



Public Health  
England

Protecting and improving the nation's health

## **York Health Economics Consortium**

**A rapid review of evidence on the  
cost-effectiveness of interventions  
to improve the oral health of  
children aged 0-5 years**

## About Public Health England

Public Health England exists to protect and improve the nation's health and wellbeing, and reduce health inequalities. It does this through world-class science, knowledge and intelligence, advocacy, partnerships and the delivery of specialist public health services. PHE is an operationally autonomous executive agency of the Department of Health.

Public Health England  
Wellington House  
133-155 Waterloo Road  
London SE1 8UG  
Tel: 020 7654 8000  
[www.gov.uk/phe](http://www.gov.uk/phe)  
Twitter: @PHE\_uk  
Facebook: [www.facebook.com/PublicHealthEngland](http://www.facebook.com/PublicHealthEngland)

Prepared by: York Health Economics Consortium  
For queries relating to this document, please contact: [jenny.godson@phe.gov.uk](mailto:jenny.godson@phe.gov.uk)

© Crown copyright 2016

You may re-use this information (excluding logos) free of charge in any format or medium, under the terms of the Open Government Licence v3.0. To view this licence, visit [OGL](http://www.nationalarchives.gov.uk/ogl) or email [psi@nationalarchives.gsi.gov.uk](mailto:psi@nationalarchives.gsi.gov.uk). Where we have identified any third party copyright information you will need to obtain permission from the copyright holders concerned. Any enquiries regarding this publication should be sent to [jenny.godson@phe.gov.uk](mailto:jenny.godson@phe.gov.uk).

Published September 2016  
PHE publications gateway number: 2016321



# Contents

About Public Health England	2
Executive summary	4
Abbreviations	9
Introduction	10
Methods	12
Results	17
Discussion	29
Conclusions	33
References	34
Appendix 1. Search strategies	35
Appendix 2. PRISMA flow chart	50
Appendix 3. Studies excluded (based on assessment of full text), with reasons	51
Appendix 4. Detailed data extraction	53
Appendix 5. Detailed quality assessment	56

# Executive summary

## Background

This rapid review has been commissioned by Public Health England (PHE) from the York Health Economics Consortium (YHEC) to update economic evidence on oral health prevention measures reviewed in the National Institute for Health and Care Excellence (NICE) public health guidelines (PH55) on oral health published in 2014 and economic analysis of oral health promotion approaches for dental teams was reviewed as part of the NICE NG30 guidelines. The evidence identified in this review focuses on those interventions with evidence of effectiveness in improving oral health outcomes for five year olds, published since the previous reviews. It will inform the rest of the commission; the development of a user friendly modelling tool which can be used by commissioners of oral health improvement programmes to determine the cost effectiveness and return on investment (ROI) of oral health initiatives.

## Objectives

This report describes a rapid review of recently published evidence on the cost effectiveness of interventions to improve oral health in children aged 0-5 years, specifically:

- what is the cost-effectiveness of oral health promotion interventions involving supervised tooth brushing with fluoride toothpaste with 0-5 year olds?
- what is the cost-effectiveness of oral health promotion interventions involving the use of fluoride varnish with 0-5 year olds?
- what is the cost-effectiveness of water fluoridation to improve oral health in 0-5 year olds?
- what is the cost-effectiveness of oral health promotion interventions involving the provision of toothbrushes and toothpaste to 0-5 year olds?
- what is the cost-effectiveness of oral health promotion interventions performed in home visits by health workers with 0-5 year olds?

## Methods

Searches of eight databases and three conferences were conducted in March 2016 to identify economic evaluations of the specified oral health interventions in relation to children aged 0-5 years, published in English since 2012 and generalisable to England. This partially updated an earlier review conducted to inform NICE guidance PH55. Eligible studies were data extracted, quality assessed and summarised.

## Results

From the 4,144 records retrieved, five studies (in six reports) met the review eligibility criteria. Quality was measured by considering issues around study design, data collection and analysis and interpretation of results. Two studies (reported in three papers) were judged to be of good quality <sup>[6,3,11]</sup>, two to be of moderate quality <sup>[4,12]</sup> and one study <sup>[5]</sup> was weak.

### Supervised tooth brushing

The previous review <sup>[1]</sup> undertaken to support the NICE guidance (PH55) <sup>[2]</sup> did not review this intervention. The current review has identified a Scottish study (Anopa <sup>[6]</sup>) of good quality that found supervised tooth brushing for children whilst attending Scottish nurseries to be cost saving. The implications for England are assessed in the discussion section below.

### Fluoride varnish

The previous review <sup>[1]</sup> undertaken to support the NICE guidance (PH55) <sup>[2]</sup> found two weak studies in children aged under six in the USA, suggesting that adding fluoride varnish to standard care results in financial savings from avoided treatment of tooth decay which exceeded the programme costs.

The current review has identified three further papers (conducted in the USA) which look at programmes of which fluoride varnish (and in one case, home topical fluoride) was one component. One study <sup>[3]</sup> found fluoride varnish cost saving applied to all children between six and 60 months and another <sup>[4]</sup> the reverse. Insufficient detail was provided in the papers to say with certainty why the difference occurs. The third study did not report separately on the cost-effectiveness of the varnish component.

### Water fluoridation

The previous review of cost-effectiveness studies <sup>[1]</sup> undertaken to support the NICE guidance (PH55) <sup>[2]</sup> found weak evidence from one economic evaluation carried out in children aged 0-5 years in the USA that water fluoridation programmes are cost saving.

This review has identified two further studies (conducted in the USA) (Atkins <sup>[3]</sup> of moderate quality and Edelstein <sup>[4]</sup> of poor quality) which look at programmes in which water fluoridation formed one part, one of which found water fluoridation to be cost saving. These studies are of limited generalisability to England because they were undertaken in the USA from the perspective of Medicaid and presented hypothetical savings with little information on the basis of the calculations.

## Provision of toothbrushes and toothpaste

The previous review <sup>[1]</sup> undertaken to support the NICE guidance (PH55) <sup>[2]</sup> found one economic evaluation with minor limitations suggesting that providing fluoride toothpaste and a toothbrush by post to children aged 0-5 years reduced levels of tooth decay, but did not provide details of saving from treatment costs avoided.

This review has identified two further papers (conducted in the USA) (Atkins <sup>[3]</sup> and Edelstein <sup>[4]</sup>) which found that toothbrush provision and fluoride toothpaste (within a multicomponent programme) are cost saving. An Australian study of the impact of home visits by oral health therapists on early childhood caries <sup>[5]</sup>, which also involved the provision of toothbrushes and toothpaste, also found it was cost saving compared to usual care (visiting the dentist). Although this was a good quality study it has limited generalisability to England in particular because of a high annual discount to costs and benefits.

## Home visits

The previous review <sup>[1]</sup> undertaken to support the NICE guidance (PH55) <sup>[2]</sup> did not investigate the effectiveness of home visits. In the current review we identified an Australian study of the impact of home visits by oral health therapists on early childhood caries <sup>[5]</sup> as well as the provision of toothbrushes and toothpaste. The model found that both telephone contacts and home visits were cost saving compared to usual care (ie visiting the dentist). Although this was a good quality study, it has limited generalisability to England in particular because of a high annual discount to costs and benefits (a discount rate of 5% per annum was applied in the study whereas 1.5%pa is the NICE reference case for public health interventions in England) and different healthcare costs and caries rates in Australia compared to England.

## Discussion

In this review of studies published since 2013, five relevant studies were identified. Four of the five studies were based outside of the UK which limits the generalisability of their cost-effectiveness evidence to England due to the differential costs between countries and issues such as differences in the underlying tooth decay rate between countries.

The Scottish cost-minimisation study (Anopa) of a national tooth brushing programme <sup>[6]</sup> is both of good quality and is more relevant to England, taking into account that the reimbursement system is different in Scotland and therefore potential costs of treatment may also be different. There is some doubt about the strength of the evidence base since the analysis assumes that the total reduction in tooth decay in five year old children between 2001/02 and 2009/10 is due to the tooth brushing programme. The

authors undertook a hypothetical analysis that provided evidence that the biggest savings of the programme may result from the most economically deprived children<sup>[6]</sup>.

There are limitations associated with the conduct of a rapid review. Despite an extensive search, relevant studies may have been missed. This review is limited to studies published since 2013 and up until March 2016. Some, but not all, of the review questions have, however, been subject to review prior to 2013. There may be further relevant cost-effectiveness studies (for example on the one topic with generalisable information, supervised tooth brushing) published prior to 2013 than those reviewed here.

## Conclusions

There are few published studies of the interventions in question that add to the cost-effectiveness evidence base for these interventions in children aged 0-5 years.

Using data from a single recent study of supervised tooth brushing in Scottish nurseries<sup>[6]</sup>, there is a suggested total cost saving (of actual and anticipated dental treatments) of £61.51 per child after removing the programme cost of £15.78 per child. At a population level of 54,812 five year olds in Scotland in 2009/10, this equated to a saving after programme costs of £3.37 million. With regard to the costs of general anaesthetic (GA) treatment, the annual savings (which may generate cashable savings) from GA treatment costs have been calculated using the sensitivity analysis data in this paper and could range from £31.72 (2009 UK£) per child to £146.39 (2009 UK£) per child after the costs of the programme.

It should also be noted that GA costs vary between England and Scotland and, although the Scottish study<sup>[6]</sup> used a cost of £653.26 for extraction under GA, the tariff cost of such a GA procedure in England has been estimated as £836<sup>[7]</sup>.

However, the study is weakened by doubts about the strength of the effectiveness evidence underpinning the analysis and the generalisability of Scottish dental treatment costs to England may be limited.

No robust and generalisable information on the cost-effectiveness of fluoride varnish or on the provision of toothbrushes and toothpaste was found for the same age group. No recent robust and generalisable studies on the cost-effectiveness of water fluoridation to improve oral health in 0-5 year olds were identified. No recent robust and generalisable information on the cost-effectiveness of oral health promotion interventions performed in home visits by health workers with 0-5 year olds was identified.

The scarcity of cost-effectiveness evidence should not be interpreted as evidence that these interventions are not effective or cost-effective. The review did not look for effectiveness evidence without cost-effectiveness and absence of evidence on cost-effectiveness is not the same as evidence of absence.

Given the paucity of published cost-effectiveness evidence on oral health interventions to children under five that is generalisable to England, PHE commissioned a bespoke return on investment calculator from YHEC. The calculator allows effectiveness data on interventions to be used to estimate the potential economic benefits from specific interventions using tooth decay prevalence rates and treatment costs specifically for England. The tool can be found on the PHE website.

## Abbreviations

CH-9D	Child Health Utility
DH	Department of Health
EYCC	Early Years and Child Care Centres
NICE	National Institute for Health and Care Excellence
PHE	Public Health England
QALY	Quality-adjusted life years
ROI	Return on investment
YHEC	York Health Economics Consortium

# Introduction

## Introduction to the disease area

This report describes a rapid review of recently published evidence on the cost effectiveness of interventions to improve oral health in children aged 0-5years.

Oral health problems include gum (periodontal) disease, tooth decay (caries), tooth loss and oral mucosal disease including oral cancers. However, tooth decay is the most common oral disease affecting children and young people in England and is mostly preventable<sup>[8]</sup>. The focus of this rapid review is the cost-effectiveness of programmes that have evidence of effectiveness<sup>[2, 8]</sup> in reducing tooth decay at age five years. Good oral health is also an important part of ensuring good general health and wellbeing<sup>[8]</sup>. Poor oral health can have far reaching negative effects on school readiness, school absence, communication, eating and socialisation. In addition, there can be a loss of productivity from parents or carers who have to take time off work to take their children to the dentist.

There have been recent improvements in the oral health of children in England. However, inequalities remain between poorer and richer communities as well as regionally<sup>[9]</sup>. In 2015, 24.7% of five year olds had tooth decay but the figure was lower in south east England (20.1%) and higher in the north west of England (33.3%)<sup>[9]</sup>.

## Background

Current standards and guidance in the area include the public health guidelines (PH55) published by the National Institute for Health and Care Excellence (NICE) for the Department of Health (DH)<sup>[2]</sup> and PHE's evidence-informed toolkit aimed at helping local authorities commission better oral health for children and young people<sup>[8]</sup>.

PH55 is aimed at public health and wider social and educational bodies as well as personnel within them and makes recommendations on how to assess oral health needs, develop local strategies and deliver community-based interventions in England<sup>[2]</sup>. Oral health should be achieved through:

- promoting and protecting oral health by improving diet and reducing consumption of sugary food and drinks, alcohol and tobacco
- improving oral hygiene
- increasing the availability of fluoride
- encouraging people to go to the dentist regularly
- increasing access to dental services

PH55 included a review of economic evaluations of oral health prevention measures <sup>[1]</sup> and there was a subsequent review of oral health promotion approaches for dental teams <sup>[10]</sup> for NICE NG30 guidelines.

PHE's toolkit outlines the responsibilities that local authorities have within oral health as dictated by the Health and Social Care Act in 2012 and regulations <sup>[8]</sup>. The toolkit also provides support for local authorities in delivering this care, including bringing together and assessing the best available evidence. This enables the development of evidence-informed programmes to improve oral health in children and young people.

## Purpose of this review

This review is part of a project commissioned through PHE's health economics commissioning framework. PHE has commissioned this project in order to inform commissioners and those in a position to implement oral health improvement initiatives, supplying them with the knowledge to inform their decision making around oral health interventions.

The evidence identified in this rapid review will inform the rest of the project: the development of a user-friendly modelling tool which can be used by local authorities to determine the cost-effectiveness and return on investment (ROI) of an oral health initiative, or combination of initiatives, for their local area.

## Objective of this review

This rapid review investigates the following questions around interventions which have been found to have evidence of effectiveness in reducing tooth decay in five year old children <sup>[2, 8]</sup>:

- what is the cost-effectiveness of oral health promotion interventions involving supervised tooth brushing with fluoride toothpaste with 0-5 year olds?
- what is the cost-effectiveness of oral health promotion interventions involving the use of fluoride varnish with 0-5 year olds?
- what is the cost-effectiveness of water fluoridation to improve oral health in 0-5 year olds?
- what is the cost-effectiveness of oral health promotion interventions involving the provision of toothbrushes and toothpaste to 0-5 year olds?
- what is the cost-effectiveness of oral health promotion interventions performed in home visits by health workers with 0-5 year olds?

## Methods

### Eligibility criteria

To identify relevant evidence for the rapid review, clear definitions of the population of interest, interventions, comparators and study types of interest were specified, as well as limits which could be applied to the review questions. These eligibility criteria are shown in Table 1.

**Table 1. Eligibility criteria for the review**

	<b>Eligible studies</b>	<b>Ineligible studies</b>
<b>Population</b>	Children aged between 0 and 5 years old.  Studies of mixed populations of adults and children where the data for children are presented separately.	Children aged over 5 years of age.  Adults  Studies of mixed populations where data are not reported for eligible children separately.
<b>Interventions</b>	Oral health interventions including one or more of the following: <ul style="list-style-type: none"> <li>• Delivered by health workers during home visits;</li> <li>• Involving fluoride varnish;</li> <li>• Providing toothbrushes and toothpaste;</li> <li>• Supervised tooth brushing;</li> <li>• Water fluoridation.</li> </ul>	Studies of oral and other interventions where the data for oral interventions are not reported separately.  Oral health interventions other than those specified here.
<b>Comparators</b>	Other oral health interventions  No intervention	Studies of oral and other interventions where the data for oral interventions are not reported separately.
<b>Outcomes</b>	Oral health outcomes including levels of tooth decay numbers of fillings, numbers of teeth removed, quality of life  Cost-effectiveness outcomes including cost per quality-adjusted life year (QALY), cost per filling avoided, cost per extraction avoided, intervention costs, return on investment of the initiative.	Non-oral health outcomes
<b>Study designs</b>	Economic evaluations (cost-effectiveness studies, cost-utility studies, cost-benefit analyses);  Costing reports;  Systematic reviews of economic evaluations;  Health technology assessments reporting reviews of economic evaluations or new models.	Studies with no economic evidence

	<b>Eligible studies</b>	<b>Ineligible studies</b>
<b>Limits</b>	Publications in English  Publications in full text  Publications published 2013 onwards	Publications in languages other than English  Publications in abstract form only including conference abstracts  Publications published before 2013.

## Search strategy

We searched eight databases and three conferences (Table 2) to identify potentially relevant studies. The MEDLINE (OvidSP) strategy is shown in Figure.1 and the other search strategies are reported in Appendix A. Strategies were adapted according to the options available in each database, both from the perspective of subject indexing and also from the options offered by different search interfaces.

This was a rapid review and the search strategy was not designed to be exhaustive, but aimed to target studies most likely to be relevant to the research question, whilst retrieving a volume of records that was manageable within the timescales and resources of the project.

**Table 2. Information resources searched**

<b>Information Resource</b>	<b>Interface/URL</b>
MEDLINE and MEDLINE in Process	OvidSP
Embase	OvidSP
NHS Economic Evaluation Database (NHS EED)	Cochrane Library
Health Technology Assessment (HTA) database	Cochrane Library
EconLit	OvidSP
Cost-effectiveness Analysis (CEA) Registry	<a href="https://research.tufts-nemc.org/cear4">https://research.tufts-nemc.org/cear4</a>
RepEC (Research Papers in Economics)	<a href="https://ideas.repec.org/">https://ideas.repec.org/</a>
PubMed	<a href="http://www.ncbi.nlm.nih.gov/pubmed/advanced">http://www.ncbi.nlm.nih.gov/pubmed/advanced</a>
ISPOR conference abstracts	<a href="http://www.ispor.org/RESEARCH_STUDY_DIGEST/index.asp">http://www.ispor.org/RESEARCH_STUDY_DIGEST/index.asp</a>
iHEA conference abstracts	<a href="https://ihea2015.abstractsubmit.org/presentations/">https://ihea2015.abstractsubmit.org/presentations/</a>
HTAi conference abstracts	<a href="http://www.htai2015.org/events/2015-htai-annual-conference/agenda-24fdbeb646af4856894b56e17ef6bd6e.aspx">http://www.htai2015.org/events/2015-htai-annual-conference/agenda-24fdbeb646af4856894b56e17ef6bd6e.aspx</a>
	2014 abstract book
Handsearching	(1) records identified by checking conference abstracts for later publications (2) records identified by checking any other publications for associated papers

**Figure.1. Strategy for Ovid MEDLINE(R) in-process & other non-indexed citations and Ovid MEDLINE(R) <1946 to present>**

- 1 (oral care or oral health or oral hygiene or dental care or dental health or dental hygiene or school dentist\$ or community dentist\$ or public health dentist\$.ti,ab. (40543)
- 2 ((home visit\$ or health worker\$ or health visitor\$) and (dental or oral or caries or tooth or teeth)).ti,ab. (822)
- 3 (oral disease\$ or oral neoplasm\$ or oral cancer\$ or dental disease\$ or mouth disease\$ or dental decay or mouth neoplasm\$ or mouth cancer\$ or gum disease\$ or DMF or caries or ((tooth or teeth) adj2 (decay\$ or loss)) or gingivitis or periodontal disease\$ or periodontitis or ((dental or oral) adj plaque)).ti,ab. (97356)
- 4 tooth brushing/ or toothpastes/ or fluorides, topical/ or Mouthwashes/ (15636)
- 5 "Pit and Fissure Sealants"/ (3000)
- 6 (fluorid\$ or tooth paste\$ or tooth brush\$ or toothpast\$ or toothbrush\$ or fissure sealant\$ or mouthwash\$ or mouth wash\$ or flossing or dental floss).ti,ab. (47926)
- 7 Oral Health/ or exp Dental Care/ or exp Mouth Diseases/pc or Periodontal diseases/pc or Oral Hygiene/ or school dentistry/ or public health dentistry/ or community dentistry/ (59813)
- 8 Health Education, Dental/ or Cariostatic Agents/ (10439)
- 9 (preventive health services/ or Primary Prevention/ or Secondary Prevention/) and (dental or oral or caries or tooth or teeth).ti,ab. (1616)
- 10 (exp health services accessibility/ or healthcare disparities/ or vulnerable populations/) and (dental or oral or caries or tooth or teeth).ti,ab. (4156)
- 11 (Brushathon or smile or smiles or smiling or smile4life or (brushing adj3 life) or national oral health plan or child-smile or childsmile or smileathon).ti,ab. (4394)
- 12 or/1-11 (205172)
- 13 case report.tw. or letter/ or historical article/ or comment/ or editorial/ or (exp animals/ not humans/) (6138924)
- 14 12 not 13 (175051)
- 15 economics/ (26660)
- 16 exp "costs and cost analysis"/ (195197)
- 17 economics, dental/ (1876)
- 18 exp "economics, hospital"/ (21203)
- 19 economics, medical/ (8857)
- 20 economics, nursing/ (3933)
- 21 economics, pharmaceutical/ (2607)
- 22 (economic\$ or cost or costs or costly or costing or price or prices or pricing or pharmacoeconomic\$.ti,ab. (541725)
- 23 (expenditure\$ not energy).ti,ab. (21100)
- 24 value for money.ti,ab. (1154)
- 25 budget\$.ti,ab. (21587)
- 26 or/15-25 (675030)
- 27 ((energy or oxygen) adj cost).ti,ab. (3196)
- 28 (metabolic adj cost).ti,ab. (982)
- 29 ((energy or oxygen) adj expenditure).ti,ab. (19009)
- 30 or/27-29 (22389)
- 31 26 not 30 (669937)
- 32 14 and 31 (7366)
- 33 limit 32 to english language (6699)
- 34 limit 33 to yr="2010 -Current" (2378)

## Record selection

Search results were loaded into EndNote bibliographic software. Results were deduplicated against the search results of the previous review<sup>[1]</sup> and against each other.

One experienced researcher removed the obviously irrelevant records such as animal studies and reports obviously not related to oral health from the result set.

Records were loaded into Covidence software where a health economist assessed the titles and abstracts of the records for relevance to the rapid review eligibility criteria (Table 1).

The full text of potentially relevant papers was obtained where possible and a health economist assessed the full text in detail for relevance to the eligibility criteria and made the final selection of studies to inform the review.

The number of records excluded at each stage of the review process are shown in the study selection diagram (Appendix B). Studies excluded after assessment of the full document are listed in the excluded studies table (Appendix C) with the reasons for exclusion.

## Study data extraction and quality assessment

One health economist carried out quality assessment and data extraction for each study, and their extraction was checked by a second researcher who is a specialist in systematic reviews of economic evaluations. Any disagreements or clarifications were discussed by the two researchers.

## Data Extraction

The following data categories were extracted from all eligible included studies:

- bibliographic data
- publication type
- country of study
- study design
- type of economic evaluation or model
- study aim/objective
- study participant inclusion and exclusion criteria
- intervention(s) and comparator(s) (if applicable)
- population group description and their characteristics at baseline, along with any differences between study groups, where applicable;

- number of participants
  - patient group age (mean years)
- for models;
  - summary of model
  - modelling inputs
  - modelling techniques
  - source(s) of effectiveness data
  - clinical outcomes measured and methods of valuation used
- currency used
- years to which costs apply
- methods of handling cost data
- perspective (eg NHS)
- outcome measures used in economic evaluations
- quality-adjusted life years (QALYs)
- costs (broken down by component, where possible)
- incremental cost-effectiveness ratios (ICERs)
- direction of result with appropriate quadrant location
- statistical analysis for patient-level stochastic data
- uncertainty around cost-effectiveness
- sensitivity analysis
- author's conclusions

Where more than one publication describing a single study was identified, the data was compiled into a single entry to avoid double counting.

The quality of the economic evaluations was assessed using an instrument adapted from Drummond and Jefferson which is recommended by NICE in their specification document for submission of economic evidence in single technology appraisals<sup>[11]</sup>. The instrument is detailed in Appendix E.

## Data synthesis

Each study was summarised and critically appraised in terms of quality and also generalisability to England. The volume of evidence to answer each of the rapid review questions was summarised.

## Results

### Results of the searches

Database searches were carried out in March 2016. The database, conference and hand searches retrieved 8,251 records (Table 3). Following deduplication, 4,144 records were assessed for relevance.

**Table 3. Resources searched and records retrieved**

Information resource	Number of records identified	Number of records after deduplication against other new records
MEDLINE and MEDLINE in Process	2378	1952
PubMed	716	78
NHS Economic Evaluation Database (NHS EED)	596	75
EconLit	355	62
Cost-effectiveness Analysis (CEA) Registry	0	0
Health Technology Assessment (HTA) database	283	77
RepEC (Research Papers in Economics)	0	0
Conference abstracts	6	2
Embase (OvidSP)	3915	1896
Hand searching - records identified by checking conference abstracts for later publications	1	1
Hand searching - records identified by checking any other publications for associated papers	1	1
Total records	8251	4144

### Included studies

Five studies reported in six papers met the eligibility criteria for the review <sup>[3-6, 12, 13]</sup>. One of the studies was from the UK <sup>[6]</sup>, three from the USA <sup>[3, 4, 13]</sup> and one (reported in two papers) from Australia <sup>[5, 12]</sup>.

Summary data about the studies are shown in Table 4 and Table 5 and detailed data extraction tables are shown in Appendix D. A summary assessment of the quality of the studies is provided in Table 6 and the detailed quality assessment is in Appendix E.

**Table 4. Summary of study designs, population, intervention, comparator and model**

Study	Design	Country	Patient population	Intervention*	Comparator	Summary of model
Anopa <sup>[6]</sup>	Cost analysis.	Scotland	All children aged 3-5 (n= 54,812 in 2009/10).	Nursery tooth brushing programme including supervised tooth brushing in nurseries and toothpaste packs on six occasions for home use	No supervised nursery brushing	Simple cost calculation, essentially based upon a decision tree.
Atkins <sup>[3]</sup>	Simple cost calculation using published effectiveness evidence.	Alaska, USA	All children aged 6-60 months. Estimates based on child population of 2,575.	Specific dental interventions: <u>water fluoridation</u> , dental sealants, <u>fluoride varnish</u> , tooth brushing with fluoride toothpaste, conducting initial dental exams on children <18 months of age and <u>provision of toothbrushes</u> .	Not applicable	Not a model. Simple cost calculation based upon current costs of caries treatment, current caries incidence, current deployment of interventions, effectiveness of interventions and potential savings if uptake of interventions increased.
Edelstein <sup>[4]</sup>	System dynamics modelling.	USA	Children under 6. Assumed 450,000 pre-school children were eligible.	9 preventive interventions: <u>water fluoridation</u> , <u>fluoride varnish (to all preschoolers and targeted at those at high risk)</u> , fluoride toothpaste, medical screening and fluoride varnish application, bacterial transmission reduction, motivational interviewing, dental prevention visits, secondary prevention, and combinations; and the effect of defluoridating New York City.	Not applicable	Limited information provided. Described as a system dynamics model that tracks caries progression.
Koh <sup>[5]</sup> & Plonka <sup>[12]</sup>	RCT	Australia	Children aged 6-60 months (n=296). 188 home visits intervention; 58 telephone contacts intervention; 40 reference controls/usual care	Home visit and telephone interventions by oral health visitors  The home-visit intervention consisted of five <u>home visits</u> ('Home visit') by oral health therapists when the children were aged 6, 12, 18, 30 and 42 months. Children received dental examinations and mothers received dental care instructions for durations of approximately 30 minutes.  The telephone intervention ('Telephone contacts') consisted of five telephone calls when the children were aged 6, 12, 18, 30 and 42 months, during which oral health therapists gave dental care instructions. The calls were 15 - 20 minutes long and instructions included tooth brushing and dietary advice.	The usual care groups received no dental contact, which is typical of dental services for the age group. The groups included children aged 24 and 60 months.	[Plonka] A Markov model combined data on dental caries incidence, dental treatments, quality of life and costs for a cohort of children from age 6 months to 6 years. Constructed in Treeage Pro 2013 (TreeAge Software Inc., Williamstown, MA, USA).

Study	Design	Country	Patient population	Intervention*	Comparator	Summary of model
Samnali ev <sup>[13]</sup>	RCT	USA	Children younger than 60 months with active caries or a history of caries (n=518).  Disease management group: n=395; baseline group: n=123	<p>Clinical assessments were performed at 24, 36, 48 and 60 months.</p> <p>Pilot disease management programme, aimed at preventing early childhood caries among children younger than 5 years. It included in-office and at-home components.</p> <p>In-office: assessment of the patient's caries risk at each visit, <u>applying fluoride varnish</u> and setting self-management goals for home care. Parents were coached about the factors that lead to caries and told how tooth decay can be prevented and stopped. A clinical examination assessed for the presence of new demineralization and cavitation along with remineralization. The number of visits was determined by the most recent caries risk assessed, in conjunction with the restorative or surgical treatment needed and desired.</p> <p>For at-home care, parents were given a menu goals to work on before the next visit. Such goals included basic caries control strategies such as more frequent tooth brushing, <u>using topical fluorides at home</u>, and modifying the diet to include less frequent intake of carbohydrates and sugars. A fluoride or alternative were also recommended.</p>	Conventional dental treatment (historical data).	Generalized linear models were used to estimate incremental costs and effectiveness. All analyses were conducted with SAS 9.3® (SAS Institute Inc., SAS 9.1.3, Cary, NC, USA).

\*Aspects of the intervention of interest to this review are underlined  
 RCT = Randomised Controlled Trial, UK = United Kingdom, USA = United States

**Table 5. Summary of study oral health and cost-effectiveness outcomes**

Study	Oral Health Outcomes	Cost-effectiveness Outcomes
Anopa [6]	<p>Teeth decayed, filled and extracted for intervention (nursery tooth brushing and home toothpaste pack programme) vs comparator (no programme)</p> <p>Filled teeth in 5 year olds                      Before programme (2001/02): Zero national dental inspections of 5 year olds                      2002/03: 17,857                      Post programme (2009/10): 10,909</p> <p>Number of decayed teeth in 5 year olds                      Before programme (2001/02): Zero national dental inspections of 5 year olds                      2002/03: 113,844                      Post programme (2009/10): 57,167</p> <p>Number of children with 1 tooth missing in 5 year olds                      Before programme (2001/02): Zero national dental inspections of 5 year olds                      2002/03: 1,937                      Post programme (2009/10): 766</p> <p>Number of children with 2 or more teeth missing in 5 year olds                      Before programme (2001/02): Zero national dental inspections of 5 year olds                      2002/03: 7,139                      Post programme (2009/10): 2,837</p>	<p>Total intervention costs</p> <p>Total costs of treatments before programme began: £150.91 per child (2001/2002)                      Total costs of programme: £15.78 per child per year in 2009/10                      Total cost of treatments 8 years after start of programme (2009/10) £73.62 per child</p> <p>Cost saving, calculated from information in the paper, after the cost of the programme (£15.78 per child) was £61.51 per child. Extrapolating this out to all five year olds in Scotland in 2009/10, this equated to a potential £3.37m population level saving after the cost of the programme..</p> <p>Hypothetical analysis by deprivation level showed that the reduction in costs would be highest in the most deprived areas and lowest in the least deprived.</p>
Atkins [3]	<p>Reduction in caries at year 1</p> <p>Fluoride varnish (n=1311)                      Mean applications per child per year: 1.68                      Number of children with caries: 95                      Total number of caries: 740                      % effectiveness: 0.18                      Number of caries averted: 133</p> <p>Water fluoridation (n=929)                      Number of children with caries: 65                      Total number of caries: 525                      % effectiveness: 0.26                      Number of caries averted: 137</p> <p>Toothbrush/toothpaste (n=1416)                      Number of children with caries: 103</p>	<p>Total intervention costs</p> <p>Per child per year costs of delivering intervention                      Fluoride varnish: \$662                      Water fluoridation: \$278                      Toothbrush/toothpaste: \$605</p> <p>Minimum estimates of cost saving per child from averted caries in year one                      Fluoride varnish: \$2,056 (assumed 18% effective and 100% coverage)                      Water fluoridation: \$3,081 (assumed 26% effective and 68% coverage)                      Toothbrush/toothpaste: \$2,390 (assumed 21% effective and 100% coverage)</p>

Study	Oral Health Outcomes	Cost-effectiveness Outcomes
	Total number of caries: 799 % Effectiveness: 0.21 Number of caries averted: 168	
Edelstein <sup>[4]</sup>	<p>Full water fluoridation to New York City:                      Percentage of children with cavities:26.4%;                      Percentage reduction compared with baseline: 3.3%</p> <p>Fluoride varnish to pre-schoolers receiving Medicaid assuming 40% reduction in rate of new cavities:                      Percentage of children (6 months to 6 years) with cavities: 18.7%;                      percentage of reduction in children (6 months to 6 years) compared with baseline: 31.5%                      Percentage of children (2 years to 6 years) with cavities: 24.0%;                      percentage of reduction in children (2 years to 6 years) compared with baseline: 12.1%                      Percentage of children at high risk (2 years to 6 years) with cavities: 26.7%;                      percentage of reduction in children at high risk (2 years to 6 years) compared with baseline: 2.2%</p> <p>Tooth brushing:                      Percentage of children with cavities if a 50% increase in all Medicaid pre-schoolers aged 2-3 years: 25.6%;                      Percentage reduction compared to baseline if a 50% increase in all Medicaid pre-schoolers aged 2-3 years: 6.2%</p> <p>Percentage of children with cavities if a 50% increase in high risk Medicaid pre-schoolers aged 2-3 years: 25.9%;                      Percentage reduction compared to baseline if a 50% increase in high risk Medicaid pre-schoolers aged 2-3 years: 5.1%</p>	<p>Total intervention costs</p> <p>Total costs                      Full water fluoridation to New York City: \$1,221,375                      Fluoride varnish to pre-schoolers receiving Medicaid:</p> <ul style="list-style-type: none"> <li>• \$241,786,256 to all aged 6 months to 6 years;</li> <li>• \$170,385,376 to all aged 2 years to 6 years;</li> <li>• \$19,247,422 to those at high risk aged 2 years to 6 years</li> </ul> <p>Tooth brushing:</p> <ul style="list-style-type: none"> <li>• \$15,071,346 if a 50% increase in all Medicaid pre-schoolers aged 2-3 years;</li> <li>• \$1,702,680 if a 50% increase in high risk Medicaid pre-schoolers aged 2-3 years</li> </ul> <p>Total savings in cost of cavity repairs over 10 years                      Full water fluoridation to New York City: \$12,201,128                      Fluoride varnish to pre-schoolers receiving Medicaid assuming 40% reduction in rate of new cavities:</p> <ul style="list-style-type: none"> <li>• \$106,970,152 to all aged 6 months to 6 years;</li> <li>• \$48,601,440 to all aged 2 years to 6 years;</li> <li>• \$12,584,128 to those at high risk aged 2 years to 6 years</li> </ul> <p>Tooth brushing:</p> <ul style="list-style-type: none"> <li>• \$22,330,792 if a 50% increase in all Medicaid pre-schoolers aged 2-3 years;</li> <li>• \$5,465,688 if a 50% increase in high risk Medicaid pre-schoolers aged 2-3 years</li> </ul> <p>Net savings over 10 years                      Full water fluoridation to NYC: \$10,979,753                      Fluoride varnish to pre-schoolers receiving Medicaid assuming 40% reduction in rate of new cavities:</p> <ul style="list-style-type: none"> <li>• -\$134,816,104 to all aged 6 months to 6 years;</li> <li>• -\$121,783,936 to all aged 2 years to 6 years;</li> <li>• -\$6,663,294 to those at high risk aged 2 years to 6 years</li> </ul> <p>Tooth brushing:</p> <ul style="list-style-type: none"> <li>• \$7,259,446 if a 50% increase in all Medicaid pre-schoolers aged 2-3 years;</li> <li>• \$3,763,008 if a 50% increase in high risk Medicaid pre-schoolers</li> </ul>

Study	Oral Health Outcomes	Cost-effectiveness Outcomes
		<p>aged 2-3 years</p> <p>Return on Investment - dollars saved in dental repair for each dollar spent on the intervention</p> <p>Full water fluoridation to NYC: \$9.99</p> <p>Fluoride varnish to pre-schoolers receiving Medicaid assuming 40% reduction in rate of new cavities:</p> <ul style="list-style-type: none"> <li>• \$0.44 to all aged 6 months to 6 years;</li> <li>• \$0.29 to all aged 2 years to 6 years;</li> <li>• \$0.65 to those at high risk aged 2 years to 6 years</li> </ul> <p>Tooth brushing:</p> <ul style="list-style-type: none"> <li>• \$1.48 if a 50% increase in all Medicaid pre-schoolers aged 2-3 years;</li> <li>• \$3.21 if a 50% increase in high risk Medicaid pre-schoolers aged 2-3 years</li> </ul>
<p>Koh <sup>[5]</sup> &amp; Plonka <sup>[12]</sup></p>	<p>HRQoL (utility value), number of caries, plaque</p> <p>[Koh] Adapted the Child Health Utility (CHU-9D) paediatric quality of life multi-attribute instrument so that parents could respond as proxies for their children.</p> <p>'Healthy': 1.0 (full health)</p> <p>'Caries': 0.90 (SD 0.12) (Range: 0.38 to 1.00)</p> <p>Children with &lt; 5 carious/filled teeth: 0.91 (SD 0.12)</p> <p>Children with &gt; 5 carious/filled teeth: 0.88 (SD 0.11)</p> <p>Number of carious teeth for every 100 children over 5.5 years</p> <p>Usual care: 258</p> <p>Telephone intervention: 158</p> <p>Home visits intervention: 145</p> <p>[Plonka] Children with caries at 24 months: n (%)</p> <p>Home visits: 3 (1.5%)</p> <p>Telephone contacts: 4 (6.8%)</p> <p>Reference controls: 9 (22.5%)</p> <p>P-values</p> <p>Home visit vs Telephone: P=0.05</p> <p>Home visit vs Reference controls: P&lt;0.00001</p> <p>Telephone vs Reference controls: P=0.03</p> <p>Plaque on child's maxillary incisors at 24 months (%)</p> <p>Home visit: 20%</p> <p>Telephone: 30%</p>	<p>Total intervention costs, QALYs, ICER outcome</p> <p>Programme costs: Per person; Low sensitivity values (per person); High sensitivity values (per person)</p> <p>Home visit: 20.8; 18.2; 24.6</p> <p>Telephone interview: 14.3; 12.1; 16.4</p> <p>Vehicle costs for home visits: 11.0; 9.4; 12.6</p> <p>QALYs for 100 children over 5.5 years: Effects; Incremental effects</p> <p>Usual care: 540;</p> <p>Telephone: 546; 6</p> <p>Home visits: 547; 7</p> <p>Cost-effectiveness for 100 children over 5.5 years: costs; incremental costs; ICER</p> <p>Usual care: 348,903;</p> <p>Telephone: 204,193; -144,709; Dominant relative to usual care</p> <p>Home visits: 181,870; -167,032; Dominant relative to usual care and telephone intervention.</p>

Study	Oral Health Outcomes	Cost-effectiveness Outcomes
Samnaliev <sup>[13]</sup>	Reference Controls: 43% Not reported	Total intervention costs  Incremental health care costs per patient: 3 months; 6 months; 12 months Baseline: 698; 1,092; 2,023 Disease management programme: 677; 889; 1,271 Difference: 21 (P = 0.84); 203 (P = 0.17); 752 (P = 0.003)  Incremental societal costs per patient: 3 months; 6 months; 12 months Baseline: 955; 1,441; 2,465 Disease management programme: 935; 1,255; 1,796 Difference: 20 (P = 0.85); 215 (P = 0.24); 669 (P = 0.009)

CHU-9D = Child Health Utility, HRQoL = Health Reported Quality of Life, NYC = New York City, SD = Standard Deviation

**Table 6. Summary of study quality assessment (detailed quality assessment is presented in Appendix E)**

Answer	Anopa <sup>[6]</sup>	Atkins <sup>[3]</sup>	Edelstein <sup>[4]</sup>	Koh <sup>[5]</sup> & Plonka <sup>[12]</sup>	Samnaliev <sup>[13]</sup>
<b>Study Design</b>					
Yes (indicative of higher quality)	7	4	5	6	6
No (indicative of quality issues)	0	3	2	1	1
Not applicable	0	0	0	0	0
<b>Data Collection</b>					
Yes (indicative of higher quality)	8	6	3	12	9
No (indicative of quality issues)	1	2	6	0	3
Not applicable	5	6	5	2	2
<b>Analysis and Interpretation of Results</b>					
Yes (indicative of higher quality)	7	7	4	14	8
No (indicative of quality issues)	2	5	9	0	7
Not applicable	6	3	2	1	0
<b>Overall</b>					
Yes (indicative of higher quality)	22	17	12	32	23
No (indicative of quality issues)	3	10	17	1	11
Not applicable	11	9	7	3	2
	Good	Moderate	Weak	Good	Moderate

## UK study

One study met the eligibility criteria and was based in the UK <sup>[6]</sup>. Anopa undertook an economic evaluation, from a NHS perspective, of the nursery tooth brushing programme (including distribution of toothpaste packs for home use) introduced in 2001 that is now part of the Scotland-wide Childsmile programme. The intervention was supervised tooth brushing for children whilst attending Scottish nurseries (now known as Early Years and Child Care Centres (EYCC)).

According to Scottish dental inspection data, lower rates of actual and anticipated treatment (fillings and extractions) and decayed teeth were reported in 2010 compared to 2001 for children aged five.

Anopa assumed that the change between 2001 and 2010 was entirely due to the nursery tooth brushing and home toothpaste pack programme <sup>[6]</sup>. They therefore

applied the filling, extraction and decayed tooth rates seen in 2001 to the 2010 population of five year olds, to estimate what these would have been without the programme. The average costs of a decayed tooth (fillings and extractions) were estimated from data from the literature, the Information and Services Division (ISD) and the Scottish Dental Remuneration Amendment. These costs were then applied to the actual and projected decayed tooth rates in five year old children to estimate the total cost savings in dentistry to the NHS arising from the programme.

Using data presented in Anopa<sup>[6]</sup> there is a suggested total cost saving (of actual and anticipated dental treatments) of £61.51 per child after removing the programme cost of £15.78 per child. At a population level of 54,812 five year olds in Scotland in 2009/10, this equated to a saving after programme costs of £3.37 million. With regard to the costs of general anaesthetic (GA) treatment, the annual savings (which may generate cashable savings) from GA treatment costs has been calculated using the sensitivity analysis data in this paper and could range from £31.72 (2009 UK£) per child to £146.39 (2009 UK£) per child after the costs of the programme.

Anopa also undertook a hypothetical analysis that provided evidence that the biggest savings of the programme may result from the most economically deprived children<sup>[6]</sup>.

Although Anopa is well described and costs and treatment patterns are well evidenced, it has limitations. The evidence base is drawn not from a trial but from a population level analysis<sup>[6]</sup>. The quality of the analysis is also almost entirely determined by whether the assumption holds that falling tooth decay rates between 2001/02 and 2009/10 in five year olds were entirely due to the nursery tooth brushing programme.

## Studies from the USA

Three of the studies, Atkins<sup>[3]</sup>, Edelstein<sup>[4]</sup> and Samnaliev<sup>[13]</sup> were based in the USA and were conducted from the perspective of Medicaid.

Atkins<sup>[3]</sup> and Edelstein<sup>[4]</sup> both provided estimates for the possible cost savings from fluoride varnish, fluoridation of water and provision of toothbrushes and fluoride toothpaste to pre-school aged Alaskan-American native children in the Yukon-Kuskokwim delta region of Alaska and children in New York State.

Whilst Atkins<sup>[3]</sup> used a basic calculation to estimate the impact of increasing coverage through the interventions, Edelstein<sup>[4]</sup> used a system dynamics model. However, both approaches were essentially driven by the same inputs: current levels and costs of cavities, current uptake of interventions, costs derived from public reimbursement datasets and effectiveness of interventions based upon published literature and clinical opinion, with assumptions about the potential level of intervention uptake. Both studies were cost minimisation analyses rather than cost effectiveness analyses.

Atkins reported that for native children in a district of Alaska, all of the interventions would be cost saving. The mean number of fluoride varnish applications was 1.68 per child per year. Fluoride varnish would save \$2,056 (in 2011 US\$) per child (100% coverage and 18% effective at reducing caries), providing toothbrushes and toothpaste would save \$2,390 per child (100% coverage and assumed 21% effective) and water fluoridation would save \$3,081 per child (68% coverage and 26% effective).

Edelstein also found that providing water fluoridation to all residents of New York City and increasing tooth brushing by 50% in pre-schoolers aged two to three years would produce net savings for total cavity treatment costs over 10 years of \$11.0 million and \$7.3 million respectively. In contrast to Atkins <sup>[3]</sup>, Edelstein <sup>[4]</sup> reported that in New York State, fluoride varnish would incur costs over 10 years costing \$134.8 million if provided to all children aged six months to six years. The reason for this difference cannot be determined from the papers as the effectiveness assumed in Edelstein for fluoride varnish is higher than in Atkins (31.5% vs 26%) and the current annual rate of cavities appears much higher in the Edelstein study (27.3% vs 7.3%, although it is not clear whether the Edelstein figure is incidence or prevalence)

In contrast to the hypothetical savings estimated by Atkins <sup>[3]</sup> and Edelstein <sup>[4]</sup>, Samnaliev <sup>[13]</sup> undertook an economic analysis alongside a randomised control trial of a two component disease management programme to reduce childhood caries in children younger than five years old with active caries or a history of caries. The analysis was again cost minimisation with simple modelling of costs attached to outcomes using hospital charges, Medicaid costs for those in the treatment groups and those in the control arm of matched children receiving usual care (visiting the dentist). In a separate analysis, parents' productivity loss in terms of days lost from work due to caries in their children were estimated.

The first part of the programme was based in dental surgeries, and involved applying fluoride varnish and setting self-management goals for home care based upon coaching parents about how their children could avoid tooth decay. Dental visit schedules were made based upon a risk categorisation of each child developing tooth decay).

The second part of the programme was 'at home'. Parents were given information on how to avoid tooth decay in their children. This included dietary advice. Parents were also given topical fluorides to use in the home, two to three times per day.

Both programmes were cost saving over 12 months. The 'usual care' group incurred incremental Medicaid costs of \$2,023 (in 2011 US\$) per child (\$2,465 for productivity loss). This compared to \$1,271 per child (\$1,796 for productivity loss) with the disease management programme.

The quality of the Atkins<sup>[3]</sup> and Edelstein<sup>[4]</sup> studies as economic analyses were low. Both were hypothetical savings with limited information provided about the basis for the calculations. Edelstein was particularly poor in this regard. There were no major concerns about the quality of Samnaliev<sup>[13]</sup>.

## Study from Australia

One Australian study (Koh 2015) looked at the economic impact of home visits by oral health therapists or telephone contacts compared to usual dental care on early childhood caries<sup>[5]</sup>. The perspective of the analysis was societal with costs to the parent and health system considered. The economic analysis directly used trial data from 325 children aged between zero and 24 months who either received three home visits or three telephone contacts at age six, 12 and 18 months. The trial and interventions were described in a paper by Plonka<sup>[12]</sup> with data on follow up to 60 months of age reported in Koh<sup>[5]</sup>.

The home visits involved two oral health therapists visiting at the same time. The oral health therapists examined the babies' teeth, observed the mother cleaning the babies' teeth and provided advice on technique. A questionnaire on oral hygiene habits was completed. As part of the visit, mothers were reminded to clean their babies' teeth twice a day with fluoride toothpaste. Toothpastes and brushes were supplied free of charge.

The telephone contact group were given the same questionnaire and oral hygiene instructions at each contact point and were also given free toothpastes and brushes.

The usual care group received no additional intervention.

Koh developed a two state Markov model (healthy teeth and caries) using the trial outcomes: children who developed tooth decay (caries) up to the age of 60 months<sup>[5]</sup>. If a child was in the 'caries' state there was a probability that the child would require filling, a crown or extraction: the probability was taken from the database of the clinic where the trial was conducted. Costs of treatment were taken from the fee schedule of the Australian Dental Association and hospital data. The hospital data were poorly described. Travel costs, out of pocket medication and lost pay were estimated from forms completed by parents in the trial. Utility data were derived from parental completed Child Health Utility (CHU-9D) forms.

The model reported 258 caries lesions per 100 children over 5.5 years in the usual care group, 158 caries lesions per 100 children in the telephone group and 145 caries lesions per 100 children in the home visit group. Mean costs per person for the two interventions were \$14.30 (in 2014 US\$) for telephone contacts and \$20.80 for home visits. Total discounted quality-adjusted life years (QALYs) per person over 5.5 years were 5.40 for usual care, 5.46 for telephone contacts and 5.47 for home visits.

Both telephone contacts and home visits were cost saving compared to usual care and so were considered to be dominant strategies <sup>[5]</sup>. Telephone contacts saved \$144,709 per 100 children and home visits an additional \$22,323 making home visits the dominant strategy overall as it generated more QALYs at a lower overall cost compared to the alternatives. The dominance of the interventions over usual care was insensitive to changes in any of the key model parameters or assumptions.

Koh 2015 was a good quality study although we note that a 5% annual discount to costs and benefits was applied. This is well above the 1.5% per annum rate which is the National Institute for Health and Care Excellence (NICE) reference case for public health interventions <sup>[5]</sup>.

## Discussion

This rapid review focused on evidence for children aged 0-5 years with research published since 2013. We have identified 5 studies that add some information to the cost effectiveness evidence base, although all have limitations and most are multi-component programmes.

### Supervised toothbrushing

The previous review <sup>[1]</sup> undertaken to support the NICE guidance (PH55) <sup>[2]</sup> did not review this intervention. The current review has identified a Scottish study that found supervised tooth brushing for children whilst attending Scottish nurseries to be cost saving and a hypothetical analysis found that the cost savings increased as socio-economic deprivation levels of children increased.

### Fluoride varnish

The previous review <sup>[1]</sup> undertaken to support the NICE guidance (PH55) <sup>[2]</sup> found only two weak studies in children aged under six in the USA suggesting that adding fluoride varnish to standard care results in financial savings from avoided caries treatments which exceed the programme costs.

The current review has identified three further papers (conducted in the USA) which look at programmes of which fluoride varnish (and in one case, home topical fluoride) was one component. One study <sup>[3]</sup> assumed the effectiveness of dental varnish applications to be between 18% and 24%, based on the literature, at a cost of US\$28.50 per unit and had 52% population coverage. It found fluoride varnish to be cost saving with \$2,056 spend averted per child for each \$662 spent. Another study <sup>[4]</sup> used the following assumptions of effectiveness of fluoride varnish resulting in disease reduction: 22% and 40% (simulations were provided for both levels of effectiveness), at a cost of US\$30 per application. This study did not find fluoride varnish to be cost saving; for each dollar spent on the program, between \$0.15 and \$0.65 were saved (depending on the specific age group, risk level of caries and level of effectiveness assumed). The conflicting conclusions cannot be explained from the information contained in each paper.

The third study did not report separately on the cost-effectiveness of the varnish component. The studies were not explicit about which staff group applied the fluoride varnish and, depending on the group used, this might have a significant impact on the costs of the intervention and its cost-effectiveness.

## Water fluoridation

The previous review <sup>[1]</sup> undertaken to support the NICE guidance (PH55) <sup>[2]</sup> found weak evidence from one economic evaluation, carried out in children aged 0-5 years in the USA, that water fluoridation programmes are cost saving.

This review has identified two further studies (conducted in the USA) (Atkins <sup>[3]</sup> and Edelstein <sup>[4]</sup>) which look at programmes of which water fluoridation formed a part and one found water fluoridation to be cost saving.

## Provision of toothbrushes and toothpaste

The previous review <sup>[1]</sup> undertaken to support the NICE guidance (PH55) <sup>[2]</sup> found one economic evaluation with minor limitations suggesting that providing fluoride toothpaste and a toothbrush by post to children ages 0-5 years reduced tooth decay, but did not provide details of savings from treatment costs avoided.

This review has identified two further papers (conducted in the USA) (Atkins <sup>[3]</sup> and Edelstein <sup>[4]</sup>) which found that toothbrush provision and fluoride toothpaste (within a multicomponent programme) are cost saving. An Australian study of the impact of home visits by oral health therapists on early childhood caries <sup>[5]</sup>, which also involved the provision of toothbrushes and toothpaste, also found it was cost saving compared to usual care (visiting the dentist).

## Home visits

The previous review <sup>[1]</sup>, undertaken to support the NICE guidance (PH55) <sup>[2]</sup>, did not address this question specifically. In the current review we identified an Australian study on the impact of home visits by oral health therapists on early childhood caries <sup>[5]</sup> as well as the provision of toothbrushes and toothpaste. The study found that both telephone contacts and home visits were cost saving compared to usual care (visiting the dentist) but that home visits were more cost effective than telephone contacts.

## Generalisability

Economic studies based outside of England will always be limited in their generalisability to England due to the differential costs between countries. For example, the cost of a filling in the one Scottish study <sup>[6]</sup> was £7.87 compared to US costs of \$135 <sup>[13]</sup> and \$143 <sup>[3]</sup> and an Australian cost of \$83 <sup>[5]</sup>. In addition, cost effectiveness is determined in all studies by the underlying tooth decay rate before intervention. This varies between studies and also between the UK and other countries <sup>[5]</sup> which further weakens the generalisability of non-UK cost effectiveness studies in this disease area to a UK setting.

The threshold analyses presented by Atkins <sup>[3]</sup> and Edelstein <sup>[4]</sup> were therefore not only of low quality but the findings cannot be generalised to England. They do not add to the cost-effectiveness evidence base for the interventions considered in the review.

Samnaliev <sup>[13]</sup> and Koh <sup>[5]</sup> were both good quality economic studies based upon RCTs, but still suffer from the fact that the cost-effectiveness evidence was driven by costs that are not applicable to England. The trial findings may therefore be relevant for UK policy makers, but the economic evidence less so. This is particularly the case for Samnaliev <sup>[13]</sup> as it was only a cost minimisation analysis and so the only economic benefit is derived from the costs and not a measure of patient benefit. Koh <sup>[5]</sup> did report QALYs that may help understand the potential economic impact of the programmes evaluated with an England setting. However, the results of the study could not be modified to a UK setting using the information provided in the paper without completely rebuilding the Koh model and would require evidence on effectiveness for a population with a tooth decay rate closer to that in the UK (38% compared to the 60% for usual care in the trial which populated the model). The Samnaliev <sup>[13]</sup> and Koh <sup>[5]</sup> studies therefore, also do not add to the cost-effectiveness evidence base of the interventions considered in the review.

The Scottish cost-minimisation study of a national tooth brushing programme <sup>[6]</sup>, is both of reasonable quality and is relevant to England, taking into account that the reimbursement system is different in Scotland and therefore potential costs of treatment may also be different. However, there is some doubt about the strength of the evidence base as it is an analysis that assumes that the total reduction in tooth decay in five year old children between 2001/02 and 2009/10 is due to the tooth brushing programme. The perspective of a public health evaluation should be the entire public sector or society. For example, Commissioning Better Oral Health <sup>[8]</sup> outlined the cost burden that tooth decay incurs to the NHS and how tooth decay can be linked to school absence and school readiness which incur costs elsewhere to the public sector. The perspective of the Anopa study was the NHS only. Using data presented in Anopa <sup>[6]</sup> there is a suggested total cost saving (of actual and anticipated dental treatments) of £61.51 per child after removing the programme cost of £15.78 per child. At a population level of 54,812 five year olds in Scotland in 2009/10, this equated to a saving after the programme costs of £3.37 million. With regard to the costs of general anaesthetic (GA) treatment, the annual savings (which may generate cashable savings) from GA treatment costs have been calculated using the sensitivity analysis data in this paper and could range from £31.72 (2009 UK£) per child or as high as £146.39 (2009 UK£) per child after the costs of the programme.

It should also be noted that GA costs vary between England and Scotland and whilst the Scottish study <sup>[6]</sup> used a cost of £653.26 for extraction under GA the tariff cost of such a GA procedure in England has been estimated as £836 <sup>[7]</sup> (also ref the ROI).

However, the study is weakened by doubts about the strength of the effectiveness evidence underpinning the analysis and the generalisability of Scottish dental treatment costs to England may be limited.

### Limitations of this review

This was a rapid review. Record selection was undertaken by a single reviewer and hence relevant records may have been missed. Although a substantial number of databases were searched and conference abstracts were checked for related full publications, there might be other studies to be identified in databases that could not be searched in the time available.

This review is limited to studies published since 2013. Some of the review questions have been subject to review previously but some of the review questions (such as home visits and supervised tooth brushing) have not. This means that there may be additional relevant cost-effectiveness studies (for example on the one topic where we have generalisable information, supervised tooth brushing) published prior to 2013.

## Conclusions

Overall there are few published studies on the interventions in question that add to the cost-effectiveness evidence base of these interventions in children aged 0-5 years.

There is a single recent study of supervised tooth brushing in Scottish nurseries <sup>[6]</sup> which suggests that this intervention is cost saving but the study is weakened by doubts about the strength of the effectiveness evidence underpinning the analysis and potentially limited generalisability of Scottish dental treatment costs to England.

We have found no robust and generalisable information on the cost-effectiveness of fluoride varnish or on the provision of toothbrushes and toothpaste with the same age group. We have found no recent robust and generalisable studies on the cost-effectiveness of water fluoridation to improve oral health in 0-5 year olds. We have found no recent robust and generalisable information on the cost-effectiveness of oral health promotion interventions performed in home visits by health workers with 0-5 year olds.

The scarcity of cost-effectiveness evidence should not be interpreted as evidence that these interventions are not effective or cost-effective. The review did not look for effectiveness evidence in isolation and absence of evidence on cost-effectiveness is not the same as evidence of absence.

Given the paucity of published cost-effectiveness evidence on oral health interventions to children under five that is generalisable to England, PHE commissioned a bespoke return on investment calculator from YHEC. The calculator allows effectiveness data on interventions to be used to estimate the potential economic benefits from specific interventions using tooth decay prevalence rates and treatment costs specifically for England. The tool can be found on the PHE website.

## References

1. Coffin D, Craig JC, Arber M, Glanville J. Literature review of economic evaluations on oral health improvement programmes and interventions. York: York Health Economics Consortium; 2013.
2. National Institute for Health and Care Excellence. Oral health: local authorities and partners London: National Institute for Health and Care Excellence; 2014. Available from: <https://www.nice.org.uk/guidance/ph55/chapter/About-this-guideline>.
3. Atkins CY, Thomas TK, Lenaker D, Day GM, Hennessy TW, Meltzer MI. Cost-effectiveness of preventing dental caries and full mouth dental reconstructions among Alaska Native children in the Yukon-Kuskokwim delta region of Alaska. *J Public Health Dent*. 2016
4. Edelstein BL, Hirsch G, Frosh M, Kumar J. Reducing early childhood caries in a Medicaid population: a systems model analysis. *J Am Dent Assoc*. 2015;146(4):224-32.
5. Koh R, Pukallus M, Kularatna S, Gordon LG, Barnett AG, Walsh LJ, *et al*. Relative cost-effectiveness of home visits and telephone contacts in preventing early childhood caries. *Community Dent Oral Epidemiol*. 2015;43(6):560-8.
6. Anopa Y, McMahan AD, Conway DI, Ball GE, McIntosh E, Macpherson LM. Improving Child Oral Health: Cost Analysis of a National Nursery Toothbrushing Programme. *PLoS ONE*. 2015;10(8):e0136211.
7. Department of Health. NHS reference costs. London: Department of Health; 2015. Last updated 27 Nov 2015. Available from: <https://www.gov.uk/government/publications/nhs-reference-costs-2014-to-2015>.
8. Public Health England. Local authorities improving oral health: commissioning better oral health for children and young people. An evidence-informed toolkit for local authorities London: Public Health England; 2014. 1-66. Available from: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/321503/CBOHM\\_aindocumentJUNE2014.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/321503/CBOHM_aindocumentJUNE2014.pdf).
9. Public Health England. National dental epidemiology programme for England: oral health survey of five-year-old children 2015. A report on the prevalence and severity of dental decay. London: Public Health England; 2016. 1-41. Available from: [http://www.nwph.net/dentalhealth/14\\_15\\_5yearold/14\\_15\\_16/DPHEP%20for%20England%20H%20Survey%205yr%202015%20Report%20FINAL%20Gateway%20approved.pdf](http://www.nwph.net/dentalhealth/14_15_5yearold/14_15_16/DPHEP%20for%20England%20H%20Survey%205yr%202015%20Report%20FINAL%20Gateway%20approved.pdf).
10. Lord J, Longworth L, Singh J, Onyimadu O, Fricke J, Bayliss S, *et al*. Oral Health Guidance – Economic analysis of oral health promotion approaches for dental teams. Uxbridge: Birmingham & Brunel Consortium External Assessment Centre (BBC EAC); 2015. Available from: <https://www.nice.org.uk/guidance/ng30/evidence/economic-analysis-2240894125>.
11. Drummond MF, Jefferson TO. Guidelines for authors and peer reviewers of economic submissions to the BMJ. *BMJ*. 1996;313(7052):275-83.
12. Plonka KA, Pukallus ML, Barnett A, Holcombe TF, Walsh LJ, Seow WK. A controlled, longitudinal study of home visits compared to telephone contacts to prevent early childhood caries. *Int J Paediatr Dent*. 2013;23(1):23-31.
13. Samnaliev M, Wijeratne R, Kwon EG, Ohiomoba H, Ng MW. Cost-effectiveness of a disease management program for early childhood caries. *J Public Health Dent*. 2015;75(1):24-33.
14. Macpherson LM, Ball GE, Brewster L, Duane B, Hodges CL, Wright W, *et al*. Childsmile: the national child oral health improvement programme in Scotland. Part 1: Establishment and development. *Br Dent J*. 2010;209(2):73-8.

## Appendix 1. Search strategies

### A1.1: Source: MEDLINE in-process & other non-Indexed citations and MEDLINE

Interface/URL: OvidSP

Database coverage dates: 1946 to present

Search date: 29/03/2016

Retrieved records: 2,378

#### Search strategy:

- 1 (oral care or oral health or oral hygiene or dental care or dental health or dental hygiene or school dentist\$ or community dentist\$ or public health dentist\$).ti,ab. (40543)
- 2 ((home visit\$ or health worker\$ or health visitor\$) and (dental or oral or caries or tooth or teeth)).ti,ab. (822)
- 3 (oral disease\$ or oral neoplasm\$ or oral cancer\$ or dental disease\$ or mouth disease\$ or dental decay or mouth neoplasm\$ or mouth cancer\$ or gum disease\$ or DMF or caries or ((tooth or teeth) adj2 (decay\$ or loss)) or gingivitis or periodontal disease\$ or periodontitis or ((dental or oral) adj plaque)).ti,ab. (97356)
- 4 tooth brushing/ or toothpastes/ or fluorides, topical/ or Mouthwashes/ (15636)
- 5 "Pit and Fissure Sealants"/ (3000)
- 6 (fluorid\$ or tooth paste\$ or tooth brush\$ or toothpast\$ or toothbrush\$ or fissure sealant\$ or mouthwash\$ or mouth wash\$ or flossing or dental floss).ti,ab. (47926)
- 7 Oral Health/ or exp Dental Care/ or exp Mouth Diseases/pc or Periodontal diseases/pc or Oral Hygiene/ or school dentistry/ or public health dentistry/ or community dentistry/ (59813)
- 8 Health Education, Dental/ or Cariostatic Agents/ (10439)
- 9 (preventive health services/ or Primary Prevention/ or Secondary Prevention/) and (dental or oral or caries or tooth or teeth).ti,ab. (1616)
- 10 (exp health services accessibility/ or healthcare disparities/ or vulnerable populations/) and (dental or oral or caries or tooth or teeth).ti,ab. (4156)
- 11 (Brushathon or smile or smiles or smiling or smile4life or (brushing adj3 life) or national oral health plan or child-smile or childsmile or smileathon).ti,ab. (4394)
- 12 or/1-11 (205172)
- 13 case report.tw. or letter/ or historical article/ or comment/ or editorial/ or (exp animals/ not humans/) (6138924)
- 14 12 not 13 (175051)
- 15 economics/ (26660)
- 16 exp "costs and cost analysis"/ (195197)
- 17 economics, dental/ (1876)

- 18 exp "economics, hospital"/ (21203)
- 19 economics, medical/ (8857)
- 20 economics, nursing/ (3933)
- 21 economics, pharmaceutical/ (2607)
- 22 (economic\$ or cost or costs or costly or costing or price or prices or pricing or pharmaco-economic\$.ti,ab. (541725)
- 23 (expenditure\$ not energy).ti,ab. (21100)
- 24 value for money.ti,ab. (1154)
- 25 budget\$.ti,ab. (21587)
  
- 26 or/15-25 (675030)
- 27 ((energy or oxygen) adj cost).ti,ab. (3196)
- 28 (metabolic adj cost).ti,ab. (982)
- 29 ((energy or oxygen) adj expenditure).ti,ab. (19009)
- 30 or/27-29 (22389)
- 31 26 not 30 (669937)
- 32 14 and 31 (7366)
- 33 limit 32 to english language (6699)
- 34 limit 33 to yr="2010 -Current" (2378)

## **A1.2: Source: Embase**

Interface/URL: OvidSP

Database coverage dates: 1996 to 2016 week 13

Search date: 29/03/16

Retrieved records: 3,915

### **Search strategy:**

Database: Embase <1996 to 2016 Week 13>

- 1 (oral care or oral health or oral hygiene or dental care or dental health or dental hygiene or school dentist\$ or community dentist\$ or public health dentist\$.ti,ab. (26706)
- 2 ((home visit\$ or health worker\$ or health visitor\$) and (dental or oral or caries or tooth or teeth)).ti,ab. (598)
- 3 (oral disease\$ or oral neoplasm\$ or oral cancer\$ or dental disease\$ or mouth disease\$ or dental decay or mouth neoplasm\$ or mouth cancer\$ or gum disease\$ or DMF or caries or ((tooth or teeth) adj2 (decay\$ or loss)) or gingivitis or periodontal disease\$ or periodontitis or ((dental or oral) adj plaque)).ti,ab. (65960)
- 4 tooth brushing/ or toothpaste/ or fluoride varnish/ or mouthwash/ (11472)
- 5 fissure sealant/ (1449)

- 6 (fluorid\$ or tooth paste\$ or tooth brush\$ or toothpast\$ or toothbrush\$ or fissure sealant\$ or mouthwash\$ or mouth wash\$ or flossing or dental floss).ti,ab. (29081)
- 7 dental health/ or dental procedure/ or exp mouth disease/pc or mouth hygiene/ or school dentistry/ or (dentistry/ and public health service/) (38434)
- 8 dental health education/ or anticaries agent/ (4886)
- 9 (preventive health service/ or primary prevention/ or secondary prevention/) and (dental or oral or caries or tooth or teeth).ti,ab. (2223)
- 10 (health care delivery/ or health care organization/ or health care facility/ or financial management/ or health care disparity/ or vulnerable population/ or health care planning/) and (dental or oral or caries or tooth or teeth).ti,ab. (8341)
- 11 (Brushathon or smile or smiles or smiling or smile4life or (brushing adj3 life) or national oral health plan or child-smile or childsmile or smileathon).ti,ab. (4220)
- 12 or/1-11 (137456)
- 13 case report.tw. or letter.pt. or editorial.pt. or ((animal experiment/ or animal model/ or animal tissue/ or nonhuman/) not exp human/) (3701253)
- 14 12 not 13 (121550)
- 15 health-economics/ (17673)
- 16 exp economic-evaluation/ (206453)
- 17 exp health-care-cost/ (200219)
- 18 exp pharmacoeconomics/ (143353)
- 19 (economic\$ or cost or costs or costly or costing or price or prices or pricing or pharmacoeconomic\$).ti,ab. (581980)
- 20 (expenditure\$ not energy).ti,ab. (22246)
- 21 value for money.ti,ab. (1454)
- 22 budget\$.ti,ab. (21172)
- 23 or/15-22 (827571)
- 24 ((energy or oxygen) adj cost).ti,ab. (2306)
- 25 (metabolic adj cost).ti,ab. (835)
- 26 ((energy or oxygen) adj expenditure).ti,ab. (19280)
- 27 or/24-26 (21834)
- 28 23 not 27 (823511)
- 29 14 and 28 (8795)
- 30 limit 29 to (english language and yr="2010 -Current") (3915)

**A1.3: Source: NHS Economic Evaluation Database (NHS EED) - issue 2 of 4, April 2015 (after this issue the database closed)**

Interface / URL: Cochrane Library/Wiley Interscience (online)

Database coverage dates: Information not found

Search date: 20/3/16

Retrieved records: 596

## Search strategy:

- #1 oral:ti,ab,kw 92369
- #2 (dental or dentist\* or mouth\* or gum or gums or DMF or caries or tooth\* or teeth\* or gingiv\* or periodont\* or fluorid\* or fissure\* or sealant\* or floss\*) 44592
- #3 ("oral care" or "oral health" or "oral hygiene" or "oral disease" or "oral diseases" or "oral neoplasm" or "oral neoplasms" or "oral cancer" or "oral cancers" or "oral plaque") 4123
- #4 (Brushathon or "smile month" or smile4life or "smile 4 life" or "smile for life" or "brushing for life" or "designed to smile" or "national oral health plan" or child-smile or "child smile" or childsmile or "smile with a prophet" or "winning smiles" or "smokefree and smiling" or "smiling and smokefree" or smileathon or "creative smiles" or "city smiles" or "smile sack" or "bright smiles") 2
- #5 ("public health" or school\* or communit\* or "food bank" or "food banks" or shelter\* or neighbourhood\* or neighborhood\* or region\* or area\* or population\*):ti,ab near/3 (access\* or inaccess\* or obtain\* or unobtain\* or utilisation or utilization or "service uptake" or "service take-up" or "service take-up" or attend\* or non-attend\* or nonattend\*):ti,ab 1362
- #6 MeSH descriptor: [Dental Devices, Home Care] explode all trees 340
- #7 MeSH descriptor: [Toothpastes] explode all trees 660
- #8 MeSH descriptor: [Fluorides, Topical] explode all trees 419
- #9 MeSH descriptor: [Mouthwashes] explode all trees 1376
- #10 MeSH descriptor: [Pit and Fissure Sealants] explode all trees 345
- #11 MeSH descriptor: [Oral Health] explode all trees 261
- #12 MeSH descriptor: [Dental Care] explode all trees 547
- #13 MeSH descriptor: [Mouth Diseases] explode all trees and with qualifier(s):  
[Prevention & control - PC] 1524
- #14 MeSH descriptor: [Periodontal Diseases] explode all trees and with qualifier(s):  
[Prevention & control - PC] 917
- #15 MeSH descriptor: [Oral Hygiene] explode all trees 1839
- #16 MeSH descriptor: [School Dentistry] explode all trees 96
- #17 MeSH descriptor: [Public Health Dentistry] explode all trees 2865
- #18 MeSH descriptor: [Cariostatic Agents] explode all trees and with qualifier(s):  
[Therapeutic use - TU] 1070
- #19 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 Publication Year from 1993 to 2016, in Economic Evaluations 596

#### **A1.4: Source: Health Technology Assessment database (HTA) - issue 1 of 4, Jan 2016**

Interface/URL: Cochrane Library/Wiley Interscience (online)

Database coverage dates: Information not found

Search date: 20/3/16

Retrieved records: 283

#### **Search strategy:**

ID	Search	Hits
#1	oral:ti,ab,kw	92369
#2	(dental or dentist* or mouth* or gum or gums or DMF or caries or tooth* or teeth* or gingiv* or periodont* or fluorid* or fissure* or sealant* or floss*)	44592
#3	("oral care" or "oral health" or "oral hygiene" or "oral disease" or "oral diseases" or "oral neoplasm" or "oral neoplasms" or "oral cancer" or "oral cancers" or "oral plaque")	4123
#4	(Brushathon or "smile month" or smile4life or "smile 4 life" or "smile for life" or "brushing for life" or "designed to smile" or "national oral health plan" or child-smile or "child smile" or childsmile or "smile with a prophet" or "winning smiles" or "smokefree and smiling" or "smiling and smokefree" or smileathon or "creative smiles" or "city smiles" or "smile sack" or "bright smiles")	2
#5	("public health" or school* or communit* or "food bank" or "food banks" or shelter* or neighbourhood* or neighborhood* or region* or area* or population*):ti,ab near/3 (access* or inaccess* or obtain* or unobtain* or utilisation or utilization or "service uptake" or "service takeup" or "service take-up" or attend* or non-attend* or nonattend*):ti,ab	1362
#6	MeSH descriptor: [Dental Devices, Home Care] explode all trees	340
#7	MeSH descriptor: [Toothpastes] explode all trees	660
#8	MeSH descriptor: [Fluorides, Topical] explode all trees	419
#9	MeSH descriptor: [Mouthwashes] explode all trees	1376
#10	MeSH descriptor: [Pit and Fissure Sealants] explode all trees	345
#11	MeSH descriptor: [Oral Health] explode all trees	261
#12	MeSH descriptor: [Dental Care] explode all trees	547
#13	MeSH descriptor: [Mouth Diseases] explode all trees and with qualifier(s): [Prevention & control - PC]	1524
#14	MeSH descriptor: [Periodontal Diseases] explode all trees and with qualifier(s): [Prevention & control - PC]	917
#15	MeSH descriptor: [Oral Hygiene] explode all trees	1839
#16	MeSH descriptor: [School Dentistry] explode all trees	96
#17	MeSH descriptor: [Public Health Dentistry] explode all trees	2865
#18	MeSH descriptor: [Cariostatic Agents] explode all trees and with qualifier(s): [Therapeutic use - TU]	1070

#19 #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 Publication Year from 1993 to 2016, in Technology Assessments283

### **A1.5: Source: Econlit**

Interface / URL: OvidSP

Database coverage dates: 1886 to Feb 2016

Search date: 19/03/16

Retrieved records: 355

### **Search strategy:**

Database: Econlit <1886 to February 2016>

- 1 ((dental or oral or dentist\$) adj5 (health\$ or hygiene or care)).af. (139)
- 2 ((dental or oral or dentist\$) adj5 (promot\$ or improv\$ or advis\$ or advic\$ or program\$ or campaign\$ or scheme\$ or initiative\$ or prevent\$)).af. (34)
- 3 ((dental or oral or dentist\$) adj5 (access\$ or inaccess\$ or availab\$ or unavailab\$ or obtain\$ or unobtain\$ or uptake or up-take or takeup or take-up or attend\$ or utilisation or utilization)).af. (54)
- 4 ((dental or oral or dentist\$) adj5 (school or community or public health)).af. (16)
- 5 ((mouth\$ or oral) and (disease\$ or cancer\$ or neoplasm\$)).af. (113)
- 6 (dental disease\$ or dental decay or gum disease\$ or periodont\$ or DMF or caries or plaque or gingiv\$).af. (34)
- 7 ((tooth\$ or teeth\$) adj5 (decay\$ or loss)).af. (10)
- 8 (toothbrush\$ or tooth-brush\$ or toothpaste\$ or tooth-paste\$ or fluorid\$ or fissure\$ or sealant\$ or floss\$ or mouthwash\$ or mouth-wash\$ or mouthrinse\$ or mouth-rinse\$ or cariostatic).af. (107)
- 9 (Brushathon or smile month or smile4life or smile 4 life or smile for life or brushing for life or designed to smile or national oral health plan or child-smile or child smile or childsmile or smile with a prophet or winning smiles or (smokefree adj2 smiling) or smileathon or creative smiles or city smiles or smile sack or bright smiles).af. (0)
- 10 or/1-9 (420)
- 11 limit 10 to (yr="1993 -Current" and english) (355)

### **A1.6: Source: Cost-effectiveness Analysis (CEA) registry**

Interface/URL: <https://research.tufts-nemc.org/cear4>

Database coverage dates: Information not found. Has been funded from 1976 to 2014.

Search date: 20/3/16

Retrieved records: two new records

## Search strategy:

Note: Basic search interface used. 'search for articles' selected. Search terms used in the full search contents box. Each search run and any results downloaded separately.

brushathon = 0 results  
brushing = 0 results  
caries = 0 results  
cariostatic = 0 results  
childsmile = 0 results  
child-smile = 0 results  
dental = 34 results (1 new and relevant)  
dentist = 1 results (new)  
dentistry = 2 results (none new)  
dentists = 1 result (new, but duplicate)  
dmf = 0 results  
fissure = 1 result (new, but not relevant)  
fissures = 1 result (new, but not relevant)  
floss = 0 results  
flossed = 0 results  
flosses = 0 results  
flossing = 0 results  
fluoridation = 0 results  
fluoride = 1 result (none new)  
fluorides = 0 results  
gingivitis = 0 results  
gum = 30 results (none relevant)  
mouth = 5 results (none relevant)  
mouthrinse = 0 results  
mouth-rinse = 0 results  
mouthrinses = 0 results  
mouth-rinses = 0 results  
mouthwash = 0 results  
mouth-wash = 0 results  
mouthwashes = 0 results  
mouth-washes = 0 results  
oral cancer = 2 results (none new)  
oral cancers = 0 results  
oral care = 0 results  
oral disease = 2 results (none new)  
oral diseases = 0 results  
oral health = 3 results (2 new, both duplicates)  
oral hygiene = 1 result (duplicate)

oral neoplasm = 0 results  
oral neoplasms = 0 results  
periodontal = 1 result (NEW)  
periodontitis = 0 results  
plaque = 11 results (0 relevant)  
sealant = 0 results  
sealants = 0 results  
smile = 1 result (0 new)  
smile4life = 0 results  
smileathon = 0 results  
smiles = 0 results  
smiling = 0 results  
teeth = 1 result (duplicate)  
tooth = 2 results (1 new, duplicate)  
toothbrush = 0 results  
tooth-brush = 0 results  
toothbrushes = 0 results  
tooth-brushes = 0 results  
tooth brushing = 0 results  
tooth-brushing = 0 results  
toothpaste = 0 results  
tooth-paste = 0 results  
toothpastes = 0 results  
tooth-pastes = 0 results

#### **A1.7: Source: RePEc (Research Papers in Economics)**

Interface/URL: <https://ideas.repec.org/>

Database coverage dates: Information not found

Search date: 20/3/16

Retrieved records: 211

#### **Search strategy:**

Note: Each search run separately.

The search interfaces have changed since 2013 and the previous searches yielded tens of thousands of results. The following searches were undertaken with adaptations to reflect the fact that many false drops were produced by terms such as 'fissures'

All searches were limited to 'Partner – RePEc'. All results were added to EconomistsOnline folder, and downloaded as one file of 301 results.

411 documents matched the search for "oral care" OR "oral health" OR "oral hygiene" OR dental OR dentist\* OR "gum disease\*" OR caries OR tooth OR teeth OR gingiv\* OR periodont\* OR "dental plaque" or "oral plaque" OR toothbrush\* OR tooth-brush\* OR toothpaste\* OR tooth-paste\* OR "topical fluoride" OR floss\* OR mouthwash\* OR mouth-wash\* OR mouthrinse\* OR mouth-rinse\* OR cariostatic in titles and keywords.

Downloaded 208 records added or modified since 2012.

159 documents matched the search for ((oral OR mouth\*) AND (promot\* OR improv\* OR advis\* OR advic\* OR program\* OR campaign\* OR scheme\* OR initiative\* OR prevent\* OR disease\* OR neoplasm\* OR cancer)) NOT ("oral care" OR "oral health" OR "oral hygiene" OR dental OR dentist\* OR "gum disease\*" OR caries OR tooth OR teeth OR gingiv\* OR periodont\* OR "dental plaque" or "oral plaque" OR toothbrush\* OR tooth-brush\* OR toothpaste\* OR tooth-paste\* OR "topical fluoride" OR floss\* OR mouthwash\* OR mouth-wash\* OR mouthrinse\* OR mouth-rinse\* OR cariostatic) in titles and keywords.

Downloaded 1 relevant record. Most of the records were about oral cancer or foot and mouth disease in animals.

1 documents matched the search for brushathon OR "smile month" OR smile4life OR "smile 4 life" OR "smile for life" OR "brushing for life" OR "designed to smile" OR "child-smile" OR "child smile" OR childsmile OR "smile with a prophet" OR "winning smiles" OR smileathon OR "creative smiles" OR "city smiles" OR "smile sack" OR "bright smiles" in titles and keywords.

1 record downloaded

9 documents matched the search for fluoridation in titles and keywords.

1 record downloaded

### **A1.8: PubMed**

Interface / URL: <http://www.ncbi.nlm.nih.gov/pubmed/advanced>

Database coverage dates: Information not found

Search date: 29/3/16

Retrieved records: 716

Search results are limited to those published 2010 to 2016.

Search (oral disease[Title/Abstract] OR oral disease[Title/Abstract] OR oral neoplasm[Title/Abstract] OR oral neoplasms[Title/Abstract] OR oral cancer[Title/Abstract] OR oral cancers[Title/Abstract] OR dental disease[Title/Abstract] OR dental diseases[Title/Abstract] OR mouth disease[Title/Abstract] OR mouth diseases[Title/Abstract] OR dental decay[Title/Abstract] OR mouth

neoplasm[Title/Abstract] OR mouth neoplasms[Title/Abstract] OR mouth cancer[Title/Abstract] OR mouth cancers[Title/Abstract] OR gum disease[Title/Abstract] OR gum diseases[Title/Abstract] OR caries[Title/Abstract] OR tooth decay[Title/Abstract] OR decayed teeth[Title/Abstract] OR tooth loss[Title/Abstract] OR lost teeth[Title/Abstract] OR gingivitis[Title/Abstract] OR periodontal disease[Title/Abstract] OR periodontal diseases[Title/Abstract] OR periodontitis[Title/Abstract] OR dental plaque[Title/Abstract] OR oral plaque[Title/Abstract])) AND (prevent[Title/Abstract] OR preventing[Title/Abstract] OR prevention[Title/Abstract] OR prevented[Title/Abstract] OR preventative[Title/Abstract] OR control[Title/Abstract] OR controlling[Title/Abstract] OR controlled[Title/Abstract] OR reduce[Title/Abstract] OR reduced[Title/Abstract] OR reducing[Title/Abstract] OR reduction[Title/Abstract])) AND (((public health OR school OR schools OR community OR food bank OR food banks OR shelter OR shelters OR neighbourhood OR neighbourhoods OR neighbourhood OR neighborhoods OR region OR regions OR regional OR area OR areas OR population) AND tiab OR Child Day Care Centers[mesh:noexp] OR Schools, Nursery[mesh:noexp] OR community health centers[mesh:noexp] OR substance abuse treatment centers[mesh:noexp] OR community mental health centers[mesh:noexp] OR child guidance clinics[mesh:noexp] OR maternal-child health centers[mesh:noexp] OR Sheltered Workshops[mesh:noexp]))) OR (((tooth brushing[mesh:noexp] OR toothpastes[mesh:noexp] OR fluorides, topical[mesh:noexp] OR Mouthwashes[mesh:noexp] OR Pit and Fissure Sealants/tu[mesh:noexp] OR fluoride[tiab] OR fluoridated[tiab] OR toothpaste[tiab] OR toothpastes[tiab] OR toothbrush[tiab] OR toothbrushes[tiab] OR fissure sealant[tiab] OR fissure sealants[tiab] OR mouthwash[tiab] OR mouthwashes[tiab] OR mouth wash[tiab] OR mouth washes[tiab] OR flossing[tiab] OR floss[tiab]))) AND ((promote[Title/Abstract] OR promoting[Title/Abstract] OR promoted[Title/Abstract] OR improve[Title/Abstract] OR improved[Title/Abstract] OR improving[Title/Abstract] OR improves[Title/Abstract] OR improvement[Title/Abstract] OR improvements[Title/Abstract] OR advise[Title/Abstract] OR advised[Title/Abstract] OR advising[Title/Abstract] OR advice[Title/Abstract] OR program[Title/Abstract] OR programs[Title/Abstract] OR programme[Title/Abstract] OR programmes[Title/Abstract] OR campaign[Title/Abstract] OR campaigns[Title/Abstract] OR scheme[Title/Abstract] OR schemes[Title/Abstract] OR initiative[Title/Abstract] OR initiatives[Title/Abstract] OR prevent[Title/Abstract] OR preventing[Title/Abstract] OR prevention[Title/Abstract] OR prevented[Title/Abstract] OR preventative[Title/Abstract] OR control[Title/Abstract] OR controlling[Title/Abstract] OR controlled[Title/Abstract] OR reduce[Title/Abstract] OR reduced[Title/Abstract] OR reducing[Title/Abstract] OR reduction[Title/Abstract]))) OR (((diet[Title/Abstract] OR dietary[Title/Abstract] OR food[Title/Abstract] OR foods[Title/Abstract] OR foodstuff[Title/Abstract] OR foodstuffs[Title/Abstract] OR nutrition[Title/Abstract] OR nutritional[Title/Abstract] OR smoke[Title/Abstract] OR smokers[Title/Abstract] OR smoker[Title/Abstract] OR smoking[Title/Abstract] OR tobacco[Title/Abstract] OR alcohol[Title/Abstract] OR alcoholic[Title/Abstract] OR alcoholism[Title/Abstract]))) AND (((oral care[Title/Abstract]

OR oral health[Title/Abstract] OR oral hygiene[Title/Abstract] OR dental care[Title/Abstract] OR dental health[Title/Abstract] OR dental hygiene[Title/Abstract] OR school dentist[Title/Abstract] OR school dentists[Title/Abstract] OR community dentist[Title/Abstract] OR community dentists[Title/Abstract] OR public health dentist[Title/Abstract] OR public health dentists[Title/Abstract])) AND ((promote[Title/Abstract] OR promoting[Title/Abstract] OR promoted[Title/Abstract] OR improve[Title/Abstract] OR improved[Title/Abstract] OR improving[Title/Abstract] OR improves[Title/Abstract] OR improvement[Title/Abstract] OR improvements[Title/Abstract] OR advise[Title/Abstract] OR advised[Title/Abstract] OR advising[Title/Abstract] OR advice[Title/Abstract] OR program[Title/Abstract] OR programs[Title/Abstract] OR programme[Title/Abstract] OR programmes[Title/Abstract] OR campaign[Title/Abstract] OR campaigns[Title/Abstract] OR scheme[Title/Abstract] OR schemes[Title/Abstract] OR initiative[Title/Abstract] OR initiatives[Title/Abstract] OR prevent[Title/Abstract] OR preventing[Title/Abstract] OR prevention[Title/Abstract] OR prevented[Title/Abstract] OR preventative[Title/Abstract])))) OR (((Oral Health[mesh:noexp] OR Dental Care[mesh] OR Mouth Diseases/pc[mesh] OR Periodontal diseases/pc[mesh:noexp] OR Oral Hygiene[mesh:noexp] OR school dentistry[mesh:noexp] OR public health dentistry[mesh:noexp] OR community dentistry[mesh:noexp])) AND (Health Promotion[mesh:noexp] OR Health Education, Dental[mesh:noexp] OR preventive health services[mesh:noexp] OR Primary Prevention[mesh:noexp] OR Secondary Prevention[mesh:noexp] OR Cariostatic Agents/tu[mesh:noexp] OR health services accessibility[mesh] OR healthcare disparities[mesh:noexp] OR vulnerable populations[mesh:noexp] OR Food habits[mesh:noexp] OR food preferences[mesh:noexp] OR Diet[mesh:noexp] OR diet therapy[mesh:noexp] OR Smoking Cessation[mesh] OR Alcohol Drinking[mesh])))) OR ((Brushathon[Title/Abstract] OR smile4life[Title/Abstract] OR smile[Title/Abstract] OR brushing[Title/Abstract] OR national oral health plan[Title/Abstract] OR child-smile[Title/Abstract] OR childsmile[Title/Abstract] OR smiles[Title/Abstract] OR smiling[Title/Abstract] OR smileathon[Title/Abstract])))) NOT ((Case Reports[Publication Type] OR case report[tw] OR letter[Publication Type] OR historical article[Publication Type] OR comment[Publication Type] OR editorial[Publication Type] OR (animals[mesh] NOT humans[mesh:noexp])))) AND 2010 : 2016[dp]) AND (((((expenditure[Title/Abstract] OR expenditures[Title/Abstract] OR MONEY[Title/Abstract] OR budget[Title/Abstract] OR budgets[Title/Abstract] OR budgeting[Title/Abstract])) OR (((economics[mesh:noexp] OR costs and cost analysis[mesh] OR economics, dental[mesh:noexp] OR economics, hospital[mesh] OR economics, medical[mesh:noexp] OR economics, nursing[mesh] OR economics, pharmaceutical[mesh])) OR (economic[Title/Abstract] OR economics[Title/Abstract] OR cost[Title/Abstract] OR costs[Title/Abstract] OR costly[Title/Abstract] OR costing[Title/Abstract] OR price[Title/Abstract] OR prices[Title/Abstract] OR pricing[Title/Abstract] OR pharmaco-economic[Title/Abstract] OR pharmaco-economics[Title/Abstract])))) NOT (energy cost[Title/Abstract] OR oxygen

cost[Title/Abstract] OR metabolic cost[Title/Abstract] OR energy expenditure[Title/Abstract] OR oxygen expenditure[Title/Abstract]))

### A1.9: ISPOR Conference

Interface/URL: ISPOR Scientific Presentations Database  
[http://www.ispor.org/RESEARCH\\_STUDY\\_DIGEST/index.asp](http://www.ispor.org/RESEARCH_STUDY_DIGEST/index.asp)  
Database coverage dates: 2013-2016  
Search date: 01/04/2016  
Retrieved records: 5

#### Search strategy:

<b>Disease:</b>	Dental Disorders
<b>Topic:</b>	All
<b>Subtopic:</b>	All
<b>Meeting:</b>	All

<b>Keyword:</b>	'oral care'
<b>Disease:</b>	All
<b>Topic:</b>	All
<b>Subtopic:</b>	All
<b>Meeting:</b>	All

The terms below (taken from the Medline search strategy) were searched for individually in the 'Keyword' search box by 'Titles' and then 'Abstract.' Abstracts from 2013-16 were looked through for relevance.

oral care  
oral health  
oral hygiene  
dental care  
dental health  
dental hygiene  
dentist  
dentists  
dentistry  
caries  
tooth  
teeth  
decay

cavity  
cavities  
gum in Title  
gum disease in Abstract  
gum diseases in Abstract  
gingivitis  
periodontal  
periodontitis  
dental plaque  
oral plaque  
fluoride  
fluoridation  
toothpaste  
toothpastes  
toothbrush  
toothbrushes  
fissure  
mouthwash  
mouth wash  
mouth washing  
flossing  
dental floss  
cariostatic  
brushathon  
smile  
smiles  
smiling  
smile4life  
brushing  
child-smile  
childsmile  
smileathon

#### **1A.10: iHEA Conference**

The only abstracts available for searching were those from 2015.

Interface/URL: iHEA Draft Presenters, Presentations and Sessions

<https://ihea2015.abstractsubmit.org/presentations/>

Resource coverage dates: 2015

Search date: 01/04/2016

Retrieved records: 1

**Search strategy:**

Searched on the following terms via the search box:

dental  
dentist  
dentists  
dentistry  
caries  
tooth  
teeth  
decay  
cavity  
cavities  
gum  
periodontal  
periodontitis  
plaque  
fluoride  
fluoridation  
toothpaste  
toothpastes  
toothbrush  
toothbrushes  
fissure  
mouthwash  
mouth wash  
mouth washing  
flossing  
brushathon  
smile  
smiles  
smiling  
smile4life  
brushing  
child-smile  
childsmile  
smileathon

Not used due to large number of results:

oral care  
oral health  
oral hygiene  
gingivitis  
cariostatic

Additional terms used:

preschool  
pre-school  
infant  
child  
children  
home  
prevention  
promotion

**A1.11: HTAi conference**

2015 conference

<http://www.htai2015.org/events/2015-htai-annual-conference/agenda-24fdbeb646af4856894b56e17ef6bd6e.aspx>

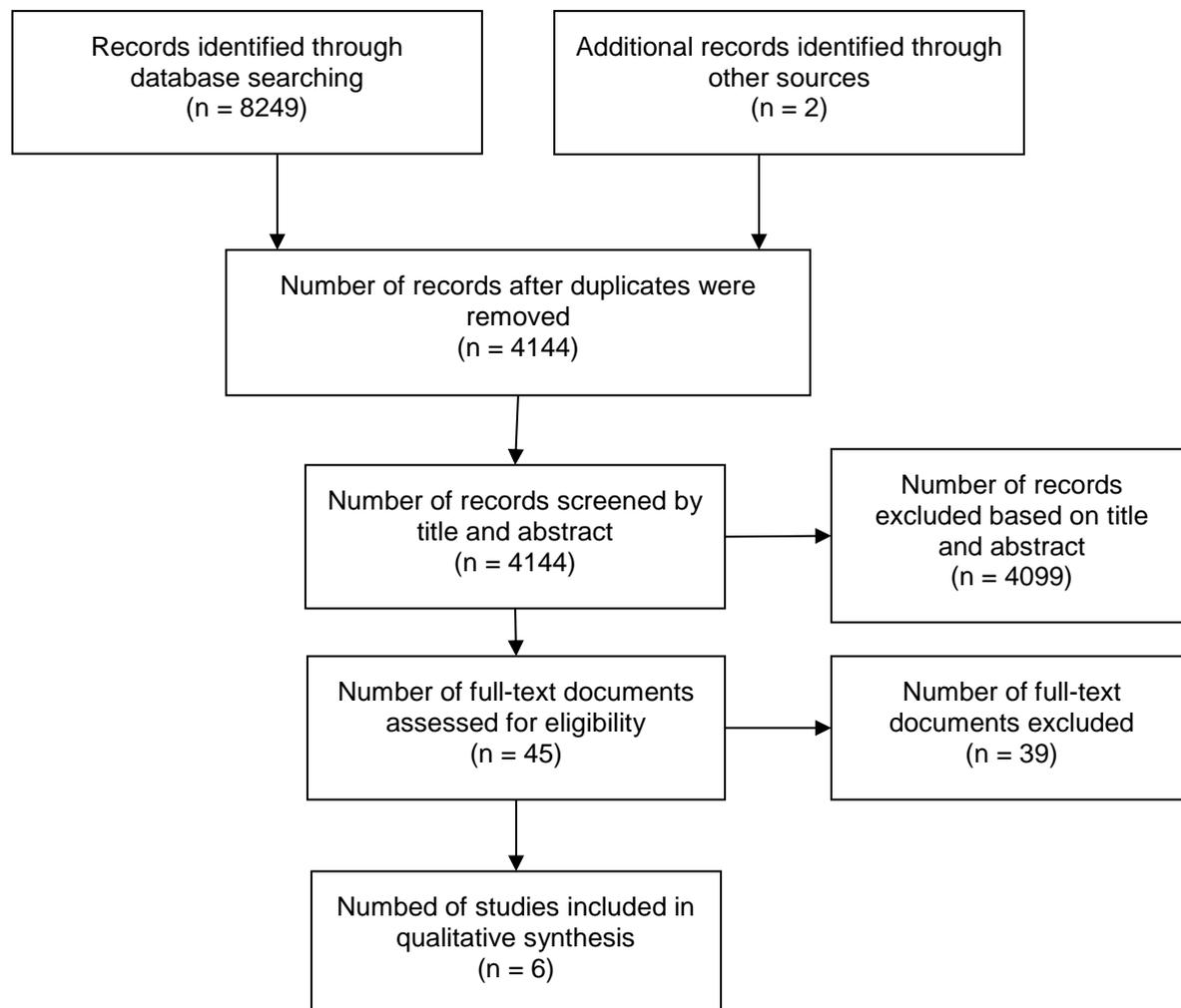
For 2015 conference we searched the web pages for each day of the conference with the keywords:

Dental  
Oral  
Caries  
Fluorid  
Tooth  
Teeth

No relevant records were identified.

The paper programme of the 2014 Washington meeting was handsearched but no relevant records were identified.

## Appendix 2. PRISMA flow chart



## Appendix 3. Studies excluded (based on assessment of full text) with reasons

Study reference	Exclusion reason
Alsharif AT, Kruger E, Tennant M. A population-based cost description study of oral treatment of hospitalized Western Australian children aged younger than 15 years. <i>J Public Health Dent.</i> 2015;75(3):202-9.	Ineligible outcomes
Andas CA, Ostberg AL, Berggren P, Hakeberg M. A new dental insurance scheme--effects on the treatment provided and costs. <i>Swed Dent J.</i> 2014;38(2):57-66.	Non-English language
Banoczy J, Rugg-Gunn A, Woodward M. Milk fluoridation for the prevention of dental caries. <i>Acta Med Acad.</i> 2013;42(2):156-67.	Ineligible outcomes
Bhaskar V, McGraw KA, Divaris K. The importance of preventive dental visits from a young age: systematic review and current perspectives. <i>Clin Cosmet Investig Dent.</i> 2014;8:21-7.	Literature review - checked references
Canadian Agency for Drugs and Technologies in Health (CADTH). Periodic dental examinations for oral health: a review of clinical effectiveness, cost effectiveness, and guidelines .Ottawa: Canadian Agency for Drugs and Technologies in Health;2014: Available from: <a href="http://onlinelibrary.wiley.com/o/cochrane/clhta/articles/HTA-32015000267/frame.html">http://onlinelibrary.wiley.com/o/cochrane/clhta/articles/HTA-32015000267/frame.html</a>	Adult population
Chong S. Helping healthy smiles. <i>AJP.</i> 2011;92(1090):48-50.	Ineligible study design
Chou R, Cantor A, Zakher B, Mitchell JP, Pappas M. Prevention of dental caries in children younger than 5 years old: systematic review to update the U.S. Preventive Services Task Force Recommendation. Evidence Syntheses No. 104. Rockville MD: Agency for Healthcare Research and Quality; 2014. Available from: <a href="http://onlinelibrary.wiley.com/o/cochrane/clhta/articles/HTA-32014000684/frame.html">http://onlinelibrary.wiley.com/o/cochrane/clhta/articles/HTA-32014000684/frame.html</a>	Ineligible outcomes
Douglass JM, Clark MB. Integrating oral health into overall health care to prevent early childhood caries: need, evidence, and solutions. <i>Pediatr Dent.</i> 2015;37(3):266-74.	Literature review - checked references
Duane BG, Richards D, Young L, Archibald B. Trends and costs of high concentration fluoride toothpaste prescribing in Scotland. <i>Br Dent J.</i> 2014;216(10):589-91.	Adult population
Ekstrand KR, Qvist V. The impact of a national caries strategy in Greenland after 4 years. <i>Int J Paediatr Dent.</i> 2015;25(4):255-66.	Ineligible outcomes
Frazao P. Cost-effectiveness of conventional and modified supervised toothbrushing in preventing caries in permanent molars among 5-year-old children. <i>Cad Saude Publica.</i> 2012;28(2):281-90.	Non-English language
Fyfe C, Borman B, Scott G, Birks S. A cost effectiveness analysis of community water fluoridation in New Zealand. <i>N Z Med J.</i> 2015;128(1427):38-46.	2-17 year olds
Goodwin M, Emsley R, Kelly M, Rooney E, Sutton M, Tickle M, et al. The CATFISH study protocol: an evaluation of a water fluoridation scheme. <i>BMC Oral Health.</i> 2016;16(1):8.	Ineligible study design
Helgeson M. Economic models for prevention: making a system work for patients. <i>BMC Oral Health.</i> 2015;15 Suppl 1:S11.	Adult population
Hendrix KS, Downs SM, Brophy G, Carney Doebbeling C, Swigonski NL. Threshold analysis of reimbursing physicians for the application of fluoride varnish in young children. <i>J Public Health Dent.</i> 2013;73(4):297-303.	Ineligible outcomes
Hirzy JW, Carton RJ, Bonanni CD, Montanero CM, Nagle MF. Corrigendum to Comparison of hydrofluorosilicic acid and pharmaceutical sodium fluoride as fluoridating agents-A cost-benefit analysis. <i>Environ Sci Policy.</i> 2014;38:282-84.	Adult population
Huebner CE, Milgrom P. Evaluation of a parent-designed programme to support tooth brushing of infants and young children. <i>Int J Dent Hyg.</i> 2015;13(1):65-73.	Ineligible outcomes
Johnson NW, Lalloo R, Kroon J, Fernando S, Tut O. Effectiveness of water fluoridation in caries reduction in a remote Indigenous community in Far North Queensland. <i>Aust Dent J.</i> 2014;59(3):366-71.	Population includes 5 years +
Kamel MS, Thomson WM, Drummond BK. Fluoridation and dental caries severity in young children treated under general anaesthesia: an analysis of treatment records in a 10-year	Ineligible outcomes

Study reference	Exclusion reason
case series. <i>Community Dent Health</i> . 2013;30(1):15-8.	
Ko L, Thiessen KM. A critique of recent economic evaluations of community water fluoridation. <i>Int J Occup Environ Health</i> . 2015;21(2):91-120.	Population includes 5 years +
Listl S, Galloway J, Mossey PA, Marcenes W. Global Economic Impact of Dental Diseases. <i>J Dent Res</i> . 2015;94(10):1355-61.	Ineligible outcomes
Marghalani AA, Alshahafi YA, Alshouibi EN. The cost of dental caries in Saudi Arabia. Putting numbers into context. <i>Saudi Med J</i> . 2014;35(1):93-4.	Population includes 5 years +
Marthaler TM. Salt fluoridation and oral health. <i>Acta Med Acad</i> . 2013;42(2):140-55.	Population includes 5 years +
McLaren L, McNeil DA, Potestio M, Patterson S, Thawer S, Faris P, et al. Equity in children's dental caries before and after cessation of community water fluoridation: differential impact by dental insurance status and geographic material deprivation. <i>Int J Equity Health</i> . 2016;15(1):24.	Ineligible outcomes
Moyer VA. Prevention of dental caries in children from birth through age 5 years: US preventive services task force recommendation statement. <i>Pediatrics</i> . 2014;133(6):1102-11.	Ineligible study design
Ng MW, Ramos-Gomez F, Lieberman M, Lee JY, Scoville R, Hannon C, et al. Disease management of Early Childhood Caries: ECC Collaborative Project. <i>Int J Dent</i> . 2014;2014:327801.	Ineligible outcomes
NIHR Horizon Scanning Centre (NIHR HSC). Curodont Repair and Curodont Protect for the treatment and prevention of tooth decay. Birmingham: NIHR Horizon Scanning Centre; 2013. Available from: <a href="http://onlinelibrary.wiley.com/doi/10.1111/hta.12130">http://onlinelibrary.wiley.com/doi/10.1111/hta.12130</a>	Ineligible outcomes
Nowak AJ, Casamassimo PS, Scott J, Moulton R. Do early dental visits reduce treatment and treatment costs for children? <i>Pediatr Dent</i> . 2014;36(7):489-93.	Duplicate record
Nowak AJ, Casamassimo PS, Scott J, Moulton R. Do Early Dental Visits Reduce Treatment and Treatment Costs for Children? <i>J Mich Dent Assoc</i> . 2016;98(1):36-42.	Ineligible intervention
Pukallus M, Plonka K, Kularatna S, Gordon L, Barnett AG, Walsh L, et al. Cost-effectiveness of a telephone-delivered education programme to prevent early childhood caries in a disadvantaged area: a cohort study. <i>BMJ Open</i> . 2013;3(5):e002579	Ineligible intervention
Sen B, Blackburn J, Kilgore ML, Morrissey MA, Becker DJ, Caldwell C, et al. Preventive dental care and long-term dental outcomes among ALL Kids eNot reportedollees. <i>Health Serv Res</i> . 2016;[e-pub ahead of print]:1-16.	Ineligible intervention
Shariati B, MacEntee MI, Yazdizadeh M. The economics of dentistry: a neglected concern. <i>Community Dent Oral Epidemiol</i> . 2013;41(5):385-94.	Ineligible outcomes
Siruta KJ, Simmer-Beck ML, Ahmed A, Holt LA, Villalpando-Mitchell T, Gadbury-Amyot CC. Extending oral health care services to underserved children through a school-based collaboration: Part 3--a cost analysis. <i>JDH</i> . 2013;87(5):289-98.	Population includes 5 years +
Siruta KJ, Simmer-Beck ML, Ahmed A, Holt LA, Villalpando-Mitchell T, Gadbury-Amyot CC. Extending oral health care services to underserved children through a school-based collaboration: Part 3--A cost analysis. <i>JDH</i> . 2014;88(Suppl 1):13-22.	Population includes 5 years +
Solomon ES, Voinea-Griffin AE. Texas First Dental Home: A Snapshot after Five Years. <i>Tex Dent J</i> . 2015;132(6):382-9.	Ineligible outcomes
Swedish Council on Health Technology Assessment (SBU). Arginine and caries prevention. Stockholm: Swedish Council on Health Technology Assessment; 2015. Available from: <a href="http://onlinelibrary.wiley.com/doi/10.1111/hta.12130">http://onlinelibrary.wiley.com/doi/10.1111/hta.12130</a>	Ineligible outcomes
Tchouaket E, Brousselle A, Fansi A, Dionne PA, Bertrand E, Fortin C. The economic value of Quebec's water fluoridation program. <i>J Public Health (Germany)</i> . 2013;21(6):523-33.	Population includes 5 years +
Tonmukayakul U, Sia KL, Gold L, Hegde S, de Silva AM, Moodie M. Economic models of preventive dentistry for Australian children and adolescents: A Systematic Review. <i>Oral Health Prev Dent</i> . 2015;13(6):481-94.	Ineligible outcomes
Zhang Y, Yang L. The economic burden and their predictors in preschool children with dental caries in urban Beijing. <i>Value Health</i> . 2014;17 (7):A781-A82.	Abstract only

## Appendix 4. Detailed data extraction

<b>Anopa<sup>[6]</sup></b>	
<b>Study country</b>	UK
<b>Methodology</b>	
<b>Study design/type</b>	Cost analysis
<b>Perspective</b>	NHS
<b>Intervention(s)</b> (Aspects of the intervention which are eligible for this review are underlined)	Nursery <u>tooth brushing programme</u> including supervised tooth brushing in nurseries and free distribution of toothpaste packs on at least six occasions during their first five years [14] or home use.
<b>Comparator</b>	No supervised nursery brushing (oral health status predating introduction of the programme)
<b>Primary study objectives</b>	To compare the cost of a supervised nursery tooth brushing programme with NHS cost savings from improved oral health of five year olds
<b>Year(s) study was conducted</b>	1999/2000 – 2009/2010
<b>Population</b>	
<b>Patient criteria - Inclusion criteria</b>	All children aged 3-5 in Scotland
<b>Patient criteria - Exclusion criteria</b>	NOT REPORTED
<b>Number of trial participants</b>	54,812 in 2009/10
<b>Age</b>	3-5
<b>Sex (male)</b>	NOT REPORTED
<b>Summary of Model</b>	
<b>Summary of model</b>	Simple cost calculation which is essentially based upon a decision tree.
<b>Modelling inputs</b>	Rates and costs of decayed, filled and extracted teeth. Costs of nursery tooth brushing programme.
<b>Modelling techniques</b>	Estimation of improved dental health assuming all improvement seen since the year before nursery programme is due to the programme. Outcomes were measured separately for children by deprivation level.
<b>Outcomes</b>	
<b>Source of effectiveness data</b>	Dental inspection data.
<b>Clinical outcomes measured</b>	Teeth decayed, filled and extracted.  Filled teeth in 5 year olds

<b>Anopa<sup>[6]</sup></b>	
	<p>Comparator (2001/02): Zero national dental inspections of 5 year olds 2002/03: 17,857 Intervention (2009/10): 10,909</p> <p>Number of decayed teeth in 5 year olds</p> <p>Comparator (2001/02): Zero national dental inspections of 5 year olds 2002/03: 113,844 Intervention (2009/10): 57,167</p> <p>Number of children with 1 tooth missing in 5 year olds Comparator (2001/02): Zero national dental inspections of 5 year olds 2002/03: 1,937 Intervention (2009/10): 766</p> <p>Number of children with 2 or more teeth missing in 5 year olds Comparator (2001/02): Zero national dental inspections of 5 year olds 2002/03: 7,139 Intervention (2009/10): 2,837</p>
<b>Outcomes used in economic evaluation</b>	Rates and costs of decayed, filled and extracted teeth. Costs of nursery tooth brushing programme.
<b>Resource Use and Costs</b>	
<b>Resources/costs considered</b>	Unit costs of fillings and extractions including the use of local or general anaesthetic and the average number of extractions per session.
<b>Method of capturing resource use</b>	Resources and costs were derived from Scottish Dental Remuneration Amendment combined with data from the Information and Services Division (ISD) on dental treatment claims.
<b>Method of estimating costs</b>	NA
<b>Currency and year</b>	2009 UK£
<b>Results</b>	
<b>Total costs intervention and comparator</b>	<p>Total costs of programme: £15.78 per child per year in 2009/10 Total costs of treatments £150.91 per child for the programme comparator year (2001/2002) Total cost of treatments 8 years after start of programme (2009/10) £73.62 per child</p> <p>Cost saving per child were claimed in the paper to be £86.31 or £4.73m in total. However, the numbers seem to have been incorrectly calculated and should have been £77.29 per child or £4.24m or £3.37m after the cost of the programme</p> <p>Hypothetical analysis by deprivation level showed that the reduction in costs would be highest in the most deprived areas and lowest in the least deprived.</p>
<b>Total QALYs intervention</b>	NOT REPORTED

<b>Anopa<sup>[6]</sup></b>	
<b>and comparator</b>	
<b>ICERs</b>	NOT REPORTED
<b>Summary of uncertainty analysis</b>	NOT REPORTED
<b>Sensitivity analysis</b>	Depending on the cost of general anaesthetic, cost savings by 2009/10 compared to 2001/2002 could be between £2.9m and £9.9m.
<b>Author's conclusions</b>	The nursery supervised tooth brushing programme has expected savings from reduced dental interventions in five year olds of at least 2.5 times its cost.

## Appendix 5. Detailed quality assessment

Criterion	Anopa <sup>[6]</sup>	Atkins <sup>[3]</sup>	Edelstein <sup>[4]</sup>	Koh <sup>[5]</sup> & Plonka <sup>[12]</sup>	Samnaliev <sup>[13]</sup>
<b>Study Design</b>					
1. Was the research question stated?	Yes	Yes	Yes	Yes	Yes
2. Was the economic importance of the research question stated?	Yes	No	Yes	Yes	Yes
3. Was/were the viewpoint(s) of the analysis clearly stated and justified?	Yes	Yes	Yes	Yes	Yes
4. Was a rationale reported for the choice of the alternative programmes or interventions compared?	Yes	Yes	Yes	No	Yes
5. Were the alternatives being compared clearly described?	Yes	Yes	Yes	Yes	Yes
6. Was the form of economic evaluation stated?	Yes	No	No	Yes	Yes
7. Was the choice of form of economic evaluation justified in relation to the questions addressed?	Yes	No	No	Yes	No
<b>Data Collection</b>					
8. Was/were the source(s) of effectiveness estimates used stated?	Yes	Yes	Yes	Yes	Yes
9. Were details of the design and results of the effectiveness study given (if based on a single study)?	Yes	NA	No	Yes	Yes
10. Were details of the methods of synthesis or meta-analysis of estimates given (if based on an overview of a number of effectiveness studies)?	NA	NA	NA	Yes	Yes
11. Were the primary outcome measure(s) for the economic evaluation clearly stated?	Yes	Yes	Yes	Yes	No
12. Were the methods used to value health states and other benefits stated?	NA	NA	NA	Yes	Yes
13. Were the details of the subjects from whom valuations were obtained given?	NA	NA	NA	Yes	Yes
14. Were productivity changes (if included) reported separately?	NA	NA	NA	NA	NA
15. Was the relevance of productivity changes to the study question discussed?	NA	NA	NA	NA	NA
16. Were quantities of resources reported separately from their unit cost?	Yes	Yes	No	Yes	Yes

Criterion	Anopa <sup>[6]</sup>	Atkins <sup>[3]</sup>	Edelstein <sup>[4]</sup>	Koh <sup>[5]</sup> & Plonka <sup>[12]</sup>	Samnaliev <sup>[13]</sup>
17. Were the methods for the estimation of quantities and unit costs described?	Yes	Yes	Yes	Yes	Yes
18. Were currency and price data recorded?	Yes	Yes	No	Yes	Yes
19. Were details of price adjustments for inflation or currency conversion given?	Yes	No	No	Yes	No
20. Were details of any model used given?	Yes	Yes	No	Yes	Yes
21. Was there a justification for the choice of model used and the key parameters on which it was based?	No	No	No	Yes	No
<b>Analysis and Interpretation of Results</b>					
22. Was the time horizon of cost and benefits stated?	Yes	Yes	Yes	Yes	No
23. Was the discount rate stated?	NA	Yes	Yes	Yes	No
24. Was the choice of rate justified?	NA	No	No	Yes	No
25. Was an explanation given if cost or benefits were not discounted?	NA	NA	NA	NA	No
26. Were the details of statistical test(s) and confidence intervals given for stochastic data?	NA	NA	NA	Yes	Yes
27. Was the approach to sensitivity analysis described?	Yes	No	No	Yes	Yes
28. Was the choice of variables for sensitivity analysis justified?	Yes	No	No	Yes	Yes
29. Were the ranges over which the parameters were varied stated?	Yes	Yes	No	Yes	Yes
30. Were relevant alternatives compared? (That is, were appropriate comparisons made when conducting the incremental analysis?)	NA	NA	No	Yes	Yes
31. Was an incremental analysis reported?	No	No	No	Yes	Yes
32. Were major outcomes presented in a disaggregated as well as aggregated form?	NA	Yes	No	Yes	Yes
33. Was the answer to the study question given?	Yes	Yes	Yes	Yes	No
34. Did conclusions follow from the data reported?	Yes	Yes	Yes	Yes	Yes
35. Were conclusions accompanied by the appropriate caveats?	Yes	Yes	No	Yes	No
36. Were generalisability issues addressed?	No	No	No	Yes	No