Outcomes and costs of pre-school and school-based fluoride varnish pilots

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In brief

School-based fluoride varnish programmes have the potential to increase the proportion of children attending for dental care, although it is unclear if this behaviour is sustained.

There is a potential safeguarding issue with children who are diagnosed with dental decay but do not get the treatment they need.

Recruiting and maintaining participation in such programmes requires a high-level of resource and it is unclear if this is financially-sustainable for the long term.

Objective Fluoride varnish (FV) applications reduce the risk of dental decay in research trials. These pilots were conducted to test the feasibility and costs of providing FV applications in schools. Changes in dental decay levels were also monitored. **Methods** Data were collected on the proportion of children with dental decay, mean number of teeth affected and whether the child had attended for dental care. The cost of delivering the intervention was calculated. **Results** More children were reported to be attending for dental care by the end of the pilot than at the start. The proportion of children with dental decay and the mean number of teeth affected increased, but more children seemed to have received treatment. The intervention cost about £88 per child per year, with most of the costs due to the intensive efforts needed to recruit and maintain participation in the pilots. **Conclusions** Establishing community FV programmes requires significant investment and the long-term benefits in practice are unclear. If dental decay levels are to be reduced, there is a need to improve diets, alongside fluoride strategies. This may be best achieved by integrating oral health improvement programmes into other health programmes, particularly sugar-reduction strategies.

Introduction

National trends indicate that dental decay (dental caries) in young children has declined over the last several decades, but inequalities remain. The strong association between deprivation and dental disease in children reflects the known link between social inequalities and health outcomes.[1–4] Published evidence indicates that the dental decay experience of an individual is the result of the cumulative effects of all the risk factors the individual has been exposed to and is a predictor of future dental decay experience.[5] The negative and far-reaching impacts of dental decay on the child, family, health system and wider economy are also well-documented.[6–8]

Fluoride is known to reduce the risk of dental decay and global reductions in the disease to date have been largely attributed to the increasingly widespread use of fluoride toothpaste. There is evidence that application of fluoride varnish (FV) two to four times per year, in either the permanent or primary dentition, is associated with a substantial reduction (37–43%) in the risk of dental decay.[9] There is no evidence that one-off or ad-hoc applications are effective so regular attendance is needed to realise the benefits of this intervention. UK research highlights the inverse relationship between deprivation status and uptake of dental services for children.[10,11]

National guidance recommends targeted community-based fluoride varnish programmes to reach all children, including those who do not regularly attend for dental care, although there is uncertainty about the impact on inequalities, the amount of resource needed or deliverability in practice.[12] Latest guidance from the National Institute of Health and Care Excellence (NICE) also acknowledges that there is little information about the acceptability, effectiveness and cost-effectiveness of such schemes in community settings.[13]

A pilot oral health improvement programme with FV applications was conducted in school settings across Southampton, Oxfordshire and the Isle of Wight from 2010. This paper aims to primarily report on the feasibility and costs of these pilots and any impact on dental decay levels.

The objectives were:

- To assess the feasibility of a community fluoride varnish programme in a school setting
- To note any change in the number of children whose parents reported that they had registered with a dentist
- To assess the costs of delivering an oral health improvement programme including FV applications within a school setting

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Table 1 Dental outcomes between the start and end of each pilot

Site (age group)	Length of pilot (years)	Number of children	Children with dental decay experience Number, %		Mean number of teeth affected (dmft) in children with dental decay		Children with untreated dental decay Number, %	
			Start	End	Start	End	Start	End
Isle of Wight A	2	50	12	12	4.5	5.1	12	8
(4-5 years)			24%	24%			24%	16%
Isle of Wight B	2	67	12	18	1.7	2.3	11	12
(3-4 years)			18%	27%			16%	18%
Southampton	3	83	10	12	5.1	6.1	9	10
(3-4 years)			12%	15%			11%	12%
Oxfordshire	3	189	85	129	3.8	4	75	38
(4-7 years)			45%	68%			40%	15%
Totals		**389**	**119**	**171**			**107**	**68**
			31%	**44%**			**28%**	**17%**

- To monitor any changes in the proportion of children with any decayed, missing or filled teeth (dmft) which reflects their cumulative experience of dental decay, and the mean number of teeth affected in these children during the course of the pilot.

Methods

Details of the intervention and the experience of recruiting to and maintaining participation in the pilots have been published previously.[14] A total of 458 children (77.8% of the cohort of 589) were enrolled in the seven pilots across Southampton (two sites), Oxfordshire (two sites) and Portsmouth (three sites). Daily supervised toothbrushing sessions were organised in the schools. Oral health education was provided for children, parents and school staff to encourage toothbrushing at home, improve diet and visit a dentist regularly. Parents of children who needed treatment were sent letters signposting them to local dental practices. Three applications of FV were planned, a pragmatic decision to coincide with the three school terms and in line with national recommendations.

All pilots were based in schools within areas of deprivation and where dental data and local knowledge indicated relatively high levels of dental decay. The sites had staggered start dates, depending on local plans, with the first pilots starting in 2010. The pilots were conducted over different timescales with the Isle of Wight pilots conducted over two years, whilst Southampton's and Oxfordshire's pilots continued for three years. The variations were due to local commissioning processes.

All three teams worked together to develop and implement the programme according to a common protocol. The process was led and coordinated by a consultant in dental public health (JJ), who maintained a constant flow of information and learning across the pilots to maximise the opportunity for a successful outcome for all sites.

Two of the sites (Isle of Wight B and Southampton) targeted pre-school children (aged three to four years), and the others (Isle of Wight A and Oxfordshire) targeted primary school children (aged four to seven years). Children were examined at the start and end of the programme to assess the level of dental decay experience (dmft) and identify dental treatment need. Dental examinations at all sites were carried out by dentists who had been calibrated as part of national dental survey programme. As with the national survey, only visual examinations using a mirror and light were carried out. The same dentist carried out all the dental examinations at each site. No further calibration was carried out and there was no control group as the primary purpose was to assess feasibility and costs of implementing the programme and not to assess the effectiveness of FV applications.

Parents completed a short medical history questionnaire for their child at the start of the programme, and annually thereafter, to ensure that there were no contraindications to FV applications. This was mainly around any hospitalisation for asthma (as this may indicate a potential allergy to colophony, an ingredient within Duraphat, the only FV currently licensed for use in this context within the UK). Parents were also asked if the child had ever had a dental visit.

We costed the programme as a whole, rather than just the delivery of FV applications, so that our calculations would reflect the true cost of delivering this programme. Only data collected for the purpose of local monitoring were available for the analyses. The Oxfordshire team maintained the most detailed cost data, so these data were used. The models of delivery and detailed funding bids had been developed together, so costs were broadly similar across the sites although we acknowledge that there may have been local variations.

Results

Of the cohort of 589 children, 458 (77.8%) were enrolled in the programme and complete data (that is, dental examination and questionnaire data at the start and end of each pilot) was available for 389 children (85% of the 458 enrolled children).[14] The older children were more likely to report that they had visited a dentist at the start of the intervention but they also experienced higher levels of dental decay (Table 1).

The percentage of children with dental decay experience went up in all areas except for Isle of Wight Site A. There were larger increases in the cohorts with older children. The biggest increase was in Oxfordshire with a 23% rise over three years.

At the end of the pilots, 68 out of the 389 children (17%) were diagnosed with untreated decay. Oxfordshire and the older Isle of Wight cohorts had the highest average number of teeth affected, indicating that the disease was most severe in these children. There was a substantial

Fig. 1 Percentage of children reporting a dental visit the start and end of pilots

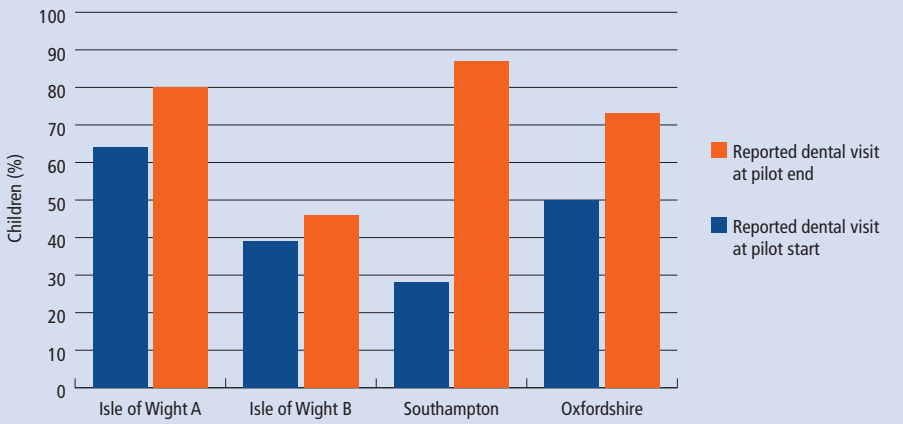

Table 2 Responsibilities and costs of delivering programme in two schools

	Annual cost
Clinical staff Senior dentist to provide clinical oversight, carry out data analyses and produce reports for commissioners. Dentist to carry out dental screening at start and end of programme Extended-duty dental nurses to carry out fluoride varnish applications	£9,500
Oral health promotion staff Manage relationship with school, recruit children, secure consent, develop resources, provide oral health education sessions and collect data at school site.	
Administrative staff Manage schedules of clinical and non-clinical staff and manage supplies of consumables and print resources.	
Non-pay costs including travel, office supplies including paper and postage and oral health improvement resources	£2,000
Delivery of FV applications Consumables including Duraphat fluoride varnish, dappens pots, applicators, tissues, gloves etc. Equipment including dental light, mirrors, computers etc.	£2,000
Total cost of programme	**£13,500**
Cost per child: including 189 enrolled children	**£71**
Cost per child: including 153 children who received minimum two applications a year	**£88**

reduction in the proportion of children with untreated dental decay in Oxfordshire by the end of the pilot but little change in other areas.

There was an increase of 36.7% in the proportion of children who were reported as having had a dental visit across the four cohorts (Fig. 1). The biggest increase was in Southampton (67.8%), followed by Oxfordshire (31.5%), Isle of Wight A (20%), and then Isle of Wight B (13%).

Staff costs made up the bulk of the total costs which reflects the resource-intensive nature for this type of intervention. A range of staff was used to ensure that the most appropriate skills were available for each of the activities and deliver the most cost-effective model. Table 2 provides a breakdown of costs, including a list of the range of staff involved.

The total cost of delivering the programme (engagement with sites, securing consent, recording and updating medical history, dental screening, delivering oral health education and fluoride varnish applications) to the 189 Oxfordshire children enrolled in the pilot was £13,500 per year (around £71 per child). When including just the 153 children who received at least two FV applications per year over the three-year period, the programme cost about £88 per child.

Discussion

Our previous paper on recruitment showed that of the total 589 children at the sites, 458 (77.8%) were enrolled, 445 (75%) received at least one FV application, 413 (70.6%) received at least two and 363 (61.6%) received all three planned applications.[14] Almost a third of children in these pilots already had dental decay experience at the start of the pilots, most of which was untreated dental decay, indicating that these children had not been attending for dental care. This reflects the national picture. Questionnaires completed by parents of 5-year-old children participating in the 2013 National Child Dental Health Survey (England, Wales and Northern Ireland) indicated that around 30% had visited a dentist in the by the age of two years, although 87% reported a dental visit in the last 12 months.[15] To prevent dental decay from becoming established, parents/carers should be encouraged and supported to take their children regularly for dental visits, starting from when the first tooth erupts.[16]

A positive outcome was an increase in the number of children who were reported as having had at least one dental visit by the end of the pilots, corroborated by the reductions in levels of untreated decay indicating that more children had received treatment. However, not all children had attended by this point and there has been no follow-up since, so it is not known if dental attendance has been maintained subsequently. There were still children who needed dental treatment by the end, some of whom may have had untreated dental decay from the start of the pilots. This potentially presents a safeguarding issue if these children then experience pain or need to have dental extractions, potentially requiring hospital admission for the procedure to be carried out under a general anaesthetic. This is not in line with giving every child the best start in life, a public health priority.[17]

We noted that dental decay experience increased in all areas but some of this may have been due to a failure to identify all the lesions at the initial examination as no radiographs were used to aid diagnosis. No conclusions about the effectiveness of FV applications can be drawn from these results as this was basically an uncontrolled evaluation. However, our results are in line with a recent Northern Ireland trial which found that providing children with FV applications, as

well as toothbrushes and fluoride toothpaste, did not have a significant preventive effect on dental decay.[18] Over the three-year trial period, 34% of children in the intervention group converted from dental caries-free to caries-active, in spite of receiving an average of 5.8 FV applications at six-monthly dental visits. The authors concluded that 'the motivation to attend the dentist on a regular basis did not translate to the adoption of other risk-reducing behaviours in the home setting, such as frequent use of fluoride-containing toothpaste or limiting the amount and frequency of sugar consumption'. In our pilots, healthy eating advice was provided but there was no dietary monitoring in place. If children had been consuming cariogenic diets, this may account for some of the observed increase in dental decay levels. A qualitative study of parents running in parallel with the Northern Ireland trial highlighted the 'ubiquitous presence of sugar in children's lives and how most parents found it very difficult to restrict the volume and frequency of sugar consumption by their children'.[18]

Targeted community FV applications are currently recommended by national guidelines as a way of reducing oral health inequalities.[12,13,19] However, the drop-off rates raise the possibility that the programme may not reduce inequalities if those children most likely to benefit are not being enrolled or are missing out on applications. Our experience is that many parents in these pilot areas were keen for their children to participate but needed additional support and information to understand and complete forms, sometimes due to literacy issues and/or busy lives. Maximising participation requires intensive efforts to engage with schools to secure and maintain their support, as well as engaging directly with parents at school settings to provide information, secure consent and complete medical history forms.

Our data indicate the high annual cost (£88 per child) of delivering this type of intensive community programme. There are limitations to our cost-analyses which were simple calculations based solely on costs captured as part of the monitoring process. To understand true costs, more detailed data on direct and indirect costs relating to delivery of the whole intervention would be needed, and it is possible that we are underestimating amounts as a result. NICE provides an example of a community FV scheme where the annual cost of delivering two FV applications for 6,000 children is estimated at around £28 per child.[20] This is already a significant cost but is much lower than our estimate. It is unclear what the participation levels in this NICE example were and whether this cost includes the significant resources needed to maintain high participation levels in such a programme over a number of years. Sustainability, including financial sustainability, is a crucial consideration for commissioners, particularly with diminishing resources.

There is clearly a need to improve diets as well as increase fluoride availability. National efforts, led by Public Health England, are already underway to reduce sugar consumption, mainly due to increasing levels of obesity.[21] Integrating oral health into national sugar-reduction, and other health strategies targeting children, would seem to be the best option to improve oral health and reduce inequalities at population level.

Conclusions

Systematic reviews indicate that FV applications have a preventive effect on dental decay. Our experience indicates that it is feasible to carry out fluoride varnish applications in a community setting. However, intensive efforts were needed to secure and maintain participation, making this an expensive intervention which may be difficult to sustain for the long term. There was an increase in the number of children attending for dental care and receiving treatment but also an increase in dental decay experience. Although this was an uncontrolled evaluation, this supports the emerging evidence that regular FV applications may not achieve reduction in dental decay levels without changes in other behaviours such as eating habits. Ultimately, oral health improvement programmes need to be part of a holistic approach, which includes dietary change as well as increasing fluoride availability, to be effective.

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