that those people likely to benefit the most from it will do so. Furthermore, the costs are borne by the NHS, and no private contribution is required.
- Calculating the capital and revenue costs of fluoridation for a population of a particular size is relatively straightforward, although these costs have to be discounted to determine the equivalent annual cost over each year of the installation's life (discounting allows the capital cost to be depreciated over the period). From this, an equivalent annual cost per person of fluoridation can be calculated, and indeed a ready-reckoner devised to determine this for populations of different sizes, and plants with different capital and revenue costs.
- Calculating the benefits of fluoridation is less straightforward. The approach used in this study draws upon work undertaken by Sanderson and Wilson [17] for Yorkshire data, based on the methodology of Birch [12], which identifies the expected reduction in tooth decay each year for children receiving fluoridated water from birth until they reach 14 years of age.
- Using population projections and knowledge of underlying oral status, it is possible to predict the numbers of decayed teeth, fillings and extractions that will be prevented each year of the life of the fluoridation installation (ie 14 years) for children born after fluoridation.
- A monetary value can then be assigned to these 'benefits', which are also discounted over the period to estimate the annual equivalent 'saving'.
- It should be noted that these calculations only consider the benefits to people born after the fluoridation of the water supply. However, those born prior to fluoridation will also benefit, although to a lesser extent. There is a paucity of research on the magnitude of the benefits of receiving fluoridated water for all of one's life, but all residents with natural teeth would benefit to some extent. For example, adults would have less decay on exposed root surfaces, and young children would have less decay in their permanent teeth. Due to the difficulties associated with quantifying such benefits, these have not been included in the calculations, but their omission means that the benefits of fluoridation are underestimated in the model.
- Considering the costs and benefits associated with water fluoridation shows which areas of Britain would benefit most. Such analysis also identifies which areas are not a priority for fluoridation, either due to good underlying oral status and/or the local water treatment works only serve a small population (eg less than 50,000). In such situations other approaches should be taken to target the families of children with particularly poor oral status. However, as the size of the population served by a particular water treatment works increases, the cost per person of fluoridation decreases, making fluoridation much more cost-effective.
- Where tooth decay risk is `medium' to `high' (average of 2.0 or more decayed teeth in children aged 5 years, and especially if there are districts where it is over 2.65), the benefits of water fluoridation are likely to be significantly greater than the costs. Such areas include most or all of Scotland, Wales, Merseyside and North West England, plus some parts of West Yorkshire.

Reducing the burden of cost to the NHS

The most common treatment of tooth decay in young children is tooth extraction which is usually carried out under general anaesthetic [18]. Following a Department of Health Review, and a General Dental Council ruling, from 1 January 2002 all general anaesthetics for dental treatment must be performed in a hospital setting with critical care facilities [19, 20]. Whilst necessary, this requirement makes the treatment of such a common disease particularly expensive, and places a strain on scarce NHS resources.

Tooth decay in young children is a particular problem in the North West of England, for example, and, each year, around 1500 general anaesthetics are administered to children for extraction of decayed teeth in the Manchester Dental Hospital alone. The cost per case is approximately £160 giving an annual cost of £240,000. However, based on recent studies [21-23], fluoridation of Manchester's water supply could reduce demand for tooth extraction under general anaesthetic by between 35% and 67%, bringing the number of cases in Manchester to between 500 and 1000 a year. At today's prices such a reduction in demand would represent cash savings of between £84,000 and £160,000 per annum - in Manchester alone! Similar savings could be expected in comparable non-fluoridated parts of the country – for example Liverpool, Leeds, Bradford, Inner London, Glasgow, Cardiff, and Belfast.

It is worth also considering the `opportunity' costs of the huge demand for general anaesthetic for tooth extraction - that is the costs of *not* using the NHS resources used in providing general anaesthetic for tooth extraction to treat conditions other than tooth decay. In the Manchester Dental Hospital three general anaesthetic sessions take place each week. Each session requires two paediatric anaesthetists, the operating dentist, the consultant paediatric dentist supervising the session, and around 10 support staff. If demand for general anaesthetic for tooth extraction were reduced, much of this human and technical resource could be used to reduce waiting lists and delays for other treatments.

Of course, none of the above takes account of the costs to the children and their parents (time lost from school and work etc), and to the children in terms of their health and well-being both while waiting several weeks for treatment, and resulting from the treatment itself. (In Manchester the waiting list for general anaesthetic for tooth extraction is generally around 500 children.) There is little doubt that in parts of the country where tooth decay remains a significant public health problem, patients and the NHS economy would benefit hugely from water fluoridation.

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