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The clinical effectiveness and cost-effectiveness of routine dental checks: a systematic review and economic evaluation

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Contents

Glossary and list of abbreviations

Technical terms and abbreviations are used throughout this report. The meaning is usually clear from the context, but a glossary is provided for the non-specialist reader. In some cases, usage differs in the literature, but the term has a constant meaning throughout this review.

Glossary

Attachment level Distance from cemento-enamel junction to the most apical penetration of the probe.

Bone loss Destruction of bone as a result of irreversible periodontitis.

Bone score Composite measure of bone loss from a defined number of teeth.

Caries Dental decay: can encompass caries in enamel as well as caries extending into dentine.

Caries lesion Dental decay. A single caries lesion can encompass: a fraction of a surface of a single tooth; one or more surfaces of a single tooth; one or more teeth.

Decayed tooth Tooth that has become carious.

Edentate No natural teeth remaining.

Filled tooth Tooth that has been restored with a filling, usually previously decayed.

Fissure sealant The obturation of pits and fissures on the surface of teeth in order to prevent the development of dental caries.

Gingivae Gums.

Gingival recession Shrinking back of the gingivae leaving part of the root exposed.

Gingival unit Gingival site – four surface units of a tooth.

Gingivitis Inflammation of the gingivae.

Missing tooth Tooth that has been lost, usually defined as missing owing to dental caries.

Oral cancer – advanced TNM stage T1 or T2 with metastases; or T3 or T4 with or without metastases.

Oral cancer – localised TNM stage T1 or T2 without metastases.

Periodontal disease Inflammation of the supporting structures of the teeth, usually associated with their destruction.

Periodontitis Inflammation of the periodontal tissues resulting in destruction of the periodontal ligament and the supporting bone.

Plaque Bacteria and their products that cling to the tooth surface when oral hygiene is neglected.

Preventive treatment approach Dental care philosophy that encourages prevention and monitoring rather than early intervention.

Probing depth/pocket depth Distance from the most coronal margin of the gingivae to the most apical penetration of the probe.

Pulpotomy The removal of vital (live) pulp from the crown of the tooth in order to maintain the vitality of the tooth root.

Ramfjord teeth Teeth nos. 16, 21, 24, 36, 41, 44.

Restorative treatment approach Dental care philosophy that encourages early intervention and repair of dental caries at an early stage.

Root caries Decay on the tooth root surface.

Root treatment Cleaning and filling of the canal within the root of a tooth, usually undertaken in non-vital (i.e. dead) teeth.

Sound tooth A tooth with no decay or fillings.

continued

continued

Tooth surface Deciduous dentition: 88 surfaces encompassing a total of 20 teeth. Permanent dentition: 120 surfaces encompassing a total of 28 teeth (excluding wisdom teeth).

Untreated caries Untreated decay; indicator often expressed as the proportion of a population with untreated/active caries.

List of abbreviations

DMFS decayed, missing and filled tooth surfaces (permanent dentition)

dmfs decayed, missing and filled tooth surfaces (deciduous dentition)

DMFT decayed, missing and filled teeth (permanent dentition)

dmft decayed, missing and filled teeth (deciduous dentition)

/12 time in months

Executive summary

Background

Oral health can be defined as a general state of well-being as a result of healthy and functioning mucosae, gingivae and dentition. Despite an increasing incidence of oral cancer in adults and static levels of periodontal disease in children, a marked improvement has been observed in general oral health (experience of periodontal disease, caries and tooth loss in adults, and caries in children) over the last three decades.

Six-monthly dental checks have been customary in the General Dental Service in the UK since the inception of the NHS and NHS regulations recognise this practice. Dental practitioners can be remunerated for performing 6-monthly checks and registration with an NHS dentist lapses with a longer than 15-month gap between visits. However, the NHS does not explicitly recommend a specific dental check recall frequency.

Despite the general improvement in oral health, important inequalities in dental health remain, particularly across socio-economic groups and between geographical areas with and without a fluoridated water supply. This has raised questions over the current lack of an explicit dental check recall policy and, in particular, whether dental check recall intervals should be adjusted to reflect oral health needs more closely in order to optimise their clinical effectiveness and cost-effectiveness.

Questions addressed by this review

- How effective are routine dental checks of different recall frequencies in improving quality of life and reducing the morbidity associated with dental caries and periodontal disease in children?
- How effective are routine dental checks of different recall frequencies in improving quality of life, reducing the morbidity associated with dental caries, periodontal disease and oral cancer, and reducing the mortality associated with oral cancer in adults?
- What is the cost-effectiveness of routine dental checks of different recall frequencies in improving quality of life and reducing the morbidity associated with dental caries and periodontal disease in children?
- What is the cost-effectiveness of routine dental checks of different recall frequencies in improving quality of life, reducing the morbidity associated with dental caries, periodontal disease and oral cancer, and reducing the mortality associated with oral cancer in adults?

Methods

A systematic review of the clinical effectiveness and cost-effectiveness of routine dental checks of different recall frequencies was undertaken.

After an informal scoping search to identify existing reviews, the search strategy for primary studies was designed to identify controlled trials and observational studies, with no language restrictions. Primary studies were identified from the following sources: electronic bibliographic databases, internet sites, contact with experts, citation checks, and a search of the Cochrane Oral Health Group specialised register of controlled trials.

The selection of studies for inclusion, and the subsequent quality assessment and data extraction were undertaken by at least two reviewers working independently, using explicit predefined criteria and proformas. A limited sensitivity analysis was performed in order to assess the impact of study quality on the clinical effectiveness findings.

A Markov decision analysis modelling exercise based on current available UK data was undertaken in order to address deficiencies in the existing literature and perform an incremental cost-effectiveness analysis of different dental check recall policies on decay experience in deciduous and permanent dentition. The cost-effectiveness of 3-, 6-, 12-, 18-, 24- and 36-month dental check recall policies was examined using transition probabilities for the progression of caries and incorporating two key risk factors: socio-economic background (manual versus non-manual) and water fluoridation.

Results

Effectiveness

Information from 25 articles reporting the results of 29 studies are included in this review. Twenty-four studies addressed the effectiveness of dental checks on caries; nine concerned periodontal disease, two oral cancer and one quality of life.

The studies included in the effectiveness review were poorly reported, which limited internal comparison (between studies) and also external comparison with the current UK situation. Heterogeneity across studies with regard to the intervention under study further limited external comparison with the current UK situation. Only four studies addressing caries in permanent or deciduous teeth included 6 months as a comparison frequency and thus addressed the review question from a UK perspective. A sensitivity analysis conducted on the outcome of dental caries indicated that the findings presented below were robust to the methodological quality of the studies.

Caries

There was little consistency in the direction of effect of different dental check frequencies between studies for outcome measures in deciduous, mixed or permanent dentition. Two separate studies demonstrated no significant difference between dental check frequency and decayed, missing and filled teeth in deciduous or mixed dentition. One study reported a significant reduction in the number of fillings with individualised dental check frequencies compared with a blanket recall policy of 12 months or longer in mixed dentition. There was a preponderance of studies reporting an increase in decay, a decrease in the number of teeth, and a decrease in fillings, with less frequent dental checks in permanent dentition.

Periodontal disease

A single study demonstrated a decrease in attachment level with a decrease in dental check frequency, which was of uncertain statistical significance. There was no consistency in the direction of effect of different dental check frequencies in permanent dentition between studies for: bleeding, probing depth/pockets, presence of plaque/calculus, bone score, gingivitis and periodontal health.

Oral cancer

One study suggests that dental check recall intervals of less than 12 months do not impact on tumour size at diagnosis. One study reports that decreasing dental check frequencies (more than 12 months) may significantly increase the stage and size of tumours at diagnosis.

Quality of life

One study demonstrated a significant association between increasing dental check frequency and the perception that oral health affects quality of life.

Cost-effectiveness

There was much uncertainty in the analyses reported in the literature (concerning data sources used, extrapolation of results, and variable modelling approaches) with no employment of sensitivity analysis techniques to address the problems. There were no published cost-effectiveness studies based on UK data and current UK practice (i.e. comparisons of dental checks performed at 6-monthly intervals compared with other frequencies). Economic studies that have considered the frequency of routine dental checks have focused on children rather than adults.

Only one formal cost-effectiveness study was identified, which reported an incremental cost of US$73 per carious surface averted when comparing 12-monthly dental assessment to no assessment.

The results of five resource impact studies appeared to be consistent; less frequent dental checks (range 7–24 months) were associated with reduced assessment and treatment, with little evidence of an adverse impact on dental health.

Decision analysis

Moving from a policy option of 6-monthly to 3-monthly dental checks was associated with a relatively small reduction in the experience of decay over 6 years in deciduous and 68 years in permanent dentition (an average of between 0.04 deciduous and 0.41 permanent teeth (non-manual, fluoridated water) and 0.12 deciduous and 0.22 permanent teeth (manual, non-fluori-dated water)), and a sharp increase in costs (around £64 per patient over 6 years in deciduous dentition and about £202 per patient over 68 years in permanent dentition). Moving from the policy option of 6-monthly dental checks for both deciduous and permanent dentition to longer frequency policies (i.e. 12, 18, 24 and 36 months) demonstrated a consistent trend of an increase in dental decay experience relative to a saving in cost. This finding holds for both deciduous and permanent dentition

and across all risk groups studied. The magnitude of the increase in decay experience is greatest in non-manual and non-fluoridated groups for both deciduous and permanent dentition.

For deciduous teeth, modelling indicates that, by moving from 6-monthly to 12-monthly dental checks, an average of between 0.2 (manual, non-fluoridated water) and 0.07 (non-manual, fluoridated water) teeth would be affected by decay experience, with a reduction in cost of around £30 per patient over 6 years. In permanent dentition, modelling indicates that, by moving from a 6-month to a 12-month recall policy, an average of between 0.14 (manual, non-fluoridated water) and 0.21 (non-manual, fluoridated water) teeth would be affected by decay experience, with a reduction in cost of between £75 and £95 respectively per patient over 68 years. The results of the economic modelling exercise appear robust to sensitivity analyses.

Conclusions

There is little existing evidence to support or refute the practice of encouraging 6-monthly dental checks in adults and children. Decision analysis modelling using current UK data to investigate further the cost-effectiveness of different dental check recall frequencies on the experience of dental decay in deciduous and permanent dentition suggests that moving to longer (more than 6-monthly) dental check frequencies, rather than shortening the currently practised recall interval, would be more cost-effective. However, the model demonstrates that cost-effectiveness varies across risk groups and therefore consideration should be given to whether a population recall policy or a recall policy based on individual risk would be more appropriate.

Given the limitations of existing UK epidemiological data, it was not possible to undertake a modelling exercise to investigate the cost-effectiveness of different frequencies of dental checks on the experience of periodontal disease or on the morbidity and mortality associated with oral cancer.

There is a need for further primary research addressing the role of the dental check and its effectiveness in different oral diseases.

Chapter 1
Introduction

Aims and objectives

Aims
This review aims to review systematically the evidence for the clinical effectiveness and cost-effectiveness of routine dental checks, particularly whether effectiveness and cost-effectiveness are altered by the frequency of the dental check interval.

Objectives
The objectives are:

- to identify and assess systematically the evidence for the clinical effectiveness of routine dental checks of different recall frequencies
- to identify and assess systematically the evidence on costs and the health economic impact of routine dental checks of different recall frequencies
- to review UK epidemiological data relating to oral disease progression and its modifying factors
- to use the data obtained in the second and third points above to investigate, by using a decision analysis model, the influence of modifying factors on the effectiveness of routine dental checks of different recall frequencies.

Background

Description of the underlying health problem
Oral health can be defined as a general state of well-being as a result of healthy and functioning mucosae, gingivae and dentition. Despite the fact that general oral health is improving in both children and adults in most industrial countries, important variations in oral health exist that reflect a complex interaction of modifying factors for the development and management of oral disease. These modifying factors include age, diet, socio-economic status, ethnicity, tobacco use, fluoride use, dental attendance and clinician performance.[1–6]

Oral health parameters addressed by this review include caries, periodontal disease and oral cancer.

Caries
Definition
Dental caries is caused by the action of organic acids on the enamel of the tooth surface. The acid is produced by bacteria contained within dental plaque from components of the diet, mainly sugars. The result is demineralisation of the teeth. Primary caries occurs in unrestored teeth and secondary caries is associated with existing restorations. Early carious lesions in enamel are the result of a dynamic process of demineralisation and remineralisation due to movement of calcium, phosphate and other ions. The tooth surface is in dynamic equilibrium with saliva and the bacterial plaque that may be present in the mouth. Caries progresses when the balance of ionic movement is towards demineralisation. The progression of caries thus varies according to individual and external characteristics such as frequency of sugar consumption and predisposing medical conditions such as xerostomia, which alters the condition of saliva and fluoride exposure and encourages remineralisation.

Diagnosis and measurement
Caries can present as an active caries lesion in enamel and/or dentine, and may progress to abscess formation and tooth loss. The "caries experience" of an individual is measured by a combination of active caries, restorations (fillings) and teeth missing owing to decay.

The diagnosis of caries is usually by clinical examination complemented by radiographic examination recommended at less frequent intervals.[7] The diagnosis of caries can be difficult, particularly when it occurs between adjacent teeth (interstitial caries) and in or close to existing restorations. There is evidence of variability in dental practitioner performance, both in clinical examination[3] and in the interpretation of radiographic examinations.[1] Measurement of decay experience as opposed to active decay can be confounded by a number of factors in addition to a practitioner's diagnostic ability. These factors include professional treatment preferences (restorative compared with preventive) and uncertainty concerning the reason for missing teeth, which may occur as a result of extraction for caries or be due to periodontal disease, trauma, orthodontic treatment or natural exfoliation.

The most common measures of caries in children in the UK include the proportion with no decayed, missing or filled teeth, and the mean number of decayed, missing or filled teeth (dmft (deciduous dentition), DMFT (permanent dentition)). In adults, the most common measures of caries used are the number of decayed or unsound teeth, the number of restored teeth, the average number of teeth in dentate adults, and the proportion of adults in the population who are dentate.

Epidemiology

There is a paucity of longitudinal data concerning caries in the UK and thus of estimates of incidence. The child (<16 years) and adult (≥16 years) dental health surveys carried out in the UK every 10 years provide estimates of the changing prevalence of caries.[8–12] These surveys are likely to underestimate the prevalence of caries owing to the diagnostic criteria used. The reporting of caries is usually at a gross level (frank cavities without the aid of radiographic diagnosis) to ensure that all examiners record decay at the same level, therefore ensuring reproducibility. There has been an improvement in the prevalence of caries in both adults and children over the last 20–30 years, with the biggest improvements seen in children.

Children

Between 1973 and 1993 the number of children experiencing decayed, missing or filled teeth has fallen by over 50% for 5-year-olds and by 75% for 12- and 15-year-olds. The mean dmft for 5-year-olds has fallen from 3.5 to 1.7 and the mean DMFT for 12-year-olds has fallen from 4.8 to 1.4. In the last decade, the reduction in decay experience has been largely the result of a decrease in the number of teeth filled rather than in the number of teeth with active decay.

Adults

Between 1968 and 1998 the average number of teeth in dentate adults increased from 23.0 to 24.8. There has also been a continuous decrease in the proportion of people who are edentate, from 30% of adults in 1978 to 13% in 1998. The average number of decayed or unsound teeth in adults decreased from 1.9 to 1.1 between 1978 and 1988 but has not significantly decreased further since that time. This latter statistic is confounded by the increasing number of adults retaining more of their natural teeth, which are more likely to have been restored and are at risk of decay.

Risk factors

Experience of dental decay represents a complex interaction between the sociodemographic characteristics of individuals, such as oral health behaviours (including dental attendance), social class, educational attainment and age. General improvements in the experience of dental caries in adults and children in the UK have therefore been shown to hide important variations that manifest themselves as regional variations in the experience of dental caries.

In 1993, only self-reported regularity of dental attendance was found to be independently associated with levels of dental caries in the deciduous dentition of children. The percentage of children aged 5 in non-manual headed households who had any decay experience was 38% in those who attended for regular (within the previous 6 months) check-ups and 65% in those who attended the dentist only when they had a problem.

For the permanent dentition of children, the social class of the head of the household was found to be independently associated with decay experience. In 1993 the proportion of 12-year-olds with any decay experience increased from 45% in non-manual occupations to 68% in semiskilled or unskilled manual occupational groups. The corresponding figures for 15-year-olds were 58% and 72% respectively.

In 1998, age was the most important variable explaining differences in measures of dental caries in adults: the experience of caries increased with age. However, self-reported social class of the head of the household and individual educational attainment were found to be independently associated with experience of dental decay. For example, the percentage of adults with decayed or unsound teeth increased from 50% in non-manual headed households to 62% in households headed by individuals in semiskilled or unskilled manual occupations.

Evidence is inconsistent concerning the independence of ethnicity from material deprivation as a risk factor for caries.[13,14] However, in the UK, ethnic group differences have been observed in levels of caries in preschool children.[15] Although there appears to be no difference in the prevalence of caries between the primary dentition of white and black (black Caribbean and black African) children in the UK, dmft scores among Asian children in the UK are reported as being 1.5–2.0 times higher than in white children. In contrast, members of the Asian subgroup have less caries experience in permanent dentition than their white counterparts.[16] Religious background,

weaning and feeding practices, and maternal education (mother's ability to speak English) are indicators of caries risk.

A recent review of the effectiveness of water fluoridation concluded that there is a 14.6% increased risk of dental decay in deciduous and permanent dentition (children and adults) in areas with non-fluoridated water supplies compared with those living in areas where the water supply is fluoridated.[17]

Periodontal disease

Definition

Periodontal disease is a disease of the supporting structures of the teeth. The biological processes involved are complex and not fully understood at present. Gingivitis is caused by bacteria present in dental plaque. Gingivitis is often a precursor of periodontitis (inflammation of the periodontal (tooth supporting) ligament characterised by pocketing (measured as an increase in "probing depth")), a loss of epithelial attachment, and also loss of alveolar (tooth supporting) bone.

Diagnosis and measurement[18,19]

The diagnosis of periodontal disease is usually by clinical examination. Radiographic examination is unsuitable for detecting early periodontal disease; extensive bone loss must occur before it becomes visible on radiographs and the optimal healthy bone levels have yet to be determined for different population groups. Gingival bleeding is an indictor of gingivitis (early inflammatory changes). Periodontal pocket formation and loss of epithelial attachment provides a historical record of periodontal disease around a tooth; the depth of the pocket and the loss of epithelium attaching the tooth to supporting structures depends on the severity and duration of the inflammatory destruction. Symptoms include loose teeth and eventually tooth loss, but the condition is usually painless until the disease process has reached an advanced stage. Complications can also include the development of a periodontal abscess. The diagnosis of periodontal disease is complicated by the slow and inconsistent progression of the disease. For example, gingivitis is a necessary but not a sufficient prerequisite for periodontitis. Furthermore, the presence of periodontal pockets does not indicate active disease; tooth sites with pockets that do not bleed are unlikely to be in an active state of periodontal destruction. Reproducibility of the measurement of probing depth and attachment level is a problem in the diagnosis and measurement of periodontal disease; measurement will vary depending on the force put on the probe. Standardisation of probing force and the development of electronic probes are being increasingly used in research, although they are rarely used in epidemiological studies in the field.

Epidemiology

There is a paucity of longitudinal data from untreated populations with which to estimate the incidence of periodontal disease in the UK. It increases with age but considerable variation exists between individuals. The adult and child dental health surveys in the UK provide estimates of its prevalence in the UK.

Children

The 1993 child dental heath survey[8] indicated that there had been a decline in some measures of periodontal health since 1983, while for some measures there had been no change. The number of children with gum inflammation had increased between 1983 and 1993 (e.g. a 12% increase in gum inflammation in 8-year-olds) but there had been no apparent change in the level of pocketing and gingivitis in 15-year-olds over the same period.

In 1993[8] the proportion of UK children affected by gum inflammation ranged from 45% of 5-year-olds rising to 73% of 10-year-olds and decreasing to 53% of 15-year-olds. The proportion of 15-year-old children with mild pocketing (3.5–5.5 mm) was 10% in 1993 and the proportion with gingivitis (bleeding elicited by probing) was 45%.

Adults

As with observed trends in decay and restoration, any observed differences in the amount and degree of periodontal disease in adults will be confounded by the increasing number who are retaining their natural teeth for longer.

There appears to have been a reduction in some features of periodontal disease in adults between 1988 and 1998. In the 1988 adult dental health survey[12] 69% of the population with some teeth had some periodontal pockets and 10% had deep pockets (>6.0 mm). In the 1998 adult survey, 54% had some pocketing and 5% had deep pockets (>6 mm).[9]

Risk factors

Risk factors for periodontal disease include increasing age, the presence of plaque, calculus (calcified plaque), smoking and some medical conditions such as diabetes and HIV. However the Faculty of Dental Surgeons states that "there are no reliable prognostic indicators for periodontal disease".[20]

Apart from age, dental behaviour was found to have an effect on the periodontal condition of the teeth in the 1998 adult survey.[9] In adults who regularly attended for a dental check-up (frequency not defined) or whose last dental visit was <5 years previously, the periodontal condition was better than in those who reported attending a dentist only when they had a problem. Furthermore, reduced toothbrushing frequency was associated with a deterioration in periodontal condition. The social class of the head of the household and educational attainment were found not to have a significant effect on the periodontal condition of the teeth.

Experience of periodontal disease does not appear to be socially or culturally influenced to the same degree as dental caries. There is evidence of a lower level of oral hygiene and a higher level of periodontal disease in Asian compared with white children in both primary and permanent dentition. There is no evidence of a significant difference in levels of oral hygiene between white, black, Chinese or Vietnamese children, but significantly higher levels of gingivitis and loss of attachment have been found in older black children (black African and black Caribbean) compared with white children.[13]

Oral cancer

Definition

The definition of oral cancer used by the British Dental Association using the WHO International Classification of Diseases includes cancers of the lip, tongue, gum, floor of mouth, other unspecified parts of the mouth, oropharynx and hypopharynx.[21] The majority of oral cancers are squamous cell carcinomas.[22]

Diagnosis and measurement

Two precancerous oral lesions are recognised, erythroplasias and leukoplakias, although a considerable number of oral cancers arise *de novo*. Precancerous lesions are rare. For example, leukoplakias occur in 3–4% of the population and it is reported that, over 10 years, only 3–4% of leukoplakias will undergo malignant transformation, while approximately 15% will regress clinically.[23]

In the UK, screening for oral cancer is currently conducted by general dental practitioners on an opportunistic basis as part of routine dental care. The British Dental Association guidelines for the early detection of oral cancer recommend routine visual inspection of the oral mucosa by following a set pattern, and referral of all patients with oral lesions suspected of malignancy to oral or maxillofacial surgeons for further assessment.[24] However, there is evidence that the population groups most at risk (elderly, edentulous patients) are less likely to attend for dental checks.[25] There is currently no evidence to support population screening for oral cancer.[26]

Epidemiology

In the UK, around 2000 new cases of oral cancer are reported to cancer registries each year, representing approximately 1–4% of all malignant disease. Incidence and mortality are rising, with a strong cohort effect seen in men born since 1910. Eighty-five per cent of cases occur in people over the age of 50 years and approximately twice as many occur in men as in women. The morbidity and mortality associated with oral cancer is significant. Tumours invade and destroy local tissues and the average 5-year survival rate in England and Wales is 50%.[22]

Risk factors

Risk factors for lip and intra-oral cancers are different. Exposure to sunlight and tobacco exposure, particularly from pipe smoking, are risk factors for lip cancers, whereas for intra-oral cancers tobacco use is the most important risk factor, followed by alcohol intake; these two factors are multiplicative. Diets rich in iron, vitamin C and vitamin A have been shown to be protective.[22]

At present, no clear trend has been observed between the incidence of oral cancer and socioeconomic status, but a trend for increased mortality in socially disadvantaged groups has been observed.[27]

Differences in both incidence of and mortality from oral cancer between ethnic groups in the UK have been observed. The incidence of oral cancer appears to be higher in the UK's South Asian population than in the indigenous population, and the mortality rate from oral cancer in men from the Indian subcontinent is higher than in white men. These differences are largely attributed to practices of tobacco use, particularly tobacco chewing habits, but also to dietary factors, genetic predisposition, and a lack of awareness about the risk factors and signs of oral cancer in high-risk populations.[13] East African immigrants to the UK have been observed to exhibit a higher mortality from oropharyngeal cancer than the indigenous population.[13,27]

The impact of dental disease

The reader should refer also to individual conditions noted above.

Patient perspective

There is currently a growing interest in patient-centred oral health outcomes. Oral diseases

(excluding oral cancer) are not usually fatal but they can affect the ability to speak, eat and socialise without embarrassment. Oral disorders can affect interpersonal relationships and daily activities and, therefore, quality of life.[28] Researchers have recently attempted to define utilities associated with oral disease.[29–31]

Using the Oral Health Impact Profile,[32] the 1998 adult health survey[9] showed that 51% of adults reported having experienced one or more oral problems that had had an impact on some aspect of their life during the year preceding the survey. Forty per cent of dentate adults said they had experienced pain in the preceding 12 months; 27% had experienced psychological discomfort and 19% psychological disability. However, despite a considerable amount of developmental work in this area, there remains a paucity of validated instruments to assess quality-of-life measures in oral health; the measurement of quality of life in studies of oral health therefore remains limited.

It has been estimated that 45% of men and 41% of women in full-time employment take time off work to attend the dentist, although in most cases the time involved is less than 2 hours.[9] Furthermore, it has been shown that approximately 67% of dentate adults pay a contribution to the costs of their dental treatment; for the last treatment provided within the NHS in 1998 it was estimated that 25% of adults paid between £10 and £19 and that 4% paid over £100.[9]

Current spend on dental checks and treatment in the NHS

To the year end March 2001 the gross fee expenditure on simple examinations (code 010) within the General Dental Service for adults in England and Wales was £112,572,625[33] (including the patient charge element but excluding hospital and community dental services). To the year end March 2001, the total gross fees for examinations (all types) and treatments within the General Dental Service for adults in England and Wales were £1,490,069,176.[33]

Technology under evaluation

Identification of a frequency for routine dental checks that is optimal in terms of its clinical effectiveness and cost-effectiveness

For the purpose of this report, a routine dental check is defined as given by the NHS in its dental remuneration statement, item 1(a): "Clinical examination, advice, charting (including monitoring of periodontal status) and report".[34]

The rationale for encouraging regular dental checks is that this practice will assist individuals to keep a healthy, functioning mouth, including the teeth, gingivae and mucosae. The Faculty of Dental Surgery states that "the corner stone of preventive care is professional supervision. Continuing care, review and recall are an essential part of that supervision."[35]

Six-monthly dental checks have been customary in the General Dental Service in the UK since the inception of the NHS. NHS regulations recognise this practice. Dental practitioners can be remunerated for performing 6-monthly checks[34] and registration with an NHS dentist lapses with longer than a 15-month gap between visits.[36] However, the NHS does not explicitly recommend a specific dental check recall frequency.

With respect to recalling patients, the Faculty of Dental Surgery states: "Recall is defined as the planned, unprecipitated return of a patient who, when last seen, was in good oral health."[35]

In addition, despite:

> "considerable debate, with little factual basis, regarding the cost–benefit of a specified recall period … there should be a recall at least once per year: 6 months is a convenient interval which provides for continuity of care … milestones in dental development should trigger recall in children under regular care. There is merit in the concept of specific milestones at 3, 6, 9, and 12 years."[35]

> "With respect to periodontal disease in persons under 35 years the Faculty of Dental Surgeons recommend that all patients should be screened for the presence of periodontal disease as part of a dental examination and that 'patients with insignificant periodontal disease on initial screening should be screened again at regular routine inspections. The frequency should be at least every 12 months'."[20]

The general improvement in oral health observed over the last three decades,[8,9] accompanied by a greater understanding of risk factors for disease progression, has raised the question of whether recall intervals should be adjusted to reflect current oral health needs more closely at population, subgroup or individual levels in order to optimise the clinical and cost-effectiveness of dental checks.[2–4,36,37] Most debate has focused on whether the traditional practice of a 6-monthly blanket recall that currently exists in the UK should be lengthened.

Modernising NHS Dentistry – Implementing the NHS Plan[36] was published in September 2000. It forms the dental agenda of the modernisation programme for the NHS. It sets out the intention to redesign the NHS around patients to deliver fast, accessible care. Concerning modernisation of working patterns, the document suggests that the idea that everyone should visit the dentist every 6 months is one that is due for review. By lengthening or individualising dental examination recall intervals, access to NHS dentistry could be widened to a greater number of people. A change in recall interval would also have implications for dental workforce planning.

Possible disadvantages of lengthening recall intervals include moving away from a preventive approach, resulting in more serious sequelae of caries (bigger restorations and an increased number of extractions), and a loss of opportunity to arrest the development of periodontal disease by encouraging improved personal oral hygiene and initiating appropriate treatment.[3] There may also be risks to the development of patient–professional rapport and a loss of the potential for positive behavioural changes (advice on smoking and diet) that dentist–patient encounters provide. The possible advantages of lengthening recall intervals are a reduction in costs for both patients and the NHS, and a reduction in the amount of inappropriate treatment (mainly fewer fillings) as a result of allowing the natural arrest or regression of caries lesions in enamel and less exposure of patients to an unreliable diagnosis of caries.[2,30]

Researchers have attempted to define an optimal (cost-effective) dental check recall frequency in caries based on: the bitewing radiological diagnosis of caries and modelling of average disease progression,[1,5,30,38] dental practitioner performance,[1,30] restoration therapy longevity,[1,30] and the risk of caries.[6,30] However, an optimal recall frequency for clinical examination for multiple types of oral disease, in primary and permanent dentition and taking into account the modifying factors for disease progression outlined above, has yet to be determined.

Current service provision

For patients aged 18 years and over, clinical examination and more extensive examinations, including charting of periodontal status and in complex restorative or orthodontic cases, are possible under items 1a–1c of the statement of dental remuneration,[34] which sets a national scale of NHS fees for each type of examination, ranging from £6.15 to £19.35.

Although there is evidence of variation in the diagnostic skills of clinicians (see above) there appears to be no evidence on the variation in performance of dental practitioners in relation to the components of the basic dental check (1a) or performance of more extensive examinations (1b–1c) as defined in the statement of dental remuneration.

Payment systems for dental examinations in the UK

For patients aged under 18 years, payment for examinations is included as part of the capitation payments made to dentists for the care and treatment necessary to secure and maintain oral health. No separate examination fee is payable.

For adults, a fee per item system for payment may dictate the usual recall interval for a patient. For a standard dental examination for adults no fee can be claimed for 5 clear calendar months after the previous claim. It can be expected that 6-monthly check-ups remain the norm as a reflection of the payment system. There is no incentive for dentists to extend the recall period in those with good oral health.

For children there is no such professional financial incentive to undertake 6-monthly check-ups. If children are seen every 15 months the period of registration continues and the capitation payment rolls forward.

Eligibility and uptake of dental examinations in the UK

All UK citizens are entitled to receive NHS dental care. Patients who are exempt from payment of dental charges include children (<18 years), those aged 18 and in full time education, those on low incomes (including those who have an NHS low income scheme certificate HC2, those in receipt of income support, those in receipt of job-seekers allowance, those in receipt of working families tax credit, and those in receipt of disabled person's tax credit), pregnant women and those who have had a baby in the last 12 months. Patients who are not exempt from charges pay 80% of the total cost of dental treatment up to maximum currently set at £360. There may therefore be an incentive for non-exempt patients not to attend for asymptomatic check-ups.

From the 1993 UK child dental health survey[8] it is estimated that 59% of the child population at age 5 years, rising to 64% at age 15 years, are self-reported regular dental attenders (attended in the last 6 months). Variation in the percentages

of children never visiting a dentist by social class of the head of the household was significant only in the 5-year-old age groups, where 7% of children from non-manual households compared with 15% from semiskilled and non-skilled manual households reported never visiting a dentist.

According to the 1998 UK adult dental health survey,[9] 59% of the adult population self-reported attending for regular dental check-ups (frequency not defined) compared with 30% attending only when they had trouble with their teeth. The percentage of adults reporting regular dental attendance is greater in non-manual occupational groups (65%) than in semiskilled and unskilled manual groups (49%). These social class gradients in dental attendance patterns are supported by further work.[39] However, it is likely that reported attendance patterns are overestimates. Elderton found that only a third of adults enrolled in the Scottish General Dental Service who claimed to seek regular check-ups (attending once per year, with a gap no greater than 18 months between two attendances) actually did attend this frequently.[40] Evidence from dental records suggests that adult dental attendance may vary by region (which may be a reflection of social class differences) and/or over time. Between 1978 and 1988 only 9% of adults in Scotland had attended the dentist once per year on average with no greater than an 18-month gap between visits.[41] Between 1991 and 1999 in England and Wales the most common dental attendance frequency for adults was around 6 months (in excess of 40% of patients).[42] There is also evidence that edentulous people[25] are less likely to register with a dentist and attend for asymptomatic check-ups.

Chapter 2

Clinical effectiveness

Methods for reviewing effectiveness

Search strategy

An informal scoping search was undertaken to identify any existing systematic reviews and estimate the likely volume and nature of the primary research.

In the first instance, the search strategy for the primary studies was designed to identify randomised controlled trials. However, because insufficient trials were identified to address adequately the question posed, the searches were extended to include observational studies.

There were no restrictions by language. Searches of the electronic bibliographic databases were undertaken during February 2001.

Primary studies were identified using the following sources:

- Electronic bibliographic databases: Cochrane Library Issue 4, 2000; MEDLINE (Ovid) 1980 – December 2000; EMBASE (Ovid) 1980 – December 2000; National Research Register Issue 4, 2000. Search terms included various configurations of a range of text words (e.g. dental visits, dental frequency, dental recall and the index terms preventive dentistry, dental caries, tooth diseases and oral health). A filter to identify trials was included where appropriate. Subsequently, a filter to identify cohort and case control studies was included where appropriate. Further details are provided in appendix 1.
- Internet sites:
  - Dentanet <http://www.is.bham.ac.uk>
  - DERWeb <http://www.derweb.ac.uk/index.html>
  - MedWeb <http://www.medweb.emory.edu/Medweb/>
  - Dental Health Services Research Unit <http://www.dundee.ac.uk/dhsru>
- Contact with experts including the Faculty of General Dental Practitioners, the Faculty of Dental Surgery, Royal College of Surgeons, England, the Scottish Dental Practice Board, the Dental Practice Board for England and Wales (Eastbourne), the Central Services Agency (Dental Information) Northern Ireland, and STAKES (National Research and Development Centre for Welfare and Health, Helsinki, Finland).
- Citation lists from obtained references were checked.
- The Cochrane Oral Health Group undertook a search of their specialised register of controlled trials using a search strategy based on the subject component of our searches.

Inclusion and exclusion criteria

One reviewer (CD) initially scanned citations and abstracts generated by the search of electronic bibliographic databases and excluded articles that were clearly of no relevance to the review. The remaining articles were retrieved and explicit, predetermined inclusion criteria were applied to them and to a random 50% of articles retrieved independently by a second reviewer (KE) (see appendix 2). Disagreements were resolved through discussion with reference to a third party (RT). Overall agreement between the two independent reviewers was good (at least 70%) and all disagreements were resolved by discussion by these two reviewers. Inclusion and exclusion decisions were made independently of the detailed scrutiny of results.

Inclusion criteria

Studies were included in the final analysis if they met the following criteria:

- Study design: Any.
- Population: Deciduous dentition, mixed dentition, permanent dentition; encompassing children (<18 years) and/or adults ≥18 years).
- Intervention: Routine dental check as defined by the NHS in its dental remuneration statement: "Clinical examination, advice, charting (including monitoring of periodontal status) and report".[34] An examination of orthodontic need and radiographic investigation are not included in the NHS statement of dental remuneration, so studies considering the use of these examinations alone were excluded. In practice it proved impractical to apply the intervention inclusion criteria because no identified publications provided sufficient detail about the intervention under study. Studies were therefore included if the intervention was

termed a dental check, a dental examination, a dental visit or a dental attendance. **For the remainder of the review, the term "dental check" will be used to embrace attendance for a dental examination or dental check, and attendance for dental treatment and a dental examination/dental check.**

- Comparator: No routine dental check (as defined above) or routine dental check(s) (as defined above) of different frequency.
- Outcomes:
  - Primary outcomes: deciduous and mixed dentition (children):
    caries
    periodontal disease
    quality of life
  - Primary outcomes: permanent dentition (children and adults):
    caries
    periodontal disease
    quality of life
  - Primary outcomes: permanent dentition (adults):
    oral cancer
  - Secondary outcomes:
    mucosal lesions (other than oral cancer)
    need for orthodontic treatment
    behaviour change
- No language restriction was applied.

Exclusion criteria

Studies were excluded on the basis of the following:

- components of dental check different in comparison groups
- attendance for dental treatment only (including scaling and polishing for periodontal disease)
- date of majority of data collection before 1980 (or if date of data collection not stated date of publication 1985 or before).

Studies with data collection predating 1980 (identified where possible) were not included in this review. This cut-off was used first owing to the changes in the epidemiology of caries in the UK and elsewhere in the developed world, which were well established by this date and which would have distorted the assessment of the effectiveness of the intervention. Secondly, there was concern within the review group that differences in dental practices prior to this date (a previous greater emphasis on the restorative as opposed to the preventive care philosophy) would have confounded the assessment of effectiveness of the intervention (frequency of dental checks). Articles excluded after the application of explicit criteria are detailed in appendix 3 (*Table 1,* see appendix 3, pp. 96–98).

Assessment of study quality

The aim of the quality assessment was to summarise and compare the quality of a range of different study designs in order to refine the interpretation of results.

The objectives of quality assessment in this review were as follows:

- to assess systematically, by using structured frameworks relevant to different study designs, the quality features of individual studies
- to summarise the strengths and weaknesses of individual studies to allow a relative assessment in terms of the broad categories of selection bias and confounding, external validity, performance bias and attrition bias
- on the basis of the relative assessment, to perform a sensitivity analysis of the results.

In order to consider the breadth of evidence in this area, the inclusion criteria for the review were such that studies with a range of different designs, both controlled and observational, were included. A challenge was to assess the methodological strengths and weaknesses of studies of different designs in a way that allowed a reasonable relative assessment of their methodological quality. The use of scoring systems as a way of quantifying the quality of studies was deemed inappropriate in this case.

Each included study was assessed by using items from specific appraisal checklists appropriate to that study design (i.e. controlled trial, cohort (prospective and retrospective), case control and cross-sectional). These checklists were modified (to reflect the review topic) from those provided in the recently revised NHS Centre for Reviews and Dissemination handbook for undertaking systematic reviews.[43] The checklists used are provided in appendix 2. The assessment of validity was carried out by one reviewer (CD) and a 50% sample checked for agreement by another reviewer (KE). Overall agreement between the two independent reviewers was good (at least 70%) and all disagreements were resolved by discussion by these two reviewers. Independently of this, the accuracy of all judgements on the appropriateness of statistical analysis was double-checked by a statistician (RT).

The results of study quality are reported according to: (1) threats to validity arising from study design (i.e. selection bias, confounding and external validity); and, (2) threats to validity arising from outcome assessment and data analysis (i.e. performance bias and attrition bias).[44]

In addition to providing a framework for systematically reporting the strengths and weaknesses of included studies, quality assessment was used to gauge the severity of the implications of potential weaknesses. Some issues (e.g. differences between groups in baseline oral health status) were considered to be a major threat to validity while others were considered to be relatively minor (e.g. failure to state eligibility criteria). Although a subjective judgement, efforts were made to be as explicit as possible about the information that led to any judgement. In addition, these judgements were independently checked by two reviewers (CD and RT).

Studies were categorised according to whether any major threat to validity was judged to be present in any of the quality features examined. If this was so, the study was removed in the sensitivity analysis focusing on just those studies that were least subject to bias and confounding.

Data extraction strategy

One reviewer (CD) undertook data extraction for all studies by using a predesigned data extraction form. A second reviewer (KE) undertook data extraction for a random 50% of the included studies using the same proforma. Although disagreements were to be resolved by discussion with reference to a third party (RT) where disagreement remained, final overall agreement between the two independent reviewers (CD and KE) was good (at least 70%) and all disagreements were resolved by discussion between these two reviewers.

When information was missing, further information was sought from authors (all included studies). Replies were received concerning five articles (20%).

The following data were extracted (see appendix 2):

- details of the study population and baseline characteristics, including the potential confounders: baseline oral health status, dietary habits, fluoride use, tobacco consumption, alcohol consumption, socio-economic status, ethnicity, predisposing medical conditions, and access to the intervention under study
- details of the intervention: frequency, who performed the check (e.g. dental practitioner or allied dental professional), the components of the check and the method of remuneration of providers
- individual outcomes (see above "Inclusion criteria") plus any additional outcomes assessed using measures of variance and results of tests of significance where provided.

Data synthesis

The results were initially collated in summary tables in order to ascertain the direction of any intervention effect for each of the primary outcomes: caries, periodontal disease, oral cancer, and quality of life. The results were subcategorised according to population (deciduous dentition, mixed dentition, permanent dentition). All data tables are presented in alphabetical order of the first-listed author.

Given the heterogeneity of outcomes reported and the variation in detail of the outcome results, it was decided that the results should be summarised by grouping studies according to whether they demonstrated a "statistically significant" difference and the direction of this effect. It should be noted that this method does not formally take account of the size of the effect.

Results

Quantity of research identified (*Figure 1*)

No systematic reviews of the topic area were found. Sixty-nine abstracts or full publications that reported potentially relevant primary studies were identified from an initial 2596 potentially suitable studies detected. Forty-five came from searches of electronic databases,[25,37,45–87] five from contact with experts,[31,88–91] and 19 from citation checks.[40,41,92–108] Two publications[54,56] were related to two other (included) studies.[62,71] Appendix 3 gives the details of excluded studies, with reasons for their exclusion.

Included studies

Twenty-nine articles reporting 33 unique studies appeared to meet our inclusion criteria.[25,31,37,41,47–49,51,57,58,60–62,64,65,71,75,83,85,88,90–94,97,98(a),98(b),98(c),100(a),100(b),100(c),107] Four of these studies met the inclusion criteria pending contact with authors regarding the categorisation of individuals into dental check frequency,[47,51,75,107] but they had to be excluded at the time of writing because the authors had not responded to our requests for information.

Excluded studies

Thirty-seven studies were excluded on the basis of the full publications.[40,45,46,50,52,53,55,59,63,66–70,72–74,76–82,84,86,87,89,95,96,99,101–106] In 17 the population was not subject to a dental check or dental checks were not the subject of the study; in three the populations being compared were not subject to dental checks of different frequencies; in five studies, the dental check offered to different participant groups varied in content (apart from frequency); in six no outcome information relevant to oral health was

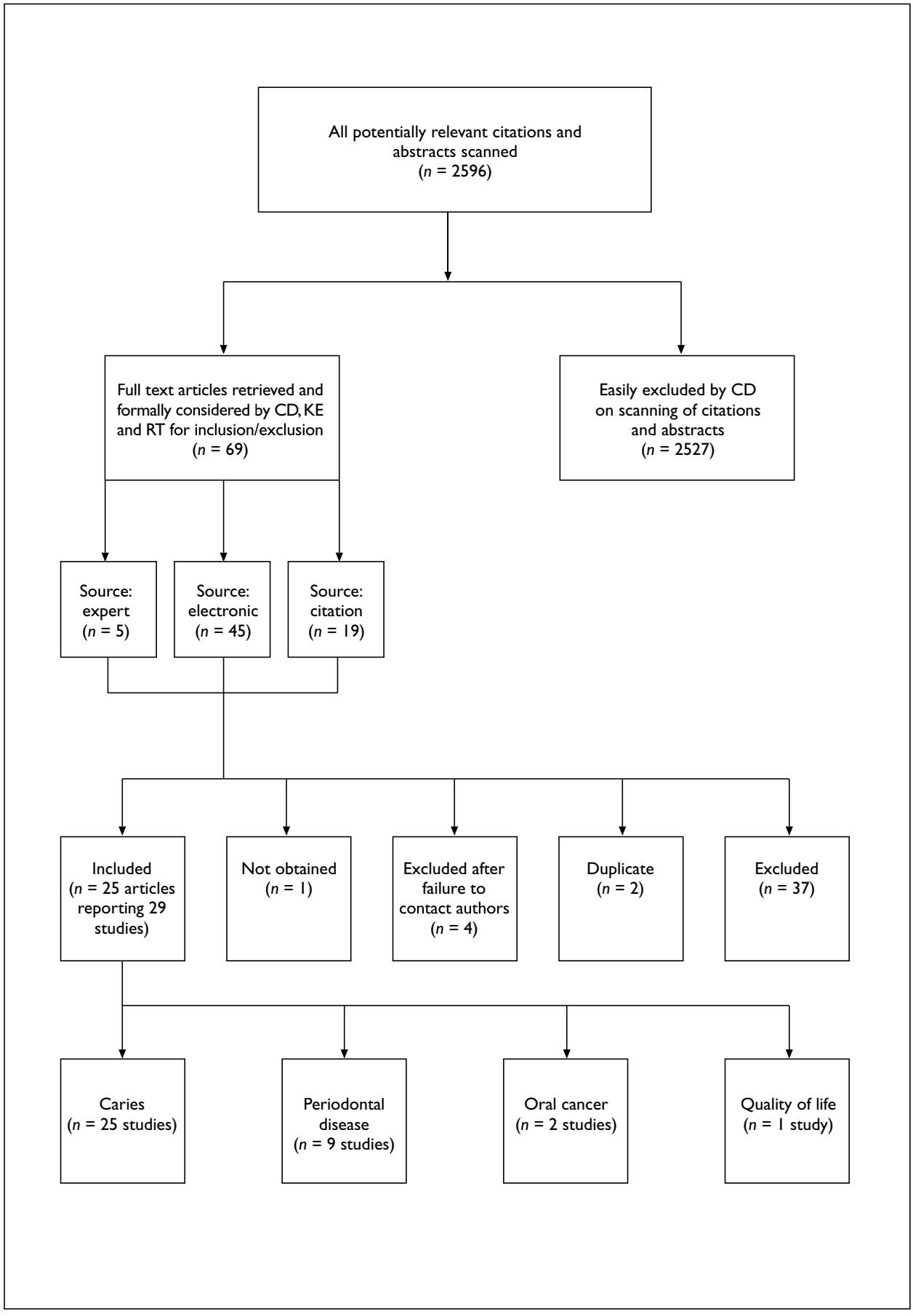

FIGURE 1 *Quantity and quality of research available*

available; in five studies the date of data collection was prior to 1980; and one study was a descriptive review (appendix 3).

Studies not obtained

One study had not been obtained at the time of writing.[108]

Characteristics of included studies and study populations

The key characteristics of the 29 included studies (reported by 25 articles) and study populations are given in *Table 2* (see pp. 20–28).

Age

The age range of the study populations ranged from 3 years to >65 years. The majority (n = 25) of studies considered permanent dentition; four considered deciduous dentition and three mixed deciduous and permanent dentition.

Location

Seven studies were conducted in the UK, 18 elsewhere in Europe, and one each in Canada, the USA, Australia and Hong Kong. In 24/29 studies the populations appeared to be representative of the target population and were based on a complete, random or quasi random sample of the target population.[31,37,41,48,49,57,60–62,71,83,85,88,90–94,97,98(a),98(b),98(c),100(a),100(b)] In five studies exclusion criteria were applied or study samples appeared to have been drawn from less representative populations.[25,58,64,65,100(c)]

Date of data collection

The inclusion criteria agreed for the review stated that the date of data collection should be 1980 or later. All data sets in which the date of data collection was stated related to 1995 or earlier and the majority of data sets (n = 18) were collected before 1990. In six included studies the date of data collection was not stated,[31,37,48,58,61,91] but they were included on the basis of publication post-1985.

Size of study

The number of individuals in 42 discrete study samples used for analysis (deciduous dentition, mixed dentition, permanent dentition) ranged between 45 and 240,145. Only one study contained a sample of less than 100. Thirty-one of the 42 samples contained more than 500 individuals and 24 of 42 samples contained more than 1000 individuals.

Access to intervention (dental check)

There was inconsistent reporting of factors that may affect individuals' access to the intervention under study and distort assessment of its effectiveness. In one study the intervention appeared free at the point of use to all participants,[48] in seven the intervention appeared free at the point of use to some members of the study population,[31,41,65,83,91,94,97] and in two the system of access was not clear but high coverage of the target population was reported.[88,90] In 19 studies insufficient information was provided to ascertain the study sample's access to the required intervention.

Frequency of dental check under investigation

The frequency of dental checks under investigation ranged from ≥6/12 to 216/12 (18 years).

Summary

There are relatively few studies investigating the relationship between dental check frequency and oral health outcomes in deciduous or mixed dentition.

The country of origin and representativeness of target populations favour comparison with the UK for the majority of studies. However, the lack of information on access to the intervention under study and the date of data collection limits comparison with the current UK situation for the majority of studies.

Interventions and comparators

Only nine studies were clearly investigating the relationship between the frequency of dental checks and oral health outcomes.[37,48,90,92,93,97,100(a),100(b),100(c)] However, in only two of these, conducted in the UK,[48,97] was it reasonable to assume that the dental check was comparable to that used in the NHS statement of remuneration. In two studies the relationship between frequency of dental treatment and/or attendance for dental checks and oral health outcomes was made.[71,94] In the majority of studies (n = 18) it was not clear if the relationship between frequency of dental checks or frequency of dental treatment and/or dental checks and oral health outcomes was being investigated.[25,31,49,57,58,60–62,64,65,85,88,91,92,98(a),98(b),98(c),100(a)]

Seventeen studies investigated the relationship between long-term (>5 years) dental check behaviour pattern and oral health outcomes.[25,41,49,58,61,62,64,65,71,83,93,97,98(a),98(b),98(c),100(a),100(b)] Thirteen investigated the relationship between recent (≤5 years) dental check behaviour and oral health outcomes.[31,37,48,57,60,85,88,90–92,94,97,100(c)]

Only 11 studies measured the intervention objectively by following individuals prospectively or by retrospectively checking dental records.[37,41,48,88,90,92–94,100(a),100(b),100(c)] Fifteen studies relied on the

reports of individuals' dental check frequency behaviour from self-administered questionnaires or interviews.[25,31,49,57,58,60–62,64,65,71,83,85,91,97] In three it was not clear how dental check frequency was ascertained.[98(a),98(b),98(c)]

Information about payment systems to dental practitioners was poorly reported. Only in the seven studies conducted in the UK could assumptions be made about remuneration.[31,41,48,65,91,94,97]

Summary
Details about the intervention under investigation were poorly reported, which limits sensitivity analysis based on the content of the intervention, in particular its relevance to the UK situation. In only two studies could it be assumed that the intervention under study was comparable specifically to the dental check as it currently applies in the UK.

Outcomes measured
Studies were included if they investigated the effect of different frequencies of dental check on one or more of the following: caries, periodontal disease, oral cancer (including mucosal lesions), need for orthodontic treatment, behavioural change, and quality of life.

In this review, the outcomes measured were subcategorised into those relating to deciduous dentition, mixed dentition or permanent dentition, in order to reflect different patterns of disease progression.

It was not considered appropriate to convert outcome information to a common format. This would have resulted in loss of data (e.g. in the conversion of "surfaces" to teeth) or was not possible (for example the conversion of "lesions" to "teeth" or "surfaces" to "teeth" for mixed dentition studies).

Twenty-five studies reported on the relationship between dental check frequency and caries; nine reported on the relationship between dental check frequency and periodontal disease; two reported on the relationship between dental check frequency and oral cancer; and one reported on the relationship between dental check frequency and quality of life. No studies were found relating to periodontal disease measures in deciduous teeth or quality-of-life measures in deciduous teeth.

Additional outcomes were reported in seven studies (see appendix 4):

- number of extractions performed (three studies[88,94,100(b)])
- number of fillings performed (three studies[88,94,100(b),100(c)])
- number of pulpotomies performed (one study[88])
- number of root treatments performed (one study[100(b)])
- number of treatments/treatment visits (one study[100(b)])
- treatment time (three studies[37,90,93]).

The majority of studies reported outcomes in terms of mean changes in measures, while a minority reported changes in the proportion or number of individuals exhibiting a certain outcome. Standardised measurement with or without scales or indexes in common use (e.g. Community Index of Periodontal Treatment Needs) were employed by the majority of researchers to measure outcomes (n = 20). In three studies[31,62,90] outcome measurement was not standardised and in six the method of measurement of outcomes was unclear or unstated.[37,60,93,98(a),98(c),100(b)]

Measures of variance (e.g. standard deviations), were not presented for all or part of the reported results for 20 out of the total of 29 included studies.[25,31,48,57,58,62,71,83,85,88,91,93,94,97,98(a),98(b),98(c),100(a),100(b),100(c)]

Tests of statistical significance were not performed and could not be calculated for all or part of the reported results of nine of the total of 29 included studies.[88,94,97,98(a),98(b),98(c),100(a),100(b),100(c)]

The length of follow-up varied for cohort and controlled trials investigating the relationship between dental check frequency and caries: 12/12 (one study), 24/12 (three studies), 5 years (one study), 6 years (three studies) and 10 years (two studies). In addition, one series of cross-sectional trials was repeated and compared over 14 years (one study). The length of follow-up for the one cohort study investigating the relationship between dental check frequency and periodontal disease was 10 years. The relationship between dental check frequency, and oral cancer and dental check frequency and quality of life, were investigated using only cross-sectional studies and retrospective case series (*Table 2*).

Summary
Although outcomes were measured objectively in the majority of studies, the type of outcome measure used varied considerably, which limits

comparison. In particular, there was insufficient reporting of variance. The length of follow-up was probably adequate for the majority of studies, with the exception of those of less than 2 years' duration that investigated the relationship between dental check frequency and measures of caries. The studies of ≥10 years' duration are likely to suffer from confounding by factors external to the intervention, such as changes in the epidemiology of disease, in technology and in the pattern of service provision.

Assessment of quality of effectiveness studies

Studies included were of five designs: controlled trials, prospective cohort studies, retrospective cohort studies, cross-sectional studies and retrospective case series. *Tables 3* and *4* (see pp. 29–31) summarise the main threats to validity arising from study design, and from the assessment of outcome and data analysis respectively. A general observation was the poor quality of reporting of included studies, as indicated by the frequency of "unknown" responses to a number of quality items. A conservative approach was taken and, if a feature was not reported, it was assumed to be absent.

The major threat to validity identified in the studies in this review was associated with study design, namely imbalance in patient characteristics across groups. In three studies[48,100(a),100(b)] there was evidence of such imbalance and therefore considerable potential for confounding. In an additional six studies[25,41,58,83,90,92] patient characteristics were not reported in enough detail to allow an assessment of similarities between comparison groups. For example, an imbalance in baseline oral health status between groups may explain differences between groups that are independent of differences in dental check frequency. Although multivariate statistical methods can be used to adjust for differences in characteristics, none of these nine studies reported such methods. In cross-sectional studies where there was some evidence that balancing characteristics or adjust-ment methods were used, confounding was considered to be less likely and therefore judged as of a "minor" threat to validity.

Two studies[90,94] reported losses to follow-up in excess of 20%. This was considered to introduce attrition bias to such a level that it may be associated with a major threat to validity.

Although a number of studies failed to report outcome results by using measures of variance, their methods of statistical analysis were appropriate and therefore not judged as a threat to validity. Similarly, the 11 studies that failed to report eligibility criteria may influence the external validity and generalisability of study findings but do not pose a threat to internal validity.

Overall, ten of the total of 29 (34%) included studies were judged to have a major threat to validity on the basis of one criterion or more. The impact of these studies of poorer methodological quality can be assessed by a sensitivity analysis (i.e. consideration of the findings with and without inclusion of these studies in the results).

Effectiveness findings: tabulation of results

Tables 5–10 (effectiveness results tables, see pp. 32–55) detail the results of the 25 articles reporting the 29 included studies that considered one or more of the four primary outcomes (caries, $n = 25$; periodontal disease, $n = 9$; oral cancer, $n = 2$, quality of life, $n = 1$). Appendix 4 (*Tables 11–16,* see appendix 4, pp. 100–107) details the results of seven studies reporting one or more of the secondary outcomes.

In the description of results, the term "dental check" will be used as a collective term to describe the intervention, owing to the apparent heterogeneity of the intervention under investigation in the included studies. Unless indicated in the tables, tests of significance were not reported and could not be calculated by the review authors. Where tests of statistical significance were not performed and could not be calculated from available data, the result is described as "of uncertain significance" in the accompanying text summary. Frequency of the intervention under investigation (dental checks) is expressed in months (/12) where reporting of data allowed. Other descriptive terms used, such as "regular" and "irregular", are taken directly from the primary studies.

Caries (range of dental check frequencies investigated ≥6/12 to "never had a dental check")

***Table 5*: Deciduous dentition – caries disease measures**

One controlled study[37] demonstrated no association between dmft and dental check frequency.

One retrospective cohort study[100(b)] demonstrated a trend for a reduction in dmft with reduced dental check frequency, which is of uncertain significance. Two observational studies[88,100(a)] illustrated a trend for a decrease in dental decay when dental check frequency was reduced from 6/12 to 12/12, which was of uncertain significance.

Summary
One controlled trial demonstrated no significant association between dental check frequency and dmft. It was not possible to conclude an association between dental decay in deciduous dentition and dental check frequency with any statistical certainty.

***Table 6*: Mixed deciduous and permanent dentition – caries disease measures**
Two controlled trials[93,100(c)] and one observational (prospective cohort) study[90] investigated the relationship between dental check frequency and caries in mixed dentition.

One controlled trial[93] investigated the relationship between dental check frequency and decayed, missing and filled surfaces in permanent dentition (DMFS), reporting no significant difference between DMFS and frequency of dental checks.

All three studies investigated the relationship between decay and dental check frequency. One controlled trial[100(c)] reported an overall decrease in decay, which was of uncertain significance, in a sample of people with individualised dental check frequencies (range 3/12–24/12) according to caries risk when compared with a sample with a blanket 12/12 dental check recall policy. One controlled trial[93] reported a significant increase in the number of deep cavities with a decrease in dental check frequency from 12/12 to 18/12. The prospective cohort study[90] reported no significant difference in decay in individuals under a blanket dental check recall policy of ≥12/12 and those with individualised dental check frequencies based on a clinical judgement of caries risk.

The prospective cohort study[90] investigated the relationship between dental check frequency and fillings, and reported a significant reduction in fillings in those with individualised recall frequencies based on a clinical judgement of caries risk compared with individuals under a blanket dental check recall policy of ≥12/12.

Summary
The results of studies investigating the relationship between dental check frequency and caries in mixed dentition demonstrate no significant association between dental check frequency and DMFT. The results of studies investigating the relationship between dental check frequency and decay in mixed dentition provide conflicting results. There is evidence for a significant reduction in the number of fillings in individuals with dental check frequencies individualised according to caries risk compared with those attending under a blanket recall policy of ≥12/12.

***Table 7*: Permanent dentition – caries disease measures**
One controlled trial[37] and 20 observational studies (four prospective cohort studies,[41,83,90,94] six retrospective cohort studies,[48,98(a),98(b),98(c),100(a),100(b)] ten cross-sectional studies,[49,57,60–62,64,65,71,88,97] and one retrospective case series[58]) investigated the relationship between dental check frequency and caries in permanent dentition.

Eleven studies[37,48,49,61,62,64,65,83,88,97,100(b)] investigating the relationship between dental check frequency and DMFT reported inconsistent findings. Two studies reported a significant increase in DMFT or DMFS with a decrease in dental check frequency.[61,97] Four reported a decrease in DMFT with a decrease in dental check frequency (two of which were significant differences[49,65]) and two were of uncertain significance.[88,100(b)] Five studies reported no significant difference between DMFT and frequency of dental attendance.[37,48,62,64,83]

Fifteen studies[48,49,57,61,62,64,65,71,83,92,97,98(a),98(b),98(c),100(a)] investigating the relationship between dental check frequency and decay reported more consistent findings. Twelve reported an increase in decay with a decrease in dental check frequency (eight of which were significant differences,[49,61,62,64,65,71,92,97] and four of which are of uncertain significance[98(a),98(b),98(c),100(a)]). Two studies reported no significant difference between decay and frequency of dental checks.[83,48] One study reported a significant association between dental check frequency and decay, but the direction of the relationship was not given.[57]

Sixteen studies[41,48,49,58,60,61,62,64,65,71,83,94,97,98(a),98(b),98(c)] investigating the relationship between dental check frequency and number of teeth reported more consistent findings. No studies reported an increase in the number of teeth with a decrease in dental check frequency. Twelve studies reported a decrease in the number of teeth with a decrease in dental check frequency (eight of which were significant differences[49,58,60,61,64,65,71,97] and four were of uncertain statistical significance[94,98(a),98(b),98(c)]). One study reported an increase in the number of individuals who became edentulous over a 10-year follow-up period but the result was of uncertain statistical significance.[41] Three studies reported no significant difference between the number of teeth/surfaces and frequency of dental checks.[48,62,83]

Nine studies[48,49,61,62,64,65,83,94,97] investigating the relationship between dental check frequency and filled teeth reported more consistent findings. One[97] reported a significant decrease followed by

a significant increase in the number of fillings with an overall decrease in dental check frequency of <6/12 to >6/12 and >6/12 to "only with trouble". Six studies reported a decrease in filled teeth/surfaces with a decrease in dental check frequency of which five out of six were significant differences.[49,61,62,64,65] Two studies reported no significant difference between filled teeth/surfaces and frequency of dental checks.[48,83]

Summary

The results of studies investigating the relationship between dental check frequency and caries in permanent dentition provide conflicting results with respect to DMFT, but more consistent results with respect to decay experience (increase in decay with decrease in dental check frequency), filled teeth (decrease in filled teeth with decrease in dental check frequency), and number of teeth (decrease in number of teeth with decrease in dental check frequency).

Periodontal disease (range of dental check frequencies investigated ≥12/12 to "never had a dental check")

***Table 8*: Permanent dentition – periodontal disease measures**

Nine observational studies (one prospective cohort study,[83] one retrospective cohort study,[48] six cross-sectional studies,[60,71,85,98(a),98(b),98(c)] and one retrospective case series[58]) investigated the relationship between dental check frequency and periodontal disease in permanent dentition.

Three studies[58,83,85] investigating the relationship between dental check frequency and bleeding reported inconsistent findings. One prospective cohort study[83] reported a significant increase in the percentage of bleeding surfaces with an increase in the distribution of dental check frequencies over a 9-year period. One[58] reported no significant relationship between the proportion of gingival units with bleeding and dental check frequency, while a further cross-sectional study[85] reported a significant negative association between bleeding index and dental check frequency.

One study investigated the relationship between attachment level and dental check frequency and reported a decrease in the proportion of individuals with an attachment level of >3 mm with an overall decrease in dental check frequency over a 9-year period, which was of uncertain statistical significance.[83]

Six studies[58,71,85,98(a),98(b),98(c)] investigated the relationship between probing depth/pockets and dental check frequency, reporting inconsistent findings. One[58] reported no significant difference in probing depth with different dental check frequencies. Two[98(a),98(b)] reported no clear trend (of uncertain statistical significance) in the proportion of teeth with pockets with a decrease in dental check frequency. One study[98(c)] reported a decrease in the proportion of teeth with pockets with a decrease in dental check frequency (of uncertain statistical significance). One[85] reported a significant increase in the mean pocket index with a decrease in dental check frequency and one[71] a significant increase in the proportion of teeth with pockets with a decrease in dental check frequency.

Three studies[48,58,85] investigated the relationship between plaque or calculus and dental check frequency, reporting inconsistent findings. One[48] reported no significant relationship between the presence of plaque on staining and frequency of dental checks. One study[85] reported a significant negative association between calculus index and frequency of dental checks, consistent with the findings of a further study,[58] which reported a significant increase in the number of surfaces with stainable plaque with a decrease in dental check frequency.

Two studies[58,60] investigated the relationship between bone score and dental check frequency and reported inconsistent findings. One[58] reported no significant relationship between bone score and dental check frequency. The other[60] reported a significant increase (worsening) in bone score with a decrease in dental check frequency in certain age groups only.

Three studies[98(a),98(b),98(c)] investigated the relationship between the presence of gingivitis and frequency of dental checks, and reported inconsistent findings. Two[98(a),98(c)] reported an increase of uncertain statistical significance in the proportion of individuals with gingivitis with decreasing dental check frequency, while the other[98(b)] reported a decrease of uncertain significance in the proportion of individuals with gingivitis with decreasing dental check frequency.

Three studies[98(a),98(b),98(c)] investigating the relationship between dental check frequency and periodontal health (the absence of gingivitis, periodontitis and calculus) report inconsistent findings. One[98(c)] reported no clear relationship between periodontal health and dental check frequency, which was of uncertain significance; two studies[98(a),98(b)] reported a decrease in periodontal health with a decrease in dental check frequency, also of uncertain significance.

Summary
The results of studies investigating the relationship between dental check frequency and measures of periodontal disease in permanent dentition provide conflicting results.

Oral cancer (range of dental check frequencies investigated ≥12/12 – 18 years)

***Table 9*: Oral cancer outcomes**
One cross-sectional study[91] and one retrospective case series[25] investigated the relationship between dental check frequency and oral cancer outcome. The retrospective case series[25] demonstrated a significant relationship between time since last dental check (12/12 to ≥18 years at intervals ≥12/12) and tumour size and stage at diagnosis. However, it remains unclear from the analysis whether there is a consistent (or linear) trend in outcome with decreasing dental check frequency. The cross-sectional study showed no significant relationship between the presence or absence of a cancerous or precancerous lesion at examination and time since last dental check (≤12/12 to >12/12).[91]

Summary
The limited available evidence from investigations on the relationship between dental check frequency and oral cancer suggests that recall intervals <12/12 do not impact on tumour size at diagnosis, but that decreasing dental check frequencies (>12/12) may significantly increase the size and stage of tumours at diagnosis.

Quality of life (range of dental check frequencies investigated ≥12/12 – <12/12)

***Table 10*: Permanent dentition – quality of life**
One cross-sectional study[31] investigated the relationship between dental check frequency and quality of life. No significant relationship was demonstrated between frequency of dental checks and a perception that oral health negatively affects quality of life. A significant relationship was demonstrated between increased frequency of dental checks and a perception that oral health positively affects quality of life, and between increased frequency of dental checks and a perception that oral health positively or negatively affects quality of life.

Summary
The limited evidence available on dental check frequency and quality of life demonstrates that attendance behaviour is associated with the perception that quality of life is affected by oral health. No studies were identified linking empirical measures of quality of life associated with oral health and dental check frequency.

Additional outcomes reported

Appendix 4, *Tables 11–16*
Appendix 4, *Tables 11–16*, detail outcomes additional to those specified by the review, which were reported by seven of the included studies. The additional outcomes relate to "general" and "caries-related" treatment measures in deciduous, mixed and permanent dentition.

In summary, outcomes were poorly reported, with frequent omission of tests of statistical significance. These factors limit the interpretation of results and internal and external comparisons.

For deciduous dentition, these studies appear to demonstrate that decreasing dental check frequency from 12 to 24 months reduces the amount of examination time and total time (examination and treatment combined) spent by practitioners but not the treatment time alone.[37,88,100(b)]

For mixed dentition, it appears that individualised dental check recall intervals compared with a blanket 12-month dental check recall policy increases the number of smaller fillings performed and decreases the number of larger fillings performed. Reducing dental check frequency from 12 to 18 months decreases the amount of examination time spent by practitioners but has a less consistent effect on the amount of time spent on treatment.[90,93,100(c)]

For permanent dentition, it appears that decreasing dental check frequency from 12 months to 24 months reduces the amount of examination time and total time (examination and treatment combined) spent by practitioners but not the treatment time alone.[37,100(b)]

Sensitivity analysis

In order to assess the impact of study quality on the findings of the effectiveness review a sensitivity analysis was undertaken. In this analysis all studies that were identified to have one or more major threats to validity were withdrawn and the results of the remaining studies were summarised.

To illustrate the potential impact of a sensitivity analysis around study quality, the outcome for caries in permanent dentition (the outcome reported by the most studies) is explored below. The direction of comparison for all outcomes is decreasing frequency of dental checks (e.g. from 6/12 to 12/12).

Tables 17–20 (see p. 56) illustrate that, when studies with a major threat to validity are removed from the

analysis, this does not appear to influence the overall pattern of results. In particular, it could be hypothesised, from empirical research,[109] that studies of poor methodological quality would tend to overestimate the effect of an intervention (i.e. more likely to result in either a significant increase or a significant decrease in outcome when comparing differing dental check frequencies). This does not appear to be the case in this example.

Given the results of the sensitivity analysis presented here and the timescale of the review, further sensitivity analysis was not undertaken.

Conclusions: existing effectiveness study results

- A detailed search strategy for effectiveness studies was employed in this review. Nevertheless, given the heterogeneous outcomes, it was not possible to test formally for the presence or absence of publication bias.
- Studies included in the effectiveness review were poorly reported (e.g. definition of the intervention), which limits internal comparison (between studies) and external comparison with the current UK situation, and may influence the synthesised results of these studies. Differences in treatment practices will particularly affect the outcomes "filled teeth" and "measures of periodontal disease".
- There was considerable heterogeneity across studies with regard to the intervention under investigation, which further limits external comparison with the UK situation.
- Furthermore, the preponderance of cross-sectional studies, combined with the majority of data collection occurring in the 1980s, will lead to considerable confounding from the effects of the continued decline in the incidence of caries during this time.
- The frequent omission of tests of statistical significance leads to uncertainty in the interpretation of results.
- Only three studies[88,97,100(a)] addressing caries in permanent teeth and caries in deciduous teeth included 6/12 as a comparison dental check frequency and thus addressed the review question from a UK perspective.
- For the investigation of the relationship between dental check frequency and measures of caries: There was little consistency between studies in the direction of effect of different dental check frequencies on the measures DMFT, decay, missing teeth and filled teeth in deciduous, mixed or permanent dentition. Two separate studies demonstrated no significant difference between dental check frequency and dmft/DMFT in deciduous or mixed dentition. One study reported a significant reduction in fillings with individualised dental check frequencies compared with a blanket recall policy of ≥12/12 in mixed dentition. There was a preponderance of studies reporting an increase in decay, a decrease in the number of teeth and a decrease in fillings with decreasing dental check frequencies in permanent dentition.
- For the investigation of the relationship between dental check frequency and measures of periodontal disease: There was no consistency in the direction of effect between studies of different dental check frequencies for the measures bleeding, probing depth/pockets, presence of plaque/calculus, bone score, gingivitis and periodontal health. A single study demonstrated a decrease in attachment level with a decrease in dental check frequency, which was of uncertain statistical significance.
- For the investigation of the relationship between dental check frequency and measures of oral cancer, one study demonstrated that decreasing dental check frequencies (>12/12 only and for intervals decreasing by ≥12/12) may result in a significantly increased tumour size and a more advanced stage at diagnosis. One study demonstrated no association between dental check frequencies ≥12/12 and <12/12 and a diagnosis of oral cancer or precancer.
- For an investigation of the relationship between dental check frequency and quality of life, one study demonstrated a significant association between increasing dental check frequency and the perception that oral health affects quality of life.
- A sensitivity analysis conducted on the outcome of dental caries indicated that these findings were robust to differences in the methodological quality of studies.

TABLE 2 *Key characteristics of included studies and populations*

Reference	Design	Country of origin	Date of data collection	Population characteristics				Access/ coverage[b]	Intervention (dental check) : frequencies compared	Outcomes	Follow-up
				n	Age (y)	Dentition[a]	Recruitment				
Ambjornsen, 1986[64]	Cross-sectional	Norway	1979–1980	159	≥67 y	P	Random sample of institutionalised and non-institutionalised adults Excluded: unfit and edentulous	Not stated	≥ every 12/12 (regular) < every 12/12 (irregular)	Caries	N/A
Bjertness *et al.*, 1986[62]	Cross-sectional	Norway	1984	144	35 y	P	Random sample of a 1949 birth cohort, Oslo	Not stated	≥ every 12/12 (regular) < every 12/12 (irregular)	Caries No. teeth	N/A
Halling and Bjorn, 1987[60]	Cross-sectional	Sweden	1980	542	Cohorts of: 50 y 58 y 62 y 66 y	P	Random sample stratified by age in the Revenue Office Register, Gothenburg	Not stated	***Last dental check:*** ≤12/12 ago >12/12 <24/12 ago ≥24/12 ago	No. teeth Periodontal disease	N/A
Jullien *et al.*, 1995[91]	Cross-sectional	UK	Not stated Date of publication 1995	2027	≥40 y	P	Outpatient department of a dental hospital (patients and relatives) List of patients registered with a medical practice	All adults eligible Coverage not stated Adults pay a proportion of the cost of a check-up unless exempt on the basis of low income	***Time since last dental check:*** ≤12/12 >12/12	Diagnosis of oral cancer Diagnosis of oral precancer	N/A

continued

TABLE 2 contd *Key characteristics of included studies and populations*

Reference	Design	Country of origin	Date of data collection	Population characteristics				Access/ coverage[b]	Intervention (dental check) : frequencies compared	Outcomes	Follow-up
				n	Age (y)	Dentition[a]	Recruitment				
Ketomaki and Luoma, 1993[100(a)]	Retrospective cohort	Finland (Vantaa)	1979–1985	Adults: 1215 Children: 5850	Adults: 23 y followed to 29 y Children: 1 y followed to 7 y	P D	All adults and children registered in the state dental service records, Vantaa	0–7 y advised dental check every 12/12 Schoolchildren invited for dental check ≥ every 12/12 Other details not stated	Every 6/12 Every 7–12/12 Every 13–18/12 Every 19–24/12 Every 25–36/12 ≤ every 37/12	Caries	6 y
Ketomaki and Luoma, 1993[100(b)]	Retrospective cohort	Finland	1979–1985	Adult (15–29 y): 2353 Children (1–7 y): 901	Adult: 15 y followed to 21 y 19 y followed to 25 y 22 y followed to 29 y Children: 1 y followed to 7 y	P P P D	All adults and children registered in the state dental service records, Vantaa	0–7 y advised dental check every 12/12 Schoolchildren invited for dental check ≥ every 12/12 Other details not stated	≥ every 12/12 < every 12/12 but ≥ every 24/12 < every 24/12 but ≥ every 36/12 Every 72/12	Caries Root treatments Extractions Fillings Treatment visits	6 y
Ketomaki and Luoma, 1993[100(c)]	Controlled trial	Finland	1988–1990	1177	3–12 y	M	Children registered at 2 static dental clinics (test) Children registered at a mobile clinic (control)	0–7 y advised dental check every 12/12 Schoolchildren invited for dental check ≥ every 12/12 Other details not stated	Every 12/12 Dental check frequency individualised according to caries risk; range 3–24/12	Caries Fissure sealants	2 y

continued

TABLE 2 contd *Key characteristics of included studies and populations*

Reference	Design	Country of origin	Date of data collection	Population characteristics				Access/ coverage[b]	Intervention (dental check) : frequencies compared	Outcomes	Follow-up
				n	Age (y)	Dentition[a]	Recruitment				
King *et al.*, 1986[61]	Cross-sectional	Hong Kong	Not stated Date of publication 1986	662	12 y	P	Cluster random sample of schools in a defined area	Not stated	Proportion of sample never had a dental check	Caries	N/A
Lie and Mellingen, 1988[58]	Retrospective case series	Sweden	Not stated Date of publication 1988	123	≤29 y to >60 y	P	Adults attending a department of periodontology at a dental school	Not stated	> every 12/12 (regular) Every 12/12–24/12 (irregular) < every 24/12 or only in emergencies	No. teeth Periodontal disease	Not clear
Lissau *et al.*, 1990[85]	Cross-sectional	Denmark	1985	756	20–21 y	P	Originated from a random sample of schoolchildren in 1974	Not stated	>2 times in last 36/12 (regular) ≤,2 times in last 36/12 (irregular)	Periodontal disease	N/A
Locker *et al.*, 1989[57]	Cross-sectional	Canada	1987	247	≥50 y	P	Quasi random: 1 out of every 26 entries from a municipal register	Not stated	≥1 dental check in last 12/12 <1 dental check in last 12/12	Root caries	N/A
Lunder, 1994[93]	Controlled trial	Norway	1986–1993	45	7 y followed to 13 y	M	Stratified random sample from a high school	Not stated	Every 12/12 Every 18/12	Caries Time spent on examination Time spent on treatment Total time spent	6 y

continued

TABLE 2 contd *Key characteristics of included studies and populations*

Reference	Design	Country of origin	Date of data collection	Population characteristics				Access/ coverage[b]	Intervention (dental check) : frequencies compared	Outcomes	Follow-up
				n	Age (y)	Dentition[a]	Recruitment				
McGrath and Bedi, 2001[31]	Cross-sectional	UK	Not stated Date of publication 2001	1860	76% 16–64 y 24% ≥65 y	P	Random sample: British postcode address file	All adults and children eligible Uptake not stated Adults pay a proportion of the cost of a check-up unless exempt on the basis of low income Children (<18 y) free at point of use	Last dental check ≤12/12 ago Last dental check >12/12 ago	Perception of how oral health affects quality of life	N/A
Marques *et al.*, 1994[49]	Cross-sectional	Oslo, Norway Porto, Portugal	Norway: 1984 Portugal: 1990	Norway: 200 Portugal: 322	Norway: 35 y Portugal: 30–39 y	P	Norway: random sample of a 1948 birth cohort, Oslo Portugal: random sample of 30–19-y-olds from local electoral list	Not stated	≥ every 12/12 (regular) < every 12/12 (irregular)	Caries No. teeth	N/A
Morrant *et al.*, 1995[48]	Retrospective cohort	England	Not stated Date of publication 1995	175	14–15 y	P	All 14–15-y-olds in 2 randomly selected secondary schools in Greater Manchester	All children eligible Uptake not stated Child (<18 y) free at point of use	Attended for an asymptomatic dental check ≤12/12 ago Did not attend for an asymptomatic dental check ≤12/12 ago	Caries	12/12

continued

TABLE 2 contd *Key characteristics of included studies and populations*

Reference	Design	Country of origin	Date of data collection	Population characteristics				Access/ coverage[b]	Intervention (dental check) : frequencies compared	Outcomes	Follow-up
				n	Age (y)	Dentition[a]	Recruitment				
Murray, 1996 [97]	Cross-sectional	UK	Adults: 1988	Adults: 1060	Adults: 25–54 y	P D	Adults: "random sample of households"	All adults and children eligible Uptake not stated Adults pay a proportion of the cost of a check-up unless exempt on the basis of low income Children (<18 y) free at point of use	Adults: Always regular dental checks Regular dental checks currently, not always Previously regular dental checks, not currently Never had regular dental checks Children: Last check ≤6/12 ago Last dental check >6/12 ago Only if experiencing problems	Caries No. teeth	N/A
			Children: 1993	Children: 1980	Children: 15 y		Children: "representative sample from maintained schools" For both age-groups, institutions excluded				
Nordstrom *et al.,* 1998[83]	Prospective cohort	Sweden	1980–1990	180	70–88 y	P	Stratified random to obtain a representative sample of individuals in the state dental insurance system	Dental insurance system covers part of dental care costs ***Coverage:*** 1980: not stated 1990: 50% target population	≥ every 12/12 Never/only if experiencing acute symptoms	Caries Periodontal disease	10 y

continued

TABLE 2 contd *Key characteristics of included studies and populations*

Reference	Design	Country of origin	Date of data collection	Population characteristics				Access/ coverage[b]	Intervention (dental check) : frequencies compared	Outcomes	Follow-up
				n	Age (y)	Dentition[a]	Recruitment				
Nuttall, 1984[94]	Prospective cohort	Scotland	1978–1983	504	Adults (≥18 y)	P	Random sample of dentate Scottish residents who participated in UK adult dental health survey	All children and adults eligible Coverage not stated Adults pay a proportion of the cost of a check-up unless exempt on the basis of low income	≥7, 6, 5, 4, 3, 2 or 1 dental check in 5 y	Extractions Fillings	5 y
Nuttall, 1991[41]	Prospective cohort	Scotland	1978–1988	702	Adults (≥18 y)	P	Random sample of dentate Scottish residents who participated in UK adult dental health survey	Uptake reported as 16.2% of those participating in the survey had a dental check ≥ every 24/12, which is the frequency required to stay in the General Dental System Adults pay a proportion of the cost of a check-up unless exempt on the basis of low income	≥11, 10, 9, 8, 7, 6, 5, 4, 3, 2 or 1 dental check in 10 y	Edentulousness	10 y
Nyyssonn, 1992[98(a)]	Cross-sectional	Finland (Mini Finland)	1980	Not stated	≥30 y	P	Not stated	Not stated	≥ every 24/12 < every 24/12 Only if experiencing problems	Caries No. teeth Periodontal disease	N/A

continued

TABLE 2 contd *Key characteristics of included studies and populations*

Reference	Design	Country of origin	Date of data collection	Population characteristics				Access/ coverage[b]	Intervention (dental check) : frequencies compared	Outcomes	Follow-up
				n	Age (y)	Dentition[a]	Recruitment				
Nyyssonn, 1992[98(b)]	Cross-sectional	Finland (Jamsa)	1990	Not stated	35–64 y	P	Not stated	Not stated	≥ every 24/12 < every 24/12 Only if experiencing problems	Caries No. teeth Periodontal disease	N/A
Nyyssonn, 1992[98(c)]	Cross-sectional	Finland (Varkaus)	1990	Not stated	≥65 y	P	Not stated	Not stated	≥ every 24/12 < every 24/12 Only if experiencing problems	Caries No. teeth Periodontal disease	N/A
Palmqvist *et al.*, 1986[71]	Cross-sectional	Sweden	1982 and 1983	188	≥65 y	P	Random sample of non-institutionalised elderly people stratified by age and place of residence	Dental insurance system Adults pay a proportion of the fee for a service; the proportion decreased with increasing cost	Regular dental checks Irregular dental checks (includes previously regular dental checks now sporadic and only in emergencies)	Caries No. teeth Periodontal disease	N/A
Riordan, 1995[88]	Cross-sectional studies conducted yearly over 14 y; 12/14 years' data included where dental check frequency changed between consecutive years	Western Australia	1980–1994 (yearly)	121,406–240,145	6–15 y	D P	Random sample of children in the state dental service in Western Australia	90% of children eligible to be in the state dental service 91% of those eligible receive care	Mean frequency of dental checks/year of study: 6.6/12 6.9/12 7.1/12 7.9/12 8.8/12 9.9/12 10.6/12 10.9/12 11.4/12 12.0/12 12.7/12 12.8/12	Caries Extractions Fillings Pulpotomies Fissure sealants	N/A

continued

TABLE 2 contd *Key characteristics of included studies and populations*

Reference	Design	Country of origin	Date of data collection	Population characteristics				Access/ coverage[b]	Intervention (dental check) : frequencies compared	Outcomes	Follow-up
				n	Age (y)	Dentition[a]	Recruitment				
Rubright *et al.*, 1996[25]	Retrospective case series	USA	1990–1994	53	Mean age men: 57.5 y Mean age women: 69.3 y	P	Case series presenting to otolaryngology clinic with pathological confirmation of diagnosis of squamous cell carcinoma of the oral cavity	Not stated	Time since last dental check: 12/12 24/12–60/12 72/12–132/12 (6–11 y) 12–17 y ≥18 y	Oral cancer: Localised vs advanced Staging T1–T4	Not clear
Sheiham *et al.*, 1985[65]	Cross-sectional	England	1980	351	16–64 y	P	Random sample from 2 industrial plants	All adults and children eligible Coverage not stated Adults pay a proportion of the cost of a check-up unless exempt on the basis of low income	Every 6/12 Every 12/12 Every 24/12 < every 24/12 Never ***Also comparisons according to pattern of attendance:*** Regular (asymptomatic attendance for dental checks) Irregular (attends for dental checks only when experiencing "trouble")	Caries	N/A

continued

TABLE 2 contd *Key characteristics of included studies and populations*

Reference	Design	Country of origin	Date of data collection	Population characteristics				Access/ coverage[b]	Intervention (dental check) : frequencies compared	Outcomes	Follow-up
				n	Age (y)	Dentition[a]	Recruitment				
Wang *et al.*, 1992[37]	Controlled trial	Norway	Not stated Date of publication 1992	58 78 49	3–5 y 16–18 y 18–20 y	D P P	All who received regular dental care in a public dental clinic	"Children in Norway eligible for regular clinical examinations"	Every 12/12 Every 24/12	Caries Examination time Treatment time Total time	2 y
Wang and Holst, 1995[90]	Prospective cohort	Norway	1991	Approx. 2750	4–18 y	M	Every 4th dental health record of children eligible for care within the Public Dental Service Private treatment excluded	Uptake: 95% of eligible children (all 3–18 y) receive care Not stated if free at point of use	≥ every 12/12 ***Dental check frequency individualised according to the following:*** High risk: dental check in <12/12 New decay, not high caries risk: dental check in 12/12 No new decay: dental check in 18/12	Caries Time spent by dentist and hygienist (check-ups and treatment)	2 y
Wang and Riordan, 1995[92]	Cross-sectional	Norway	1989–1991 (yearly)	1256	18 y	P	All 18-y-olds registered in the Public Dental Service	Not stated	≥ every 12/12 Dental check frequency individualised according to clinician (maximum interval between checks 18/12)	Caries	N/A

[a]*D, deciduous; M, mixed; P, permanent*
[b]*Details of access to intervention and population coverage/free at point of use?*
N/A, not applicable

TABLE 3 *Study quality: I. Threats to validity arising from study design*

Reference	Selection bias and confounding				External validity: were eligibility criteria stated?
	Study design	Was allocation concealed?	Were the groups similar, particularly oral health status? Differences noted? Adjustment?	Is a difference in dental check frequency the only "intervention" to explain any difference in outcome?	
Ambjornsen, 1986[64]	Cross-sectional	N/A	Yes, differences adjusted for	Unknown	Yes
Bjertness *et al.*, 1986[62]	Cross-sectional	N/A	No, adjusted for most characteristics Minor	Unknown	Yes
Halling and Bjorn, 1987[60]	Cross-sectional	N/A	No, not for all characteristics	Unknown	Yes
Jullien *et al.*, 1995[91]	Cross-sectional	N/A	Yes, differences adjusted for	Unknown	Yes
Ketomaki and Luoma, 1993[100(a),100(b)]	**Retrospective cohort**	**N/A**	**No, not for health Major**	**Unknown**	**No**
Ketomaki and Luoma, 1993[100(c)]	Controlled trial	No	No, but health status equivalent Minor	Yes	Yes
King *et al.*, 1986[61]	Cross-sectional	N/A	No, not for all characteristics	Unknown	Yes
Lie and Mellingen, 1988[58]	**Retrospective case series**	**N/A**	**Unknown Major**	**Unknown**	**Yes**
Lissau *et al.*, 1990[85]	Cross-sectional	N/A	No, but some adjustment Minor	Unknown	Yes
Locker *et al.*, 1989[57]	Cross-sectional	N/A	No, but some adjustment Minor	Unknown	Yes
Lunder, 1994[93]	Controlled trial	Unknown	No, but health status equivalent Minor	Yes	No
McGrath and Bedi, 2001[31]	Cross-sectional	N/A	Yes, differences adjusted for	Unknown	Yes
Marques *et al.*, 1994[49]	Cross-sectional	N/A	No, not for all comparisons	Unknown	Yes
Morrant *et al.*, 1996[48]	**Retrospective cohort**	**N/A**	**No, not for health status Major**	**Unknown**	**No**
Murray, 1996[97]	Cross-sectional	N/A	No, but some adjustment Minor	Unknown	Yes
Nordstrom *et al.*, 1998[83]	**Cross-sectional**	**N/A**	**Unknown Major**	**Unknown**	**No**
Nuttall, 1984[94]	Prospective cohort	N/A	Yes	Unknown	No
Nuttall, 1991[41]	**Prospective cohort**	**N/A**	**Yes, for some characteristics, but oral health status not reported Major**	**Unknown**	**No**

continued

TABLE 3 contd *Study quality: I. Threats to validity arising from study design*

Reference	Selection bias and confounding				External validity: were eligibility criteria stated?
	Study design	Was allocation concealed?	Were the groups similar, particularly oral health status? Differences noted? Adjustment?	Is a difference in dental check frequency the only "intervention" to explain any difference in outcome?	
Nyyssonn, 1992[98(a),98(b),98(c)]	Cross-sectional	N/A	No, not for all characteristics	Unknown	No
Palmqvist *et al.*, 1986[71]	Cross-sectional	N/A	Yes, differences adjusted for	Unknown	Yes
Riordan, 1995[88]	Cross-sectional	N/A	No, not for all characteristics Minor	Unknown	Yes
Rubright *et al.*, 1996[25]	**Retrospective case series**	**N/A**	**Unknown Major**	**Unknown**	**No**
Sheiham *et al.*, 1985[65]	Cross-sectional	N/A	Yes, differences adjusted for	Unknown	Yes
Wang *et al.*, 1992[37]	Controlled trial	Unknown	No, but health status equivalent Minor	Yes	Yes
Wang and Holst, 1995[90]	**Cross-sectional**	**N/A**	**Unknown Major**	**Unknown**	**Yes**
Wang and Riordan, 1995[92]	**Prospective cohort**	**N/A**	**Unknown Major**	**Unknown**	**Yes**

N/A, not applicable; bold text, study judged to have major threat to validity

TABLE 4 *Study quality: II. Threats to validity arising from methods of outcome assessment and data analysis/presentation*

Reference	Performance bias: were assessors blinded to intervention allocation?	Attrition bias		Appropriate statistical analysis/data presentation?
		Loss to follow-up (<20%)?	Were results analysed according to intention to treat?	
Ambjornsen, 1986[64]	Unknown Minor	N/A	N/A	No
Bjertness *et al.*, 1986[62]	Unknown Minor	N/A	N/A	No
Halling and Bjorn, 1987[60]	Unknown Minor	N/A	N/A	Yes
Jullien *et al.*, 1995[91]	Unknown Minor	N/A	N/A	No
Ketomaki and Luoma, 1996[100(a),100(b),100(c)]	Unknown	(b) and (c): Yes (a): Unknown	No Minor	No Minor
King *et al.*, 1986[61]	Unknown Minor	N/A	N/A	Yes
Lie and Mellingen, 1988[58]	Unknown Minor	N/A	N/A	Yes

continued

TABLE 4 contd *Study quality: II. Threats to validity arising from methods of outcome assessment and data analysis/presentation*

Reference	Performance bias: were assessors blinded to intervention allocation?	Attrition bias		Appropriate statistical analysis/data presentation?
		Loss to follow-up (<20%)?	Were results analysed according to intention to treat?	
Lissau *et al.,* 1990[85]	Unknown Minor	N/A	N/A	Yes
Locker *et al.,* 1989[57]	Unknown Minor	N/A	N/A	No
Lunder, 1994[93]	Unknown Minor	Yes	No	Yes
McGrath and Bedi, 2001[31]	Unknown Minor	N/A	N/A	Yes
Marques *et al.,* 1994[49]	Unknown Minor	N/A	N/A	Yes
Morrant *et al.,* 1995[48]	Yes	Yes (0%)	N/A	Yes
Murray, 1996[97]	Yes	N/A	N/A	No
Nordstrom *et al.,* 1998[83]	Yes	N/A	N/A	No
Nuttall, 1984[94]	**Unknown**	**No (34%) Major**	**N/A**	**No**
Nuttall, 1991[41]	Yes	Yes	N/A	No
Nyyssonn, 1992[98(a),98(b),98(c)]	Unknown Minor	N/A	N/A	No
Palmqvist *et al.,* 1986[71]	Unknown Minor	N/A	N/A	No
Riordan, 1995[88]	Unknown Minor	N/A	N/A	No
Rubright *et al.,* 1996[25]	Unknown Minor	N/A	N/A	No
Sheiham *et al.,* 1985[65]	Unknown Minor	N/A	N/A	No
Wang *et al.,* 1992[37]	No Minor	Yes (0%)	Yes	Yes
Wang and Holst, 1995[90]	**Yes**	**No (33%) Major**	**N/A**	**Yes**
Wang and Riordan, 1995[92]	No Minor	N/A	N/A	Yes

N/A, not applicable; bold text, study judged to have major threat to validity

TABLE 5 *Deciduous dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	DMFT/dmft	Decayed teeth (dt)/ caries lesions	Missing teeth	Filled teeth/filled surfaces
Ketomaki and Luoma, 1993[100(a)]	Retrospective cohort	***Total 5850***	***1–7 y***	***Dental checks:***		***% of sample with caries lesions index increment (0 to ≥4) over 6-y follow-up:***		
				≥ every 6/12		66% = 0; 12% = 1; 9% = 2; 8% = 3; 5% = ≥4		
				Every 7–12/12		84% = 0; 8% = 1; 4% = 2; 2% = 3; 2% = ≥4		
				Every 13–18/12		81% = 0; 8% = 1; 4% = 2; 2% = 3; 5% = ≥4		
				Every 19–24/12		74% = 0; 7% = 1; 9% = 2; 4% = 3; 6% = ≥4		
				Every 25–36/12		68% = 0; 8% = 1; 9% = 2; 4% = 3; 11% = ≥4		
				Every 37/12		50% = 0; 12% = 1; 9% = 2; 8% = 3; 21% = ≥4		
Ketomaki and Luoma, 1993[100(b)]	Retrospective cohort	***Total 901:***	***1–7 y***	***Dental checks:***	***Mean change in DMFT/dmft:***			
		569		≥ every 12/12	Mean change dmft/person over 6-y follow-up = 1.5 Mean change DMFT/y = 0.58 Mean change dmft/y = 0.31			
		134		< every 12/12 but ≥ every 24/12 (3–5 checks over 6 y)	Mean change dmft/person over 6-y follow-up = 1.4 Mean change DMFT/y = 0.50 Mean change dmft/y = 0.29			
		86		< every 24/12 but ≥ every 36/12 (2–3 checks over 6 y)	Mean change dmft/person over 6 y follow-up = 1.0 Mean change DMFT/y = 0.4 Mean change dmft/y = 0.24			
		112		Every 72/12 (1 check in 6 y)	Mean change dmft/person over 6 y follow-up = 0.2 Mean change DMFT/y = N/A Mean change dmft/y = N/A			

continued

TABLE 5 contd *Deciduous dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	DMFT/dmft	Decayed teeth (dt)/ caries lesions	Missing teeth	Filled teeth/filled surfaces
Riordan, 1995[88]	Cross-sectional study conducted yearly over 14 y; 12/14-y data included		***6 y***	***Mean frequency of dental checks/y of study:***		***Mean no. decayed teeth:***		
		151,206		6.6/12		2.2		
		137,324		6.9/12		2.2		
		121,406		7.1/12		2.3		
		160,083		7.9/12		1.65		
		187,337		8.8/12		1.55		
		191,641		9.9/12		1.50		
		215,484		10.6/12		1.60		
		222,767		10.9/12		1.50		
		224,830		11.4/12		1.3		
		230,871		12.0/12		1.3		
		239,438		12.7/12		1.45		
		240,145		12.8/12		Not recorded		
Wang *et al.*, 1992[37]	Controlled trial	***Total 89:***	***3–5 y***	***Dental checks:***	***Mean dmft increment/person over 2-y study period (SD):***			
		58		Every 12/12	Mean 0.9 (2.1)			
		31		Every 24/12	Mean 1.8 (2.0) — (NS)			

DMFT, decayed, missing, filled teeth (permanent dentition); dmft, decayed, missing, filled teeth (deciduous dentition); N/A, not applicable; SD, standard deviation; NS, not significant
Unless indicated in the table, tests of statstical significance were not reported and could not be calculated by the authors

TABLE 6 *Mixed deciduous and permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	dmft/s; DMFT/S dft/s; DFT/S	dt/DT	No. teeth	ft/FT fs/FS
Ketomaki and Luoma, 1993[100(c)]	Controlled trial	***Total 708:***	***3–12 y:***	***Dental checks:***		***Mean change in d/D index (0 to ≥4) (no. caries lesions)/person during 3-y follow-up:***		
		28	12	Every 12/12		1.43		
		100	11			0.53		
		90	10			0.21		
		123	9			0.15		
		122	8			0.21		
		118	7			0.17		
		81	6			0.02		
		46	3			1.02		
		708	3–12			0.32		
		Total 469:	***3–12 y:***	***Individualised according to caries risk (range 3–24/12)***		***Mean change in d/D index (no. caries lesions)/person during 3-y follow-up:***		
		67	12			0.34		
		72	11			0.40		
		76	10			0.25		
		71	9			0.18		
		57	8			0.23		
		49	7			0.10		
		37	6			0.08		
		40	3			0.78		
		469	3–12			0.29 (NS)		

continued

TABLE 6 contd *Mixed deciduous and permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	dmft/s; DMFT/S dft/s; DFT/S	dt/DT	No. teeth	ft/FT fs/FS
Lunder, 1994[93]	Controlled trial	***Total 45:***	***7 y followed to 13 y***	***Dental checks:***	***Mean DMFS increment over 6-y follow-up (SD):***	***Increment in no. deep cavities over 6 y:***		
		22 23		Every 12/12 Every 18/12	Mean 1.1 (2.1) Mean 5.1 (11.0) (NS)	0 4 ***		
Wang and Holst, 1995[90]	Prospective cohort	***Total 1784–2011 varied according to out-come measured:***	***4–18 y***	***Dental checks:***		***Mean no. new dt/DT (SD):***		***Mean no. new fs/FS (SD):***
				≥ every 12/12 Mean 12.5 (SD 3.6) Range 3/12–14/12		0.81 (1.76) Standardised to 12/12: 0.77 (1.77)		1.24 (1.65)
				Individualised dental check frequency according to clinical judgement No new decay: dental check every 18/12 New decay, low risk: dental check every 12/12 High risk: dental check > every 12/12		0.69 (1.54) (NS) Standardised to 12/12: 0.77 (1.72) (NS)		1.0 (2.3) *
		240		< every 11/12		1.2 (1.9)		1.6 (2.6)
		1187		Every 11–16/12		0.7 (1.4) (NS)		1.1 (2.4) (NS)
		391		Every 17–20/12		0.5 (1.3)		0.6 (1.6)
		67		< every 20/12		0.8 (1.8) (NS)		2.8 (12.4) (NS)

* $p \leq 0.05$ *between frequencies*
*** $p \leq 0.001$ *between frequencies*
dmft/s, decayed, missing and filled teeth/surfaces (deciduous dentition); DMFT/S, decayed, missing and filled teeth/surfaces (permanent dentition); dft/s, decayed and filled teeth/surfaces (deciduous dentition); DFT/S, decayed and filled teeth/surfaces (permanent dentition); dt/DT, decayed teeth (deciduous/permanent dentition); ft/FT, filled teeth (deciduous/permanent dentition); fs/FS, filled surfaces (deciduous/permanent dentition); d/D index, no. caries lesions; DMFS, decayed, missing and filled tooth surfaces (permanent dentition)
Unless indicated in the table, tests of statstical significance were not reported and could not be calculated by the authors

TABLE 7 *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS)	Decayed teeth (DT) Decayed surfaces (DS)	No. teeth	Filled teeth (FT) Filled surfaces (FS)
Ambjornsen, 1986[64]	Cross-sectional	***Total 159:***	***≥77 y***	***Dental checks:***	***Mean DMFT (SD):***	***Mean no. decayed teeth (SD):***	***Mean no. missing teeth (SD):***	***Mean no. filled teeth (SD):***
		93		Regular (≥ every 12/12)	24.0 (3.2)	0.8 (1.1)	11.7 (6.8)	11.4 (6.4)
		66		Irregular (< every 12/12)	23.9 (3.8) (NS)	1.6 (2.0) *	17.1 (7.2) *	5.2 (6.3) *
Bjertness *et al.*, 1986[62]	Cross-sectional	***Total 144***	***35 y***	***Dental checks:***	***Mean DMFS:***	***Mean no. decayed surfaces (DS and DFS):***	***Mean no. missing surfaces:***	***Mean no. filled surfaces:***
		Not stated		Regular (≥ every 12/12)	86.1	2.9	23.9	60.8
				Irregular (< every 12/12)	76.4 (NS)	6.1 *	22.3 (NS)	51.0 *
Halling and Bjorn, 1987[60]	Cross-sectional	***Total 542:***	***50–66 y***	***Dental checks:***			***Mean no. teeth (SD): (significant difference between frequencies at all ages except (NS)):***	
		374		≤12/12 ago			50 y: 22.1 (5.4) 58 y: 19.2 (5.70) 62 y: 17.5 (6.10) 66 y: 17.9 (6.31)	
		79		>12/12 <24/12 ago			50 y: 21.2 (7.89) 58 y: 15.6 (7.42) 62 y: 15.2 (5.78) 66 y: 11.2 (7.19)	
		89		≥24/12 ago			50 y: 18.4 (8.07) (NS) 58 y: 11.4 (7.81) 62 y: 11.2 (7.30) 66 y: 12.0 (7.42)	

continued

TABLE 7 contd *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS)	Decayed teeth (DT) Decayed surfaces (DS)	No. teeth	Filled teeth (FT) Filled surfaces (FS)
Ketomaki and Luoma, 1993[100(a)]	Retrospective cohort	***Total 1215***	***23–29y***	***Dental checks:***		***% with caries lesions index increment (D (0 to ≥4)) over 6 y:***		
				≥ every 6/12		33% = 0; 24% = 1; 16% = 2; 14% = 3; 13% = ≥4		
				Every 7–12/12		35% = 0; 28% = 1; 17% = 2; 9% = 3; 11% = ≥4		
				Every 13–18/12		28% = 0; 20% = 1; 20% = 2; 14% = 3; 18% = ≥4		
				Every 19–24/12		27% = 0; 24% = 1; 15% = 2; 14% = 3; 20% = ≥4		
				Every 25–36/12		23% = 0; 23% = 1; 15% = 2; 15% = 3; 24% = ≥4		
				Every 37/12		14% = 0; 25% = 1; 17% = 2; 10% = 3; 35% = ≥4		

continued

TABLE 7 contd *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS)	Decayed teeth (DT) Decayed surfaces (DS)	No. teeth	Filled teeth (FT) Filled surfaces (FS)
Ketomaki and Luoma, 1993[100(b)]	Retrospective cohort	***Total 1065:***	***15 y followed to 21 y***	***Dental checks:***	***Mean change in DMFT/dmft per person over 6 y follow-up:***	***Mean change in DMFT/y:***		
		647		≥ every 12/12	12.0	0.51		
		162		< every 12/12 (3–5 checks over 6 y)	13.0	0.56		
		104		< every 24/12 (2–3 checks over 6 y)	12.5	0.24		
		152		Every 72/12 (1 check in 6 y)	11.5	N/A		
		Total 714:	***19 y followed to 25 y***					
		307		≥ every 12/12	17.0	0.39		
		163		< every 12/12 (3–5 checks over 6 y)	17.5	0.39		
		88		< every 24/12 (2–3 checks over 6 y)	17.0	0.25		
		156		Every 72/12 (1 check in 6 y)	15.5	N/A		
		Total 574:	***22/3 y followed to 28/29 y***					
		166		≥ every 12/12	20.0	0.32		
		50		< every 12/12 (3–5 checks over 6 y)	19.0	0.32		
		57		< every 24/12 (2–3 checks over 6 y)	18.5	0.21		
		301		Every 72/12 (1 check in 6 y)	17.0	N/A		

continued

TABLE 7 contd *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS)	Decayed teeth (DT) Decayed surfaces (DS)	No. teeth	Filled teeth (FT) Filled surfaces (FS)
King *et al.*, 1986[61]	Cross-sectional	***Total 662:***	***12 y***	***Comparison of Chinese and non-Chinese dental check patterns:***	***Mean DMFT (SD):***	***Mean no. decayed teeth (SD):***	***Mean no. missing teeth (SD):***	***Mean no. filled teeth (SD):***
		133		Non-Chinese: 3% never had a check	1.66 (1.96)	0.45 (0.88)	0.03 (0.17)	1.18 (1.60)
		529		Chinese: 31% never had a check	2.76 (2.59) **	2.12 (2.22) **	0.10 (0.40) *	0.54 (1.21) **
Lie and Mellingen, 1988[58]	Retrospective case series	***Total 123:***		***Dental checks:***			***Mean no. teeth lost/ individual (not including wisdom teeth):***	
		80	≤29 y: *n* = 10 30–59 y: *n* = 52 ≥60 y: *n* = 18	≥ every 12/12			5.0	
		20	≤ 29 y: *n* = 2 30–59 y: *n* = 15 ≥60 y: *n* = 3	Irregular			8.7 **	
		23	≤29 y: *n* = 2 30–59 y: *n* = 14 ≥60 y: *n* = 7	Only when experiencing problems			9.4 **	

continued

TABLE 7 contd *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS)	Decayed teeth (DT) Decayed surfaces (DS)	No. teeth	Filled teeth (FT) Filled surfaces (FS)
Locker *et al.*, 1989[57]	Cross-sectional	***Total 247***	***50+ y***	***Dental checks:***		***Mann–Whitney test investigating the relationship between decayed surfaces and dental visit frequency:***		
				≥1 in last 12/12		"Significant association between one or more measures of root caries (DFS and DS) and one or more dental visits in the last year."		
				<1 in last 12/12				
Marques *et al.*, 1994[49]	Cross-sectional	***Total 341:***	***30–39 y:***	***Dental checks: regular (≥ every 12/12): irregular: (< every 12/12):***	***Mean no. DMFT (SD):***	***Mean no. decayed surfaces (SD):***	***Mean no. missing teeth (SD):***	***Mean no. filled surfaces (SD):***
		144	35	Oslo, Norway: 89% of sample – regular checks	25.0 (3.8)	3.3 (4.7)	4.8 (2.5)	59.7 (15.6)
		197	30–39	Porto, Portugal: 29% of sample – regular attenders	13.8 (6.7) ***	9.2 (13.1) ***	6.6 (4.9) ***	4.4 (6.6) ***
Morrant *et al.*, 1995[48]	Retrospective cohort	***Total 175:***	***14–15 y***	***Dental checks:***	***Mean DMFT/individual (SD):***	***Mean no. decayed teeth/individual (SD):***	***Mean no. missing teeth/individual (SD):***	***Mean no. filled teeth/individual (SD):***
		92		Attended for an asymptomatic check within the previous year	2.9 (2.80)	0.8 (1.41)	0.2 (0.67)	2.0 (2.23)
		83		Did not attend for an asymptomatic check in the previous year	3.6 (3. 33) (NS)	1.2 (1.52) (NS)	0.2 (0.73) (NS)	2.2 (2.69) (NS)

continued

TABLE 7 contd *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS)	Decayed teeth (DT) Decayed surfaces (DS)		No. teeth	Filled teeth (FT) Filled surfaces (FS)
Murray, 1996[97]	Cross-sectional	***Total 1980:***	***15 y***	***Dental checks:***	***Mean DMFT (individual):***	***Mean no. decayed teeth (individual):***		***Mean no. missing teeth (individual):***	***Mean no. filled teeth (individual):***
		1280		Regular: check in the last 6/12	2.2	0.5		0.1	1.6
		280		Occasional: check >6/12 ago	2.3	0.7		0.2	1.4
		420		Never/on advice of community dentist/if experiencing trouble	3.1	0.9		0.2	2.0
		Total 654:	***25–34 y***	***Dental checks:***		***Mean no. decayed teeth (individual):***	***Mean no. sound teeth (individual):***	***Mean no. missing teeth (individual):***	***Mean no. filled teeth (individual):***
		154		Always regular: every 6/12		0.6	14.8	4.6	12.0
		170		Regular: every 6/12 currently; not always		0.5	14.8	4.8	11.9
		233		Been regular: every 6/12; not currently		1.6	6.5	5.0	8.9
		97		Never been regular		1.6	18.2	5.4	6.8
		Total 406:	***45–54 y***	***Dental checks:***		***Mean no. decayed teeth (individual):***	***Mean no. sound teeth (individual):***	***Mean no. missing teeth (individual):***	***Mean no. filled teeth (individual):***
		87		Always regular: every 6/12		0.9	10.1	8.4	12.6
		139		Regular: every 6/12 currently; not always		0.6	11.9	8.3	11.2
		105		Been regular: every 6/12; not currently		1.4	10.9	11.2	8.5
		75		Never been regular		1.7	13.2	11.9	5.2

continued

TABLE 7 contd *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS)	Decayed teeth (DT) Decayed surfaces (DS)	No. teeth	Filled teeth (FT) Filled surfaces (FS)
Nord-strom *et al.*, 1998[83]	Prospective cohort	***Total 127***	***70 & 79-y-olds followed for 9 y to 79 & 88 y:***	***Dental check (frequency distribution 1: less frequent checks than frequency distribution 2):***	***% of sample with DMFT >0:***	***Proportion of decayed teeth:***	***Total no. teeth:***	***Proportion of filled teeth:***
				Distribution of check frequency 1:	***Check frequency distribution 1:***	***Check frequency distribution 1:***	***Check frequency distribution 1:***	***Check frequency distribution 1:***
			70-y cohort	≥ every 12/12 = 39% Never/only when experiencing acute symptoms = 61%	87.7	1.3	395	80.2
			79-y cohort	≥ every 12/12 = 27% Never/only when experiencing acute symptoms = 74%	87.6	4.7	361	76.1
				Distribution of check frequency 2:	***Check frequency distribution 2:***	***Check frequency distribution 2:***	***Check frequency distribution 2:***	***Check frequency distribution 2:***
			70-y cohort (at 79 y)	≥ every 12/12 = 52% Never/only when experiencing acute symptoms = 42%	88 (NS)	0.3 (NS)	229 (NS)	80.9 (NS)
			70-y cohort (at 88 y)	≥ every 12/12 = 25% Never/only when experiencing acute symptoms = 58%	90.5 (NS)	3.6 (NS)	193 (NS)	77.2 (NS)

continued

TABLE 7 contd *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS) Decayed surfaces (DS)	Decayed teeth (DT)	No. teeth	Filled teeth (FT) Filled surfaces (FS)
Nuttall, 1991[41]	Prospective cohort	***Total 702***	***Adult***	***No. checks over 10 y:***			***No. who became edentulous over 10 y:***	
				≥11			0	
				10			2	
				9			0	
				8			0	
				7			1	
				6			0	
				5			1	
				4			4	
				3			4	
				2			13	
				1			14	
Nuttall, 1984[94]	Prospective cohort	***Total 504***	***Adults (≥18 y)***	***No. checks over (60/12) 5 y:***			***Mean no. teeth extracted/person/5 y:***	***Mean no. new fillings/person/5 y:***
				≥7			0.1	0.5
				6			0.1	0.9
				5			0.2	0.9
				4			0.3	1.4
				3			0.2	1.3
				2			1.0	1.7
				1			1.7	2.2

continued

TABLE 7 contd *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS)	Decayed teeth (DT) Decayed surfaces (DS)		No. teeth		Filled teeth (FT) Filled surfaces (FS)
Nyyssonn, 1992[98(a)]	Cross-sectional (Mini Finland)	***Total not stated***	***≥30 y***	***Dental checks:***		***% with decayed teeth:***	***Mean no. decayed teeth:***	***Mean no. teeth:***	***% edentulous:***	
		33%		≥ every 24/12		45	1.1	23	25	
		17%		< every 24/12		68	2.8	16	28	
		50%		Only if experiencing problems		79	4.1	14	49	
Nyyssonn, 1992[98(b)]	Cross-sectional (Jamsa, Finland)	***Total not stated***	***35–64 y***	***Dental checks:***		***% with decayed teeth:***	***Mean no. decayed teeth:***	***Mean no. teeth:***	***% edentulous:***	
		41%		≥ every 24/12		41	0.8	23	2	
		29%		< every 24/12		60	1.6	20	16	
		30%		Only if experiencing problems		77	3.1	17	42	
Nyyssonn, 1992[98(c)]	Cross-sectional (Varkaus, Finland)	***Total not stated***	***35–64 y***	***Dental checks:***		***% with decayed teeth:***	***Mean no. decayed teeth:***	***Mean no. teeth:***	***% edentulous:***	
		8%		≥ every 24/12		80	1.8	13	9	
		14%		< every 24/12		63	1.9	5	58	
		78%		Only if experiencing problems		70	2.4	3	74	

continued

TABLE 7 contd *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS)	Decayed teeth (DT) Decayed surfaces (DS)	No. teeth	Filled teeth (FT) Filled surfaces (FS)
Palmqvist *et al.*, 1986[71]	Cross-sectional	***Total 188:***	***≥65 y***	***Dental checks:***		***Mean % decayed teeth in sample:***	***Mean no. remaining teeth in sample:***	
		96		Regular dental checks		7	17.1	
		92		Irregular checks = previously regular checks, now sporadic and in emergencies only		28 ***	11.2 ***	
Riordan, 1995[88]	Cross-sectional†		***8–15 y:***	***Mean frequency of checks/y of study:***	***Mean DMFT:***			
		151,206	8–12	6.6/12	8 y: 0.8 12 y: 2.6			
		137,324	8–12	6.9/12	8 y: 0.9 12 y: 2.9			
		121,406	8–12	7.1/12	8 y: 1.0 12 y: 3.0			
		160,083	8–12	7.9/12	8 y: 0.6 12 y: 2.4			
		187,337	8–12	8.8/12	8 y: 0.5 12 y: 2.2			
		191,641	8–12	9.9/12	8 y: 0.4 12 y: 1.9			
		215,484	8–12	10.6/12	8 y: 0.4 12 y: 2.1			
		222,767	8–15	10.9/12	8 y: 0.3 12 y: 1.7 15 y: 3.7			
		224,830	8–15	11.4/12	8 y: 0.3 12 y: 1.5 15 y: 3.2			
		230,871	8–15	12.0/12	8 y: 0.3 12 y: 1.2 15 y: 3.1			
		239,438	8–15	12.7/12	8 y: 0.3 12 y: 1.2 15 y: 2.35			
		240,145	8–15	12.8/12	Not recorded			

continued

TABLE 7 contd *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS)	Decayed teeth (DT) Decayed surfaces (DS)	No. teeth	Filled teeth (FT) Filled surfaces (FS)
Sheiham *et al.*, 1985[65]	Cross-sectional	***Total 314***	***16–64 y:***	***Dental checks:***	***Mean DMFT (SD):***	***Mean no. decayed teeth (SD):***	***Mean no. missing teeth (SD):***	***Mean no. filled teeth (SD):***
					No sugar tea/coffee: / ***Sugar tea/coffee:***	***No sugar tea/coffee:*** / ***Sugar tea/coffee:***	***No sugar tea/coffee:*** / ***Sugar tea/coffee:***	***No sugar tea/coffee:*** / ***Sugar tea/coffee:***
			<35	Regular: attends for checks	12.7 (4.6) / 12.0 (4.4)	0.4 (0.6) / 0.5 (0.8)	1.2 (1.6) / 2.2 (2.1)	11.2 (4.5) / 9.5 (4.2)
			≥35	Irregular: attends for checks only when experiencing "trouble" (excluding those who rarely/never attend)	10.1 (4.3) * / 9.2 (5.7) *	1.4 (1.2) ** / 1.9 (2.0) **	2.6 (2.5) ** / 3.3 (4.2) **	6.7 (5.4) ** / 4.6 (5.2) **
			<35	Regular: attends for checks	15.9 (5.4) / 17.1 (4.8)	0.5 (1.4) / 1.0 (2.0)	7.2 (4.9) / 6.4 (4.3)	8.6 (4.7) / 10.3 (4.7)
			≥35	Irregular: attends for checks only when experiencing "trouble" (excluding those who rarely/never attend)	12.4 (5.7) *16.0 (5.3) (NS)	1.8 (1.9) * / 1.9 (2.4) *	7.5 (4.0) (NS) / 10.5 (5.5) **	3.8 (3.4) ** / 4.2 (3.3) **
		Total 351	***16–64 y***	***Dental checks:***	***Multiple regression analysis:***	***Multiple regression analysis:***	***Multiple regression analysis:***	***Multiple regression analysis:***
				Every 6/12 Every 12/12 Every 24/12 < every 24/12 Never	Unstandardised multiple regression with DMFT as dependent variable: "*b*" = +0.77 (SE 0.15) $p \leq 0.01$	Unstandardised multiple regression with no. decayed teeth as dependent variable: "*b*" = –0.26 (SE 0.06) $p \leq 0.01$	Unstandardised multiple regression with no. missing teeth as dependent variable: "*b*" = –0.51 (SE 0.13) $p \leq 0.01$	Unstandardised multiple regression with no. filled teeth as dependent variable: "*b*" = +1.54 (SE 0.14) $p \leq 0.01$
Wang *et al.*, 1992[37]	Controlled trial	***Total 137:***	***16–20 y:***	***Dental checks:***	***Mean DMFS increment over 2-y study period (SD):***			
		43	16–18	Every 12/12	1.0 (1.7)			
		45	16–18	Every 24/12	2.2 (4.0)			
		23	18–20	Every 12/12	0.4 (0.8) (NS)			
		26	18–20	Every 24/12	0.9 (1.7)			

continued

TABLE 7 contd *Permanent dentition: caries disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Decay experience (DMFT/DFT/DMFS)	Decayed teeth (DT) Decayed surfaces (DS)		No. teeth	Filled teeth (FT) Filled surfaces (FS)
Wang and Riordan, 1995[92]	Cross-sectional (repeated over 3 y)	***Total 678:***	***18 y***	***Dental checks – district North (SD):***		***Mean no. sound surfaces (SD):***	***Mean no. surfaces affected by dentine caries:***		
		161		≥ every 12/12		10.2 (7.1)	2.4 (2.7)		
		173		Mean check frequency 15.8/12 (6.8)		11.1 (7.6)	3.0 (2.9) *		
		166		Mean check frequency 15.8/12 (5.4)		13.0 (7.6) *	2.9 (3.0)		
		178		Mean check frequency 15.4/12 (5.1)		14.7 (7.2) *	2.6 (2.8)		
		Total 578:		***Dental checks – district South (SD):***		***Mean no. sound surfaces (SD):***	***Mean no. surfaces affected by dentine caries:***		
		139		≥ every 12/12		10.4 (7.7)	1.0 (1.4)		
		141		Mean check frequency 13.5/12 (3.0)		10.6 (6.8)	1.1 (1.4)		
		141		Mean check frequency 13.9/12 (4.0)		12.4 (7.2) *	2.5 (2.6) *		
		157		Mean check frequency 15.8/12 (4.7)		11.1 (6.8)	2.2 (2.3) *		

* $p \leq 0.05$ *between frequencies;* ** $p \leq 0.01$ *between frequencies;* *** $p \leq 0.001$ *between frequencies;* **** $p \leq 0.0001$ *between frequencies*

† *Cross-sectional studies conducted yearly over 14 y; 12/14 years' data included*

DMFT, decayed, missing and filled teeth; DFT, decayed and filled teeth; DMFS, decayed, missing and filled tooth surfaces; DT, decayed teeth; DS, decayed tooth surfaces; FT, filled teeth; FS, filled surfaces; SD, standard deviation; NS, no significant difference between frequency groups; DFS, decayed and filled tooth surfaces; D index, no. caries lesions; N/A, not applicable; SE, standard error

Unless indicated in the table, tests of statistical significance were not reported and could not be calculated by the authors

TABLE 8 *Permanent dentition: periodontal disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Bleeding	Attachment level	Probing depth/pockets	Other
Halling and Bjorn, 1987[60]	Cross-sectional	***Total 542:***	***50–66 y***	***Dental checks:***				***Mean bone score (SD) (significant differences indicated):***
		374		Last check ≤12/12 ago				50 y: 0.87 (0.481) 58 y: 0.98 (0.472) 62 y: 1.07 (0.449) 66 y: 1.03 (0.414)
		79		Last check >12/12 but ≤ 24/12 ago				50 y: 0.89 (0.429) 58 y: 1.18 (0.587) 62 y: 1.18 (0.571) 66 y: 1.36 (0.721)
		89		Last check ≥24/12 ago				50 y: 1.09 (0.548) * 58 y: 1.19 (0.600) * 62 y: 1.17 (0.665) 66 y: 1.68 (0.771)

continued

TABLE 8 contd *Permanent dentition: periodontal disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Bleeding	Attachment level	Probing depth/pockets		Other	
Lie and Mellingen, 1988[58]	Retrospective case series	***Total 123:***		***Dental checks:***	***% gingival sites with bleeding on probing:***		***% with probing depths ≥4 mm:***	***% with probing depths ≥6 mm:***	***Bone score – mean individual marginal bone loss from 6 "Ramfjord teeth"; 4 = no bone loss:***	***% surfaces with stainable plaque:***
		80	≤29 y: *n* = 10 30–59 y: *n* = 52 ≥60 y: *n* = 18	≥ every 12/12	Mean 55.05 SD 25.36 Range 3–100		31	7	5.5	Mean 58.8 SD 27.53 Range 7–100
		20	≤29 y: *n* = 2 30–59 y: *n* = 15 ≥60 y: *n* = 3	Irregular checks	Mean 70.05 SD 30.16 Range 10–100	(NS)	40 (NS)	13 (NS)	5.6 (NS)	Mean 68.21 * SD 30.16 Range 22–100
		23	≤ 29 y: *n* = 2 30–59 y: *n* = 14 ≥60 y: *n* = 7	Checks only if experiencing problems	Mean 58.57 SD 29.87 Range 11–100		33	8.5	5.8	Mean 72.96 * SD 22.43 Range 25–100
Lissau *et al.*, 1990[85]	Cross-sectional	***Total 756***	***20–21 y***	***Dental checks:***	***Mean bleeding index (range 0–6):***		***Mean pocket index (range 0–12):***		***Mean calculus index (range 0–6):***	
				Regular: check >2 times in last 3 y	3.01 (multiple regression "*b*" = –0.43)		2.53 (multiple regression "*b*" = –0.61)		1.16 (multiple regression "*b*" = –0.64)	
				Irregular: check ≤2 times in last 3 y	3.69 ***		3.30 ***		1.94 ***	

continued

TABLE 8 contd *Permanent dentition: periodontal disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Bleeding	Attachment level	Probing depth/pockets	Other
Morrant *et al.*, 1995[48]	Retrospective cohort	***Total 175:***	***14–15 y***					***Presence of plaque:***
		92		Attended for an asymptomatic check within the previous year				No significant difference in oral hygiene (defined as the presence of plaque)*
		83		Did not attend for an asymptomatic check in the previous year				

continued

TABLE 8 contd *Permanent dentition: periodontal disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Bleeding	Attachment level	Probing depth/pockets	Other
Nord-strom *et al.*, 1998[83]	Prospective cohort	***Total 127***	***70- and 79-y-olds followed for 9 y to 79 and 88 y:***	***Dental checks (frequency distribution 1: less frequent checks than frequency distribution 2):***	***% bleeding surfaces:***	***% surfaces with attachment level >3 mm:***		
				Distribution of check frequency 1:	***Check frequency distribution 1:***	***Check frequency distribution 1:***		
			70-y cohort	≥ every 12/12 = 39% Never/only if acute symptoms = 61%	30.0	14.3		
			79-y cohort	≥ every 12/12 = 27% Never/only if acute symptoms = 74%	37.8 *	23.9 *		
				Distribution of check frequency 2:	***Check frequency distribution 2:***	***Check frequency distribution 2:***		
			70-y cohort (at 79 y)	≥ every 12/12 = 52% Never/only if acute symptoms = 42%	24.0	16.6		
			79-y cohort (at 88 y)	≥ every 12/12 = 25% Never/only if acute symptoms = 58%	37.4 *	40.3 *		

continued

TABLE 8 contd *Permanent dentition: periodontal disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Bleeding	Attachment level	Probing depth/pockets		Other	
Nyyssonn, 1992[98(a)]	Cross-sectional (Mini Finland)	***Total not stated***	***≥30 y***	***Dental checks:***			***% with shallow pockets:***	***% with deep pockets:***	***% with gingivitis:***	***% periodontally healthy (no calculus, gingivitis, periodontitis):***
		33%		≥ every 24/12			55	25	16	4
		17%		< every 24/12			51	24	22	3
		50%		Check only if problems			48	26	23	3
Nyyssonn, 1992[98(b)]	Cross-sectional (Jamsa, Finland)	***Total not stated***	***35–64 y***	***Dental checks:***			***% with shallow pockets:***	***% with deep pockets:***	***% with gingivitis:***	***% periodontally healthy (no calculus, gingivitis, periodontitis):***
		41%		≥ every 24/12			26	6	21	4
		29%		< every 24/12			24	5	13	4
		30%		Check only if problems			31	4	9	1
Nyyssonn, 1992[98(c)]	Cross-sectional (Varkaus, Finland)	***Total not stated***	***≥65 y***	***Dental checks:***			***% with shallow pockets:***	***% with deep pockets:***	***% with gingivitis:***	***% periodontally healthy (no calculus, gingivitis, periodontitis):***
		8%		≥ every 24/12			Too few were dentate		10	90
		14%		< every 24/12			13		Too few were dentate	87
		78%		Check only if problems			4		11	96

continued

TABLE 8 contd *Permanent dentition: periodontal disease measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Bleeding	Attachment level	Probing depth/pockets	Other
Palmqvist *et al.*, 1986[71]	Cross-sectional	***Total 188:***	***≥65 y***	***Dental checks:***			***Mean % teeth with pockets >3 mm/individual:***	
		96		Regular checks			36	
		92		Irregular checks = previously regular checks, now sporadic and in emergencies only			49 *	

* $p \leq 0.05$ *between frequencies*
*** $p \leq 0.001$ *between frequencies*
SD, standard deviation; NS, no significant difference between frequency groups
Unless indicated in the table, tests of statistical significance were not reported and could not be calculated by the authors

TABLE 9 *Oral cancer outcomes*

Reference	Study design	*n*	Sex/age	Intervention frequency (/12)	Outcome	
Jullien *et al.*, 1995[91]	Cross-sectional	***Total 2027:***	***44% men 56% women***	***Dental checks:***	***Presence/absence cancer/precancer:***	
		1439		Last dental check ≤12/12 ago	Logistic regression (age, gender, alcohol, tobacco, dental attendance); no significant risk of oral cancer or precancer according to dental attendance frequency	
		588		Last dental check >12/12 ago		
Rubright *et al.*, 1996[25]	Retrospective case series	***Total 53:***	***Men:* n = *33* *Mean: 57.5 y (SD 13.62); Women:* n = *20* *Mean: 69.3 y (SD 13.75)***	***Dental checks:***	***Localised* n *(%):***	***Advanced* n *(%):***
		18		Last check 12/12 ago	14 (77.5)	4 (22.2)
		11		Last check 24/12–60/12 ago	6 (54.5)	5 (45.4)
		8		Last check 72/12–132/12 ago (6–11 y)	3 (37.5)	5 (62.5)
		8		Last check 12–17 y ago	1 (12.5)	7 (87.5)
		8		Last check ≥18 y ago	0 (0)	8 (100)
		Total 53:		***Dental checks:***	***Tumour stage (T1–T4):***	
		11		Last check mean 8.09 y (SD 12.26) ago	T1	
		20		Last check mean 4.05 y (SD 4.03) ago	T2	
		10		Last check mean 10.90 y (SD 8.31) ago	T3	
		12		Last check mean 12.83 y (SD 6.98) ago	T4	

** *Significant relationship* p ≤ *0.001 (analysis of variance) between time since last dental visit and tumour size*
*** *Significant inverse relationship* p ≤ *0.001 (Chi squared) between time since last dental visit and stage of disease*
SD, standard deviation
Unless indicated in the table, tests of statistical significance were not reported and could not be calculated by the authors

TABLE 10 *Permanent dentition: quality of life*

Reference	Study design	*n*	Age range	Intervention frequency (/12)	QoL		
McGrath and Bedi, 2001[31]	Cross-sectional	***Total 1860:***	***76%: age range 16–64 y 24%: >65 y***	***Dental checks:***	***How oral health affects QoL (–ve): n (%):***	***How oral health affects QoL (+ve): n (%):***	***How oral health affects QoL (–ve and/or +ve): n (%):***
		1136		Regular: ≥12/12 since last check	693 (64)	572 (52)	845 (78)
		724		Irregular: <12/12 since last check	371 (54) (NS)	329 (48) **	494 (72) **

** $p \leq 0.01$ *between frequencies*
QoL, quality of life; NS, no significant difference between frequency groups

Note: For *Tables 11–16* see appendix 4, pp. 100–107

TABLE 17 *Outcomes with and without sensitivity analysis for DMFT in permanent dentition*

DMFT	Significant increase in outcome	Significant decrease in outcome	Non-significant difference in outcome	Uncertain statistical significance in outcome	Total
All studies	2	2	5	2	11
Studies with major threat to validity excluded	2	2	3	1	8

TABLE 18 *Outcomes with and without sensitivity analysis for decayed teeth in permanent dentition*

Decayed teeth (DT)	Significant increase in outcome	Significant decrease in outcome	Non-significant difference in outcome	Uncertain statistical significance in outcome	Total
All studies	8	0	2	5	15
Studies with major threat to validity excluded	7	0	0	5	12

TABLE 19 *Outcomes with and without sensitivity analysis for filled teeth in permanent dentition*

Filled teeth (FT)	Significant increase in outcome	Significant decrease in outcome	Non-significant difference in outcome	Uncertain statistical significance in outcome	Total
All studies	0	5	2	2 (including bi-directional significant outcome)	9
Studies with major threat to validity excluded	0	5	0	1 (bi-directional significant outcome)	6

TABLE 20 *Outcomes with and without sensitivity analysis for number of teeth in permanent dentition*

No. teeth	Significant increase in outcome	Significant decrease in outcome	Non-significant difference in outcome	Uncertain statistical significance in outcome	Total
All studies	0	8	3	5	16
Studies with major threat to validity excluded	0	7	1	3	11

Chapter 3

Health economics

Existing economic evaluations

Methods

Search strategy (appendix 1)

Information on cost-effectiveness and quality of life was sought from the following sources:

- electronic bibliographic databases: MEDLINE (Ovid) 1997–Feb 2001
- other databases: NHS Centre for Reviews and Dissemination Database of Health Technology Assessments, NHS Economic Evaluation Database (NHS EED)
- internet sites of a number of academic health economics units including Centre for Health Economics (University of York), Health Economics Research Unit (University of Aberdeen), Health Economics Research Group (Brunel University)
- citation lists from obtained references.

Inclusion and exclusion criteria (appendix 2)

Inclusion and exclusion criteria were as for effectiveness studies (see chapter 2). In addition, studies had to include an assessment of resource implications and/or costs. No language restriction was applied. Exclusion and inclusion criteria were applied by two reviewers (CD and RT).

Synthesis of results and study quality

Identified studies were summarised on three levels: (1) study characteristics; (2) methodological details; and (3) results. The headings used were adapted from Drummond and Jefferson's checklist in "Guidelines for authors and peer reviewers of economic submissions to the BMJ".[110]

Results

Number and characteristics of studies

A total of 407 studies were initially identified from bibliographic searching; 367 were easily excluded as not relevant to the review by CD, and the remaining 40 were selected for inclusion on the basis of title. Six studies were formally selected for inclusion based on the abstract and review of the full article (see *Tables 21–23*).

Included studies

Six economic studies were identified, all of which examined the impact of dental check frequency on dental decay. Four were in children and two were in adults.

Study characteristics and results

Only one of the six studies was a formal cost-effectiveness study. This study reported an incremental cost of US$73 per carious surface averted when comparing 12-month dental checks to no checks. The results of the five resource impact studies appeared to be consistent in that, with decreasing frequencies of dental checks (range 7/12–24/12), assessment and treatment time were reduced with little evidence of an adverse impact on dental health.

Conclusions: existing economic evaluations

Some of the key issues highlighted by the review are listed below:

- There were no published cost-effectiveness studies based on UK data that considered the review question of dental checks at a 6-month frequency against other dental check frequencies (i.e. of reference to current UK practice).
- The main focus of previous economic studies that have considered the frequency of routine dental checks has been on children. Limited consideration has been given to efficiency questions concerning the frequency of dental checks in adults.
- The time horizons considered by most studies have been very limited; most researchers have not looked beyond a 5-year time-frame. Linked to this is the concern that none of the studies has applied a discount rate either to costs or to benefits. This is surprising, given that the focus is on interventions that are delivered over an extended period.
- Only one of the published economic analyses has reported a cost-effectiveness or cost–utility ratio. The study by Ramos-Gomez[111] used a condition-specific measure of effect (i.e. carious surfaces averted), which is helpful in making comparisons with other policies
- There is clearly much uncertainty in the analyses reported in the literature, given the nature of the data being used and the variable approaches adopted in modelling and extrapolating beyond

TABLE 21 *Economic study characteristics I*

	Ramos-Gomez and Shepard, 1999[111]	**Wang *et al.*, 1992[37]**	**Wang and Holst, 1995[90]**	**Dawson and Smales, 1992[112]**	**Lunder, 1994[93]**	**Wang, 1998[113]**
Country	USA	Norway	Norway	Australia	Norway	Denmark, Iceland, Norway, Sweden
Comparisons	12/12 vs do nothing	12/12 vs 24/12	Mean 12.5/12 vs mean 13.7/12	Mean 1.29 y vs mean 0.93 y	12/12 vs 18/12	Usual recall intervals: Denmark 11/12 Iceland 7/12 Norway 1312 Sweden 13/12
Intervention	Risk assessment and preventive treatment	Examination and resultant treatment	Recall – routine examination	Examination and resultant treatment	Recall – examination, risk assessment, preventive therapy (other?)	Recall – routine examination
Population	Hypothetical cohort of 1-y-old children	138 children; 3, 16 and 18 y	Approx. 2750 children; 4–18 y	100 service men and women	46 high school children; 7 y	County – whole population
Time horizon	5 y	2 y	1 y	10 y	7 y	1 y

TABLE 22 *Economic study characteristics II*

	Ramos-Gomez and Shepard, 1999[111]	**Wang *et al.*, 1992[37]**	**Wang and Holst, 1995[90]**	**Dawson and Smales, 1992[112]**	**Lunder, 1994[93]**	**Wang, 1998[113]**
Perspective	Health sector	Health sector	Health sector	Health sector	Health sector	Health sector
Type of study	Cost-effectiveness (modelling)	Resource impact	Resource impact	Resource impact	Resource impact	Resource impact
Source of costs/resources	115 patients treated in US paediatric clinic	Current study (randomised controlled trial)	Current study (prospective cohort)	Current study (retrospective assessment of records)	Current study (randomised controlled trial)	Current study (ecological)
Source of benefits	Separate published study – Twetman *et al.*, 1996[114]	Current study (randomised controlled trial)	Current study (prospective cohort)	Current study (retrospective assessment of records)	Current study (randomised controlled trial)	Current study (ecological)
Discount rate	Not stated	Not stated	Not stated	Not stated	Not stated	Not stated
Price year of costs/resources	1992	?	1990–1993	1998	1986–1987	1995
Key assumptions	75% uptake of service					

TABLE 23 *Results of economic studies*

	Ramos-Gomez and Shepard, 1999[111]	Wang *et al.*, 1992[37]	Wang and Holst, 1995[90]	Dawson and Smales, 1992[112]	Lunder, 1994[93]	Wang, 1998[113]
Resources	–	***Mean total time for treatment and examination/patient:*** 3–8 y, –10 minutes 16–18 y, –18 minutes 18–20 y, –30 minutes	***Mean total time/patient (dentist equivalent minutes):*** –8 minutes	– –	***Overall mean time/patient:*** 227 vs 182 minutes ***Examination mean time/patient:*** 102 vs 71 minutes	***Preventive care time – at-risk children:*** Denmark: 45 minutes Iceland: 32 minutes Norway: 32 minutes Sweden: 27 minutes ***Preventive care time – non-risk children:*** Denmark: 12 minutes Iceland: 20 minutes Norway: 10 minutes Sweden: 8 minutes
Costs	5-y mean cost/patient: US$314 ($95 assessment; $219 treatment)	–	–	Mean (treatment) cost/patient: $AUS38 (SE 8) vs $AUS2 (SE 20)	–	–
Benefits	40% reduction in carious surfaces	DMFS: Age 3–5 y: +0.9 Age 16–18 y: +1.2 Age 18–20 y: +0.9	Decayed teeth +0.06	Mean no. restorations: 0.8 (SE 1.0) vs 0.7 (SE 2.0) Restoration 75% survival: 7.78 vs 6.25 y	DMFS increment 4.3 vs 5.1	
Incremental cost-effectiveness ratio	US$73/carious surface averted	–	–	–	–	–
Sensitivity analysis	Not reported	Not reported	Not reported	Not reported	Not reported	Not reported

–, not reported; DMFS, decayed, missing, filled tooth surfaces; SE, standard error
With the exception of Ramos-Gomez and Shepard, 1999[111] incremental differences presented are for decreasing dental check frequencies

observed data. It is therefore surprising that none of the studies employed sensitivity analysis techniques to provide some indication of the robustness of the results.

Given this lack of formal economic evidence we decided to examine the cost-effectiveness of different dental check frequencies in more detail by using decision analysis modelling, as detailed in the next section of this report.

Economic modelling

Rationale for focus on decay experience (DMFT)

Periodontal disease

It was not considered possible to examine the cost-effectiveness of dental checks of different recall frequencies on periodontal disease by using a Markov model for the following reasons:

- There is little epidemiological information about the progression of periodontal disease or longitudinal data for a UK or similar population over a sufficient period.[18] For ethical reasons the studies on the epidemiology of periodontal disease that do exist are based on sample populations who have undergone treatment.[18]
- There would be no logical basis for choosing a single outcome for estimation of cost-effectiveness from the range of adverse outcomes in periodontal disease (plaque, probing depth, attachment level, bone loss, quality of life, tooth loss), and establishing a composite outcome measure was beyond the scope of this review.
- The treatment of periodontal disease was observed to be largely independent of dental check-ups such that one dental check could identify a need for treatment, which then became self-perpetuating and not reliant on the frequency of future routine dental checks.

Oral cancer

The review team considered that the role of dental checks was to identify cancerous and precancerous lesions and to refer appropriately. To determine the optimal interval between dental checks to prevent the adverse effects of oral cancer therefore requires estimation of the likelihood of a missed precancerous or cancerous lesion progressing to a more advanced stage (associated with worse outcome) between dental checks. When investigating the practical consideration of examining the cost-effectiveness of dental checks of different recall frequencies on oral cancer using a Markov model:

- Clinical expert opinion indicated that the epidemiological factors associated with progression from early to late malignancy are not known.[115]
- Clinical expert opinion indicated that there was a lack of reliable indicators for predicting the speed or inevitability of transformation of precancerous to cancerous lesions.[115]
- Epidemiological information on the transformation of leukoplakias suggests an overall transformation rate over 10–20 years of 4–6%,[116] with the fastest, such as sublingual keratosis, transforming at a rate of 50% over 10–20 years.[116]

It was not therefore considered feasible to examine the cost-effectiveness of dental checks of different recall frequencies on oral cancer by using a Markov model. Furthermore, on the basis of the epidemiological data identified, it was considered unlikely that the dental check time intervals being considered in the Markov model for dental caries (3/12–36/12) would adversely affect the outcome of oral cancer.

Introduction and overview of modelling approach

In this section we present an original Markov decision analysis modelling exercise that we have developed in order to undertake an incremental cost-effectiveness analysis of different dental check recall policies. We also discuss the results obtained under a variety of assumptions about key parameter values. The modelling efforts herein focus on decay experience (dmft) among children aged 1–6 years with only deciduous dentition, and among children/adults aged 12–80 years with only permanent dentition (DMFT). In particular, the generation of transition probabilities for caries progression required data sources that included a range of age group data as a proxy for longitudinal data for both deciduous and permanent dentition. For this reason the most recent UK children's dental health survey was used,[8] rather than the British Association for the Study of Community Dentistry surveys.[117] The use of the UK dental health surveys allows the assumption that dental checks are effective for identifying gross decay (not aided by radiography) because these surveys are based on clinical diagnoses of gross caries by dental practitioners.

Before discussing the details, it is helpful to take a broad overview. The modelling approach employed here enables the calculation of cost and effectiveness measures for different policies on the frequency of routine dental checks, where effectiveness is measured in terms of the number of teeth free from decay, extraction or fillings

(i.e. dmft/DMFT) at the end of the simulation period. Data limitations have resulted in the costs associated with the treatment of decay focusing on restoration treatment only (fillings) and not other treatments that may be appropriately instituted as a response to caries (e.g. extractions, crowns, bridges). The models allow for heterogeneity across risk groups, defined in terms of individual characteristics associated with caries. The idea is that decision makers provided with these figures will be able to conduct incremental cost-effectiveness analyses of the different policy options, based either on data for individual risk groups or on aggregate data for all risk groups. The review does not seek to provide definitive advice about which are the "optimal policies" with regard to the frequency of routine dental checks. Rather, the aim is to aid decision making by providing useful insights and information.

The overall modelling approach consists of a number of decision analysis "submodels", one for each possible combination of risk group characteristics. Each of these submodels must be "populated" with data specific to that risk group. The advantage of this approach is that separate cost-effectiveness analyses can then be conducted for each risk group, as well as for all risk groups combined (if so desired). However, parsimony must be exercised at the outset in deciding how many risk groups, and therefore decision analysis submodels, to have in the final model. Data requirements quickly become prohibitive as the number of submodels increases.

Each submodel is in the form of a decision tree with as many branches emanating from the root decision node as there are policy options to be evaluated. At the end of each of these policy branches there is a Markov model describing the transitions made between different levels of decay experience. The Markov model at the end of each policy branch is supposed to represent the possible trajectories of individuals through different levels of decay experience over the life-cycle, thus enabling the calculation of expected cost and effectiveness measures over the life-cycle for each of the policies in each decision analytical submodel. These data can then be used in incremental cost-effectiveness analyses at the level of the decision analysis submodel itself, and/or at more aggregated levels as indicated above.

Detailed specification of modelling approach

As already noted, the number of decision analysis submodels in the final model depends on the number of risk group combinations. Two key risk factors were used for the present study: socio-economic background (manual versus non-manual) and whether or not the children/adults came from an area with fluoridated water. In order to maintain parsimony and also keep the model as simple as possible, risk factors were dichotomised. This gave rise to four possible combinations of these risk factors (manual/non-fluoridated, manual/fluoridated, non-manual/non-fluoridated, and non-manual/fluoridated), and thus eight decision analysis submodels (four for deciduous dentition and four for permanent dentition). The scenario of individuals with a mixed dentition (i.e. both deciduous and permanent dentition) has not been modelled. The reasons for this were that this is a dynamic state and therefore treatment decisions are not fixed, and also that the background epidemiology and resultant computation would be extremely complex.

Each decision analysis submodel in the present review has six policy branches emanating from the root node, corresponding to six frequencies of dental checks: 3-, 6-, 12-, 18-, 24- and 36-monthly. There is a Markov model at the end of each policy branch, with states corresponding to decay experience in terms of number of teeth affected from one cycle to the next. On the basis of clinical advice, the states are defined as 0 (representing no increment in decay experience (dmft/DMFT) from one check-up to the next), 1 (representing an increment of one tooth affected by decay experience), 3 (representing increments in decay experience of between two and four teeth), and 10 (representing increments in decay experience of between five and 20 in the case of deciduous dentition, and five and 28 for permanent dentition). Alternative specifications were explored, in particular models with 20+ states corresponding to individual teeth, but these were found to be computationally intractable with the decision analysis software used for this study (DATA3.5). The model structure is shown in *Figure 2*.

The cycle length in each Markov model is the same as the period between dental checks in the corresponding policy branch (one of 3, 6, 12, 18, 24, 36). In the model for deciduous dentition, each Markov model simulates decay experience (dmft) over a 6-year period, and the number of cycles decreases as the period between dental checks increases. Thus, the model for the 3-monthly branch has 24 cycles, the 6-monthly branch has 12 cycles, the 12-monthly branch has six cycles, the 18-monthly branch has four cycles, the 24-monthly branch has three cycles, and the 36-monthly

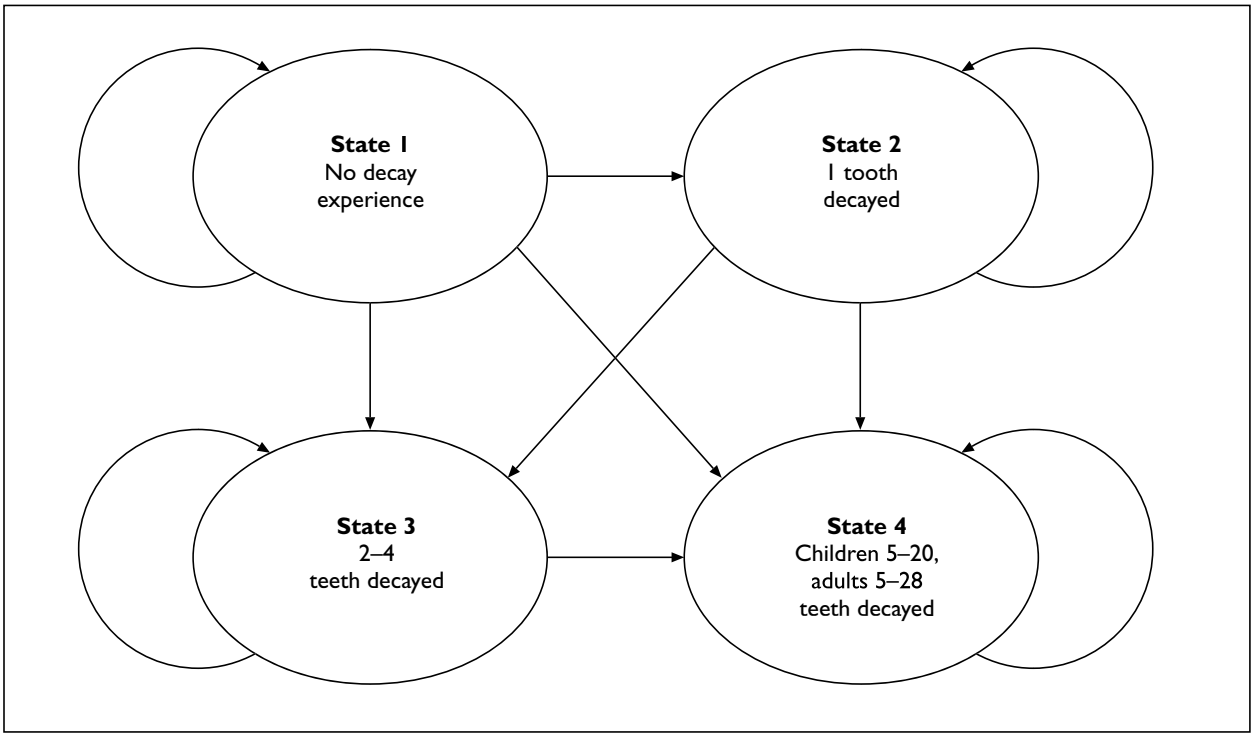

FIGURE 2 *Markov model for dental decay*

branch has two cycles. In the case of permanent dentition, each Markov model simulates decay experience (DMFT) over a 68-year period (an assumed average life expectancy of 80 years minus an assumed starting age of 12 years), and the number of cycles again decreases as the period between dental checks increases.

The base case probability of a unit increase in decay experience (dmft/DMFT) from one period to the next is calculated using the formula:

$$\text{pdecay}_{\text{base case}} = 1 - \exp(-\textit{hazard}/\text{number of cycles per year})$$

where *hazard* is the rate of progression of decay experience in terms of number of teeth affected per year. Using data from the UK children's dental health survey,[8] a base case hazard of 0.3 teeth per year is used for deciduous dentition (representing the average annual increment in an observed rise from dmft = 2 to dmft = 2.9 over 3 years among 5-year-olds), and a base case hazard of 0.37 teeth per year is used for permanent dentition (representing the average annual increment in an observed rise from DMFT = 1.4 to DMFT = 2.5 over 3 years among 12-year-olds). Sensitivity analyses are also reported (*Tables 24–39,* see appendix 5, pp.110–125) for hazard rate values 50% smaller and 50% bigger than these (i.e. 0.15 and 0.45 for deciduous dentition (*Tables 26, 28, 29* and *31*), and 0.185 and 0.555 for permanent dentition (*Tables 34, 36, 37* and *39*)).

Using these hazard rates, probabilities of a unit increase in decay experience (dmft/DMFT) from one period to the next can be computed for each policy branch. For example, in the case of deciduous dentition, the base case transition probabilities are:

3-monthly visits: $\text{pdecay}_{\text{base case}} = 1 - \exp(-0.3/4) = 0.07$
6-monthly visits: $\text{pdecay}_{\text{base case}} = 1 - \exp(-0.3/2) = 0.14$
12-monthly visits: $\text{pdecay}_{\text{base case}} = 1 - \exp(-0.3) = 0.26$
18-monthly visits: $\text{pdecay}_{\text{base case}} = 1 - \exp(-0.3 \times 1.5) = 0.36$
24-monthly visits: $\text{pdecay}_{\text{base case}} = 1 - \exp(-0.3 \times 2) = 0.45$
36-monthly visits: $\text{pdecay}_{\text{base case}} = 1 - \exp(-0.3 \times 3) = 0.59$

Thus, the probability of a unit rise in decay experience (dmft/DMFT) increases with the cycle length. Each tooth is treated as an independent unit. Thus, the probability of a 2-unit rise in decay experience from one period to the next is given by $(\text{pdecay}_{\text{base case}})^2$, the probability of a 3-unit rise in decay experience from one period to the next is given by $(\text{pdecay}_{\text{base case}})^3$ and so on. For the purposes of this study, the risk factor group "manual/non-fluoridated" is always treated as the base case.

We have assumed that the probability of experiencing caries is about 14.6% higher in non-fluoridated compared with fluoridated areas.[17] The unit transition probability for the manual/fluoridated group was therefore obtained by

applying a factor of 1 – 0.146 = 0.854 to the base case unit transition probability:

$$\text{pdecay}_{\text{manual/fluoridated}} = 0.854 \times \text{pdecay}_{\text{base case}}$$

For deciduous dentition, the baseline odds of a child having any teeth with decay experience (dmft) can be calculated as 0.58.[8] This gives a baseline probability of 0.58/1.58 = 0.3671, which is the same as the baseline probability for the non-manual socio-economic group. Using the data in *Table 40* and the rules for manipulating odds, the odds for skilled manual workers are 0.58 × 1.54 = 0.8932, which implies a probability of decay experience for the skilled manual worker group of 0.8932/1.8932 = 0.4718. Similarly, the odds for unskilled manual workers are 0.58 × 1.22 = 0.7076, which implies a probability of decay for the unskilled manual worker group of 0.7076/1.7076 = 0.4144. To obtain an overall probability of decay for the manual worker group, we took the average of these to give (0.4718 + 0.4144)/2 = 0.4431. Comparing this with the figure for non-manual workers, we see that manual workers are (0.4431/0.3671 – 1) × 100 = 20.7% more likely to experience caries than non-manual workers. In the case of deciduous dentition, the unit transition probability for the non-manual/non-fluoridated group was therefore obtained by applying a factor of 1 – 0.207 = 0.793 to the base case unit transition probability:

$$\text{pdecay}_{\text{non-manual/non-fluoridated}} = 0.793 \times \text{pdecay}_{\text{base case}}$$

Finally, the unit transition probability for the non-manual/fluoridated group was obtained by applying the two factors 0.854 and 0.793 together:

$$\text{pdecay}_{\text{non-manual/fluoridated}} = 0.854 \times 0.793 \times \text{pdecay}_{\text{base case}}$$

For permanent dentition, similar calculations yielded the formulae:

$$\text{pdecay}_{\text{non-manual/non-fluoridated}} = 0.8601 \times \text{pdecay}_{\text{base case}}$$

and

$$\text{pdecay}_{\text{non-manual/fluoridated}} = 0.854^{\dagger} \times 0.8601^{\dagger} \times \text{pdecay}_{\text{base case}}$$

where, in this case, $\text{pdecay}_{\text{base case}}$ uses the base case hazard rate of 0.37 for permanent dentition (†assuming social class and fluoridation are independent). Note that the conversion factor 0.854 due to fluoridation applies to both deciduous and permanent dentition.[17]

We have used data that suggest the average cost for a check-up alone is £6.40.[34] The average cost of a filling in deciduous dentition is given as £6.30, and the average cost of a filling in permanent dentition is given as £12.13 (appendix 6). These cost elements were used to compute the costs of the transitions in the Markov models. The computations needed to take into account the limited lifetimes of restorations, and the fact that each may have to be redone one or more times before the end of the simulation period. For the base case analysis, the following survival rates of restorations were used: in deciduous dentition, 50% over 6 years (*Table 41*); and, in permanent dentition, 50% over 12 years (*Table 42*). Sensitivity analyses were undertaken for two further possible survival rates of restorations in deciduous dentition: 100% over 6 years (appendix 5, *Tables 24, 26* and *29*) and 50% over 3 years (appendix 5, *Tables 25, 28* and *31*). Similarly, sensitivity analyses are reported below for two possible survival rates of restorations in permanent dentition: 50% over 6 years (appendix 5, *Tables 32, 34* and *37*) and 50% over 24 years (appendix 5, *Tables 33, 36* and *39*).

To show how these survival rates were used, suppose the survival rate of restorations is 50% over 6 years in the 3-monthly Markov model for

TABLE 40 *Selection of model parameters*

Parameter	Categorisation	Variables encompassed	Source
Caries progression	N/A	Deciduous and permanent dentition	O'Brien, 1993[8]
Restoration longevity	50% over 6 y 50% over 12 y	–	Chadwick *et al.*, 2001[118]
Transition costs	N/A	Restoration of a deciduous tooth Restoration of a permanent tooth Cost of a dental check (see appendix 6)	NHS Executive, 2001[34]
Risk factors:			
Socio-economic status	Manual/non-manual	Ethnicity, sugar consumption and diet	O'Brien, 1993[8]
Water fluoridation	Yes/No	–	McDonagh *et al.*, 2000[17]

N/A, not applicable; –, not reported

deciduous dentition. Then, using the same formula as for the transition rates above we have

Prob(failure of restoration within 6 years) =
$1 - \exp(-hazard) = 0.5$

$$\rightarrow hazard = 0.6931$$

The probability of failure from one cycle to the next in the 3-monthly model is then

Prob(failure of restoration in 1 cycle) =
$1 - \exp(-0.6931/24) = 0.0285$

This means that a tooth filled at the end of cycle 1 in the 3-monthly model will be refilled an average of 0.0285 times in each of the remaining 23 cycles, giving an expected cost of a filling at the end of cycle 1 equal to

£6.30 + £6.30 × 23 × 0.0285 = £10.43

In this way, a cost schedule can be calculated for fillings done at each stage of the 3-monthly Markov model for deciduous teeth, under the assumption of a 50% survival rate of restorations over 6 years. Similar calculations were done for the other survival rates reported in the sensitivity analyses in appendix 5.

In line with current Treasury guidance, a discount rate of 6% was applied to all costs in this analysis.

Model parameters

After detailed discussion and review of available and recent UK epidemiological data, the parameters for inclusion in the dental caries model were chosen and are summarised in *Table 40*. The choice of these parameters was made on the basis of available recent UK epidemiological data and also the structural constraints of the final model.

Results

Tables 41 and *42* report the results for the base case analyses for deciduous and permanent dentition respectively. The submodels vary in terms of their risk factor combination. The base case assumptions for the hazard rate for decay was 0.3 for deciduous dentition and 0.37 for permanent dentition, and the survival rate of restorations was 50% over 6 years

TABLE 41 *Base case results for deciduous dentition (hazard rate = 0.3, 50% restoration survival over 6 y)*

Frequency of dental checks	Cost/patient over 6 y (£)	Effectiveness (no. teeth free from decay, fillings or extraction)
Manual and non-fluoridated		
36-monthly	27.30	17.98
24-monthly	30.20	18.35
18-monthly	34.30	18.53
12-monthly	43.70	18.71
6-monthly	74.40	18.91
3-monthly	138.40	19.03
Manual and fluoridated		
36-monthly	23.30	18.49
24-monthly	27.50	18.68
18-monthly	32.10	18.79
12-monthly	42.00	18.91
6-monthly	73.30	19.05
3-monthly	137.50	19.13
Non-manual and non-fluoridated		
36-monthly	22.00	18.66
24-monthly	26.50	18.81
18-monthly	31.30	18.89
12-monthly	41.40	18.99
6-monthly	72.90	19.10
3-monthly	137.20	19.17
Non-manual and fluoridated		
36-monthly	19.70	18.95
24-monthly	24.70	19.03
18-monthly	29.80	19.08
12-monthly	40.10	19.14
6-monthly	72.00	19.21
3-monthly	136.50	19.25

This table falls between Tables 24 *and* 25 *on pp.110–111 (appendix 5)*

and 50% over 12 years, in deciduous and permanent dentition respectively.

Each table shows the results for the four possible risk factor groups. The first column in each table shows the policy branches (36-monthly dental checks, 24-monthly dental checks, etc.) arranged in order of increasing expected cost (given in the second column). The second column shows the expected cost per patient associated with each policy branch over the simulation period (6 years for deciduous dentition, 68 years for permanent dentition). The third column shows the effectiveness per patient of each policy branch in terms of "number of teeth free from decay, extraction or fillings".

It is not surprising that the results indicate that the most effective but also the highest cost strategy is always 3-monthly intervals for dental checks (for both deciduous and permanent dentition). However, a move from a 6-monthly to a 3-monthly interval is associated with a sharp increase in cost per patient with only a modest increase in effectiveness. This is shown graphically in *Figures 3–10*, which each represent the cost-effectiveness plane where the current policy (of a 6-monthly interval) is represented by the intersection of the horizontal and vertical axes.

Figures 3–6 show incremental cost-effectiveness ratios for deciduous dentition and all show a single point in the northeast quadrant that represents the move to a 3-monthy dental check interval (from a 6-monthly dental check interval). This point in all figures reveals that the policy incurs an additional cost with a small improvement in effectiveness. Each of these four figures also have four points in the southwest quadrant, showing that any policy to reduce the frequency of dental checks is associated with cost reduction and poorer results on effectiveness. The fall-off in effectiveness is most marked for the two manual subgroups, with the greatest decline seen in the manual and non-fluoridated group. However, in all groups, a reduction in dental check frequency to 12 months is associated with falls in effectiveness per patient of between 0.07 (non-manual and fluoridated) and 0.2 (manual and non-fluoridated), with cost reductions of around £30 per patient.

TABLE 42 *Base case results for permanent dentition (hazard rate = 0.37, 50% restoration survival over 12 y)*

Frequency of dental checks	Cost/patient over 68 y (£)	Effectiveness (no. teeth free from decay, fillings or extraction)
Manual and non-fluoridated		
36-monthly	202.00	11.94
24-monthly	203.70	15.04
18-monthly	225.00	16.33
12-monthly	240.30	16.90
6-monthly	315.60	17.04
3-monthly	515.20	17.26
Manual and fluoridated		
36-monthly	178.00	14.72
24-monthly	180.30	16.32
18-monthly	185.70	16.79
12-monthly	212.40	16.99
6-monthly	304.90	17.13
3-monthly	506.70	17.45
Non-manual and non-fluoridated		
36-monthly	178.90	14.61
24-monthly	182.20	16.28
18-monthly	186.40	16.78
12-monthly	212.90	16.98
6-monthly	305.30	17.12
3-monthly	507.10	17.44
Non-manual and fluoridated		
36-monthly	151.20	16.17
24-monthly	161.30	16.78
18-monthly	172.50	16.96
12-monthly	200.90	17.06
6-monthly	295.50	17.27
3-monthly	499.60	17.68

This table falls between Tables 32 *and* 33 *on pp.118–119 (appendix 5)*

Figures 7–10 demonstrate incremental cost-effectiveness ratios for permanent dentition, and all show a single point in the northeast quadrant, representing the move to a 3-monthy dental check interval (from a 6-monthly interval). This point in all figures again reveals that this policy in permanent dentition incurs an additional cost with a small improvement in effectiveness. These four figures each have four points in the southwest quadrant, showing that any policy to reduce the frequency of dental checks is associated with cost reduction and poorer results on effectiveness. Once again there is consistency with the deciduous dentition model in that the fall-off in effectiveness is most marked for the two manual subgroups, with the greatest decline seen in the manual and non-fluoridated group. In the latter group it is clear that the move to a 24-month or 36-month dental check frequency is associated with dramatic losses in effectiveness (i.e. a loss of 5.1 per patient) and a smaller reduction in costs when compared with dental check policies of 12-, 18- and 24-month frequencies.

These findings are broadly supported by the sensitivity analyses that were conducted, in which both the hazard rate and restoration survival assumptions were varied. The detailed results of the sensitivity analyses are reported in *Tables 24–39* in appendix 5. (Note that, in appendix 5, *Tables 29–31*, the 36-monthly dental check policy branch is missing from the results for manual/non-fluoridated. This is because, at the higher hazard rates, the probability of a transition to 0 increment in decays in the 36-monthly models was so small that it caused a numerical overflow/underflow error in DATA3.5. However, the remaining policy branches still exhibit the same overall pattern.)

Assumptions/limitations of the modelling approach employed

- The Markov model assumes that dental checks are effective in identifying gross decay. This assumption is believed to be valid on the basis that the source data from which transitional probabilities of decay experience were

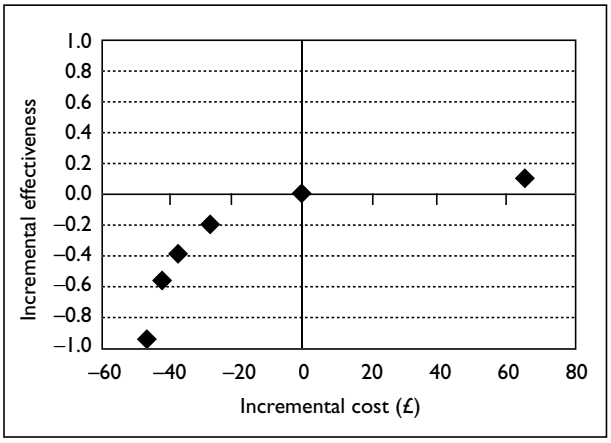

FIGURE 3 *Base case incremental costs and effects: deciduous dentition, manual and non-fluoridated*

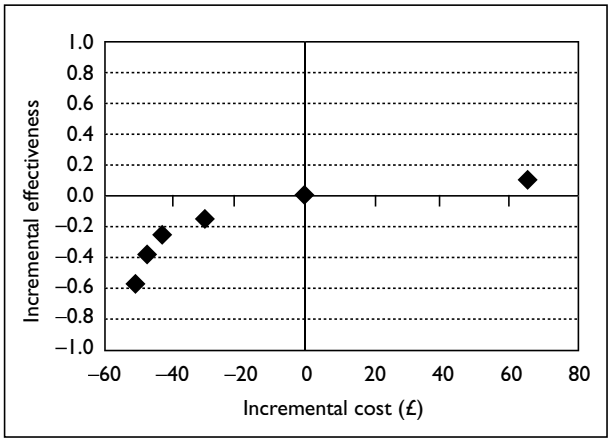

FIGURE 4 *Base case incremental costs and effects: deciduous dentition, manual and fluoridated*

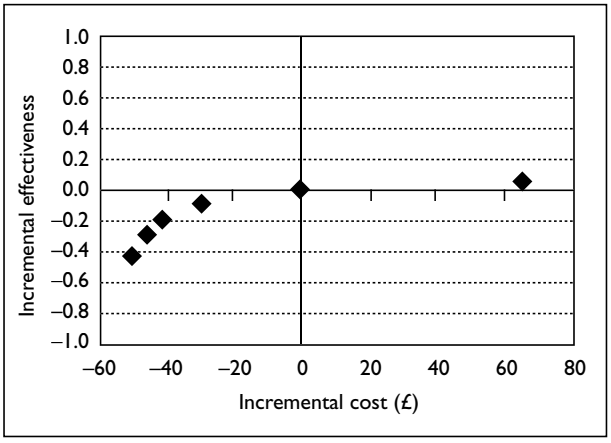

FIGURE 5 *Base case incremental costs and effects: deciduous dentition, non-manual and non-fluoridated*

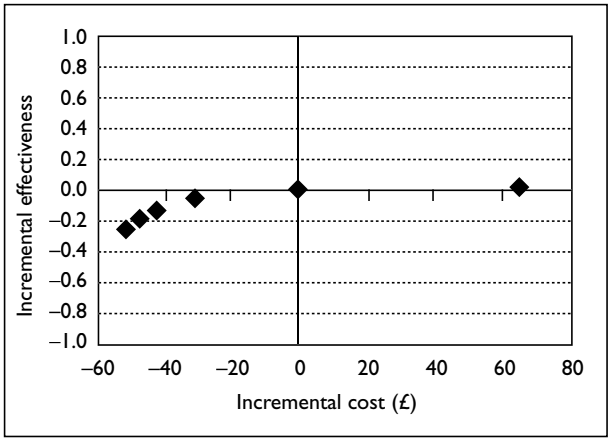

FIGURE 6 *Base case incremental costs and effects: deciduous dentition, non-manual and fluoridated*

calculated is based on dental clinicians identifying gross decay.[8] The limitation of this assumption is that no account has been taken of the effectiveness of the management (identification and treatment) of early decay (confined to enamel).
- States in the Markov models are "coarse grained" owing to clumping. It is difficult to see how this can be avoided in the context of the model in this study. It is theoretically possible to have 20+ states to account for transitions on a tooth-by-tooth basis, but the computations required for the corresponding transition probabilities are impracticable owing to limitations of time and of computer/software. It may also be unnecessary/unrealistic to go into such detail (e.g. is it necessary to have separate states representing increments of eight teeth and nine teeth affected by decay from one cycle to the next in the 3-monthly model?). Such transitions have probabilities that are virtually zero, suggesting that clumping of states into groups (as in this study) may be achieved without seriously affecting the overall results.
- Owing to the computational complexity of the model, variations in the sensitivity and specificity of the diagnostic abilities of clinicians were not formally entered as parameters into the model. However, as the caries progression used within the model was based on "real world" data, it should therefore encompass the performance of dental practitioners.
- DMFT was used as the measure of effectiveness within this model. A composite end-point such as DMFT has the potential limitation that it may fail to reflect the true changes in the underlying individual variables of which it is composed.

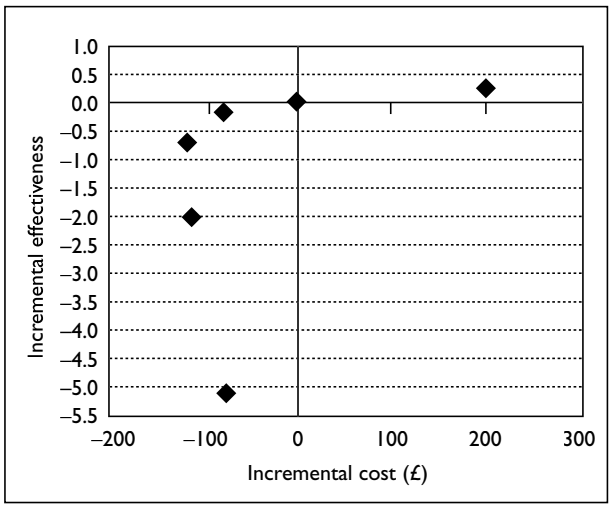

FIGURE 7 *Base case incremental costs and effects: permanent dentition, manual and non-fluoridated*

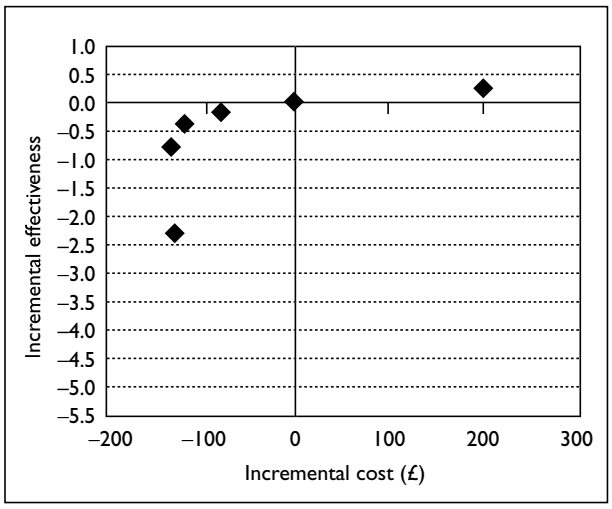

FIGURE 8 *Base case incremental costs and effects: permanent dentition, manual and fluoridated*

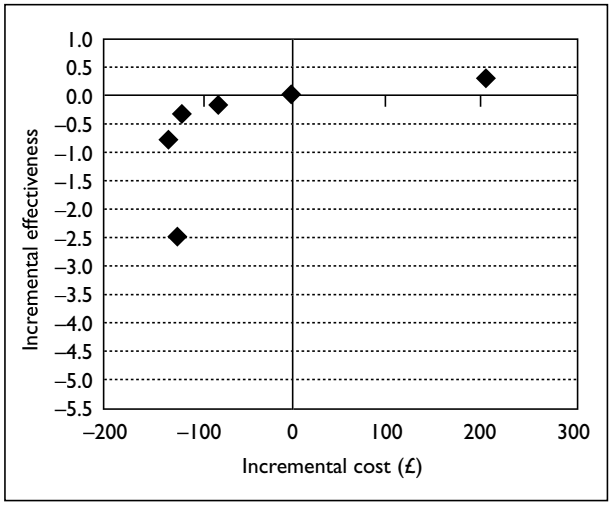

FIGURE 9 *Base case incremental costs and effects: permanent dentition, non-manual and non-fluoridated*

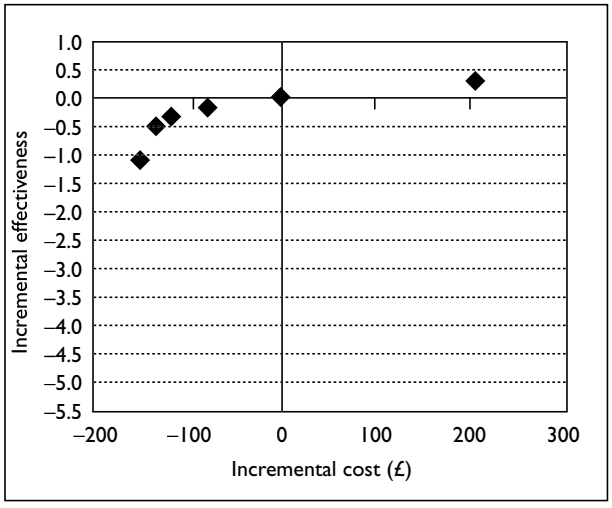

FIGURE 10 *Base case incremental costs and effects: permanent dentition, non-manual and fluoridated*

For example, over time for a given patient, the level of dental caries may fall but at the cost of an increase in the number of extracted teeth. A reduction or increase in overall DMFT score must therefore be interpreted with some caution.

- For each policy group, the hazard rate is fixed (distribution function is exponential). This means that the probability that an individual changes state within a small time interval is independent of time. For example, an individual may have a dmft = 0 for 1 month or for 10 years, but the probability of a unit change is the same. Given the exponential distribution, the probability of a unit rise in decay experience increases with the cycle length but increases at a diminishing rate. A 6-month increase in dental check frequency therefore reduces the probability of decay experience more at lower than at higher frequencies. Within each policy, the hazard rate of the restoration is constant, whereas this would be expected to be U-shaped. Sensitivity analysis has not been conducted to take account of this.
- Owing to data limitations, calculation of the average cost associated with the transition to a unit advanced decay experience (dmft/DMFT) state is based on the costs of restoration treatment (fillings) only. This assumption is likely to result in an underestimation of treatment costs (appendix 6).

Conclusions: economic modelling

- The policy option of a 6-monthly dental check was used as baseline for the comparison of costs and of effectiveness. Alternative policies were considered in terms of the change in costs and effects compared with the 6-month dental check policy.
- Moving from the policy option of 6-monthly dental checks for both deciduous and permanent dentition to policies of reduced frequencies (i.e. 12, 18, 24 and 36 months), there is a consistent trend of a reduction in survival in the number of teeth free from decay, extraction or fillings relative to a reduction in cost. This finding holds for both deciduous and permanent dentition, and across all risk subgroups.
- The magnitude of the loss in survival appears to be relatively small in clinical terms, but was greatest in non-manual and non-fluoridated groups, again for both deciduous and permanent dentition.
- Moving from a policy option of 6-monthly to 3-monthly dental checks is associated with a relatively small gain in survival and a sharp increase in costs.
- These results appear to be robust to changes in key modelling parameters, as demonstrated through the sensitivity analyses.

Chapter 4

Discussion

Three issues will be considered in this discussion: implications for the NHS, for patients and carers, and for future research of dental checks of different frequencies. The frequency of treatment of oral disease (including scaling and polishing for periodontal disease) was not considered as part of this review.

Implications for the NHS

- There is a lack of consistency in both the direction and magnitude of impact on outcome in previous effectiveness studies that have compared different frequencies of dental checks.
- Moreover, the majority of included studies have been undertaken outside of the current NHS setting.
- There is therefore little existing evidence to either support or refute the current practice of encouraging 6-monthly dental checks in children and adults.
- Modelling provided an opportunity within this review to investigate further the relative effectiveness (and cost) of different frequencies of dental checks using recent UK epidemiological and cost data.
- The policy perspective taken within the modelling was to compare the current practice of 6-monthly dental checks with alternative frequencies (3-monthly, 12-monthly, 18-monthly, 24-monthly and 36-monthly) in deciduous (dmft) or permanent (DMFT) dentition stratified by social class (manual versus non-manual) and water fluoridation.
- The dental caries model indicates that a decreasing frequency of dental checks (compared with 6 months) is associated with both a reduction in effectiveness (increase in DMFT/dmft) and a decrease in costs. Increasing the frequency of dental checks (compared with 6 months) is associated with an increase in effectiveness and a sharp increase in costs.
- For deciduous teeth, modelling indicates that, by changing to a 12-month dental check frequency from a 6-month frequency, an average of between 0.2 and 0.07 teeth would be affected by decay, filling or extraction, with a reduction in cost of around £30.00 per patient over 6 years. For permanent teeth, modelling indicates that, by changing to a 12-month dental check frequency from a 6-month frequency, an average of between 0.21 and 0.14 teeth would be affected by decay, filling or extraction, with a reduction in cost of between £75.00 and £95.00 per patient over 68 years.
- This relative incremental loss of effectiveness (for a relatively similar reduction in costs) was greatest in patients classified as lower socio-economic status and from non-fluoridated areas.
- DMFT has the advantage of being an overall measure of decay experience but it is important to note that, as a composite outcome, it is unable to reflect the differential changes in its component parts and the relative value of these with changes in dental check frequency.
- Consideration should be given to whether a policy for recall frequency should be on the basis of the total population, of population subgroups, or of individual patient risk.
- Collation and utilisation of routinely collected data should relate to and could be used to inform current and future dental health care policy.

Implications for patients and carers

- There is a paucity of evidence of the relative effectiveness of differing dental check frequencies on patient-related outcomes such as quality of life.
- Formal measures of assessing patient-related quality of life associated with oral healthcare are still in development. It was therefore not possible to incorporate quality of life into the dental caries model developed in this review, and thus there remains uncertainty in how patients would value any incremental increase in decay experience.
- Costs of dental care have been modelled in this study from a broad perspective; all costs associated with the direct provision of care (i.e. excluding patient travel and time costs) have been considered regardless of who incurs the cost. The issue of who could bear these costs (i.e. patients or the NHS) was considered to be outwith the scope of this review.

Implications for future research

- Clinical outcome measures and methodological approaches to assessing the impact of dental interventions need to be developed further.
- Further primary research is required in order to assess the relative clinical and cost-effectiveness of different frequencies of dental checks in terms of impact on dental caries, periodontal disease and oral cancer.
- The quality of design and reporting of such future research should be improved and give greater emphasis to patient-centred oral health outcomes.

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Contributions of authors

Clare Davenport was the main author. She was responsible for the day-to-day management of the report. She also: assisted with the development of the search strategy; designed the protocol; designed and piloted the data inclusion, data extraction and study quality proformas; undertook assessment of study eligibility and validity and extracted and collated study data; developed the proforma for extraction of epidemiological data for the economic modelling; liaised with external experts; and wrote and collated the report.

Rod Taylor was the project manager and took overall responsibility for the report. He advised on protocol development, undertook assessment of study quality, wrote the section on the review of previous economic studies, assisted in the general writing of the report, and provided general statistical advice.

Christian Salas and Stirling Bryan provided health economics advice, carried out and wrote up the economic modelling, and read and commented on parts of the draft report.

Anne Fry-Smith advised on the search strategy, undertook searches of electronic databases, and read and commented on the draft report.

Karen Elley assisted in protocol development, assisted in assessment of study eligibility and validity, undertook double data extraction, and contributed to the overall writing of the report.

Kate Taylor-Weetman assisted with the development of the protocol; identified, data extracted and quality checked epidemiological data contributing to the economic model; and contributed to the overall writing of the report.

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Appendix 1

Search strategies

Review of effectiveness

Randomised controlled trials

Database: Cochrane Library (CCTR) Issue 4, 2000

01 dent* and check*
02 dent* and attend
03 dent* and exam*
04 dent* and recall*
05 dent* and visit*
06 dent* and regular*
07 dent* and interval*
08 dent* and frequen*

Database: MEDLINE (Ovid) 1980 – December 2000

001 randomized controlled trial.pt.
002 controlled clinical trial.pt.
003 randomized controlled trials/
004 random allocation/
005 double blind method/
006 single blind method/
007 or/1–6
008 animal/ not human/
009 7 not 8
010 clinical trial.pt.
011 exp clinical trials/
012 (clin$ adj25 trials$).ti,ab.
013 ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or mask$)).ti,ab.
014 placebos/
015 placebo$.ti,ab.
016 random$.ti,ab.
017 research design/
018 or/10–17
019 18 not 8
020 19 not 9
021 9 or 20
022 preventive dentistry/
023 tooth diseases/pc
024 dental caries/pc
025 oral health/
026 or/22–25
027 (dent$ adj6 check$).tw.
028 (dent$ adj6 attend$).tw.
029 (dent$ adj6 exam$).tw.
030 (dent$ adj6 recall$).tw.
031 (dent$ adj6 visit$).tw.
032 (dent$ adj6 regular$).tw.
033 (dent$ adj6 interval$).tw.
034 (dent$ adj6 frequen$).tw.
035 or/27–34
036 26 or 35
037 21 and 36

Database: EMBASE (Ovid) 1980 – Dec 2000

1 caries prevention/
2 tooth diseases/pc
3 preventive dentistry/
4 dental health/
5 (dent$ adj6 check$).tw.
6 (dent$ adj6 attend$).tw.
7 (dent$ adj6 exam$).tw.
8 (dent$ adj6 recall$).tw.
9 (dent$ adj6 visit$).tw.
10 (dent$ adj6 regular$).tw.
11 (dent$ adj6 interval$).tw.
12 (dent$ adj6 frequen$).tw.
13 or/1–12
14 controlled trial/
15 randomized controlled trial/
16 clinical trial/
17 prospective study/
18 double blind procedure/
19 randomization/
20 major clinical study/
21 14 and 20
22 or/14–20
23 13 and 22

Database: National Research Register Issue 4, 2000

Search strategy as for Cochrane Library

Cohort and case studies

Database: MEDLINE (Ovid) 1980 – December 2000

001 preventive dentistry/
002 tooth diseases/pc
003 dental caries/pc
004 oral health/
005 or/1–4
006 (dent$ adj6 check$).tw.
007 (dent$ adj6 attend$).tw.
008 (dent$ adj6 exam$).tw.
009 (dent$ adj6 recall$).tw.
010 (dent$ adj6 visit$).tw.
011 (dent$ adj6 regular$).tw.
012 (dent$ adj6 interval$).tw.
013 (dent$ adj6 frequen$).tw.
014 or/6–13

015 5 or 14
016 case control studies/
017 cohort studies/
018 16 or 17
019 15 and 18

Database: EMBASE (Ovid) 1980 – Dec 2000
1 caries prevention/
2 tooth disease/pc
3 preventive dentistry/
4 dental health/
5 (dent$ adj6 check$).tw.
6 (dent$ adj6 attend$).tw.
7 (dent$ adj6 exam$).tw.
8 (dent$ adj6 recall$).tw.
9 (dent$ adj6 visit$).tw.
10 (dent$ adj6 regular$).tw.
11 (dent$ adj6 interval$).tw.
12 (dent$ adj6 frequen$).tw.
13 or/1–12
14 cohort analysis/
15 case control study/
17 14 or 15
18 13 and 17
19 (case and control).tw.
20 (odds and ratio).tw.
21 (relative and risk).tw.
22 or/19–21
23 13 and 22

Database: Cochrane Library (CCTR) Issue 4, 2000
Search strategy as for trials above

Database: National Research Register Issue 4, 2000
Search strategy as for trials above

Cost/quality of life

Database: MEDLINE (Ovid) 1997–2001
001 preventive dentistry/
002 tooth diseases/pc
003 dental caries/pc
004 oral health/
005 (dent$ adj6 check$).tw.
006 (dent$ adj6 attend$).tw.
007 (dent$ adj6 exam$).tw.
008 (dent$ adj6 recall$).tw.
009 (dent$ adj6 visit$).tw.
010 (dent$ adj6 regular$).tw.
011 (dent$ adj6 interval$).tw.
012 (dent$ adj6 frequen$).tw.
013 or/1–12
014 economics/
015 exp "costs and cost analysis"/
016 cost of illness/
017 exp health care costs/
018 economic value of life/
019 exp economics medical/
020 exp economics hospital/
021 economics pharmaceutical/
022 exp "fees and charges"/
023 (cost or costs or costed or costly or costing).tw.
024 (economic$ or pharmacoeconomic$ or price$ or pricing).tw.
025 or/14–24
026 13 and 25
027 quality of life/
028 life style/
029 health status/
030 health status indicators/
031 or/27–30
032 13 and 31

Appendix 2

Proformas for inclusion/exclusion, quality assessment and data extraction

(A) INCLUSION/EXCLUSION criteria (Stage 2)

Reviewer: CD/KE/RT

Ref ID: Author/ID .....
Date .....
Title .....

PARAMETER		Y	N	CT	Comments
POPULATION	Primary/deciduous dentition Permanent dentition				
INTERVENTION	Were at least two populations compared with *different* frequencies of routine dental check; dental check comprising *one or more of the following*: "clinical examination, advice, charting (including monitoring of periodontal status) and report"?[a]				
	Is the frequency of the recall interval given for all populations compared?[b]				
	If the "check" is given to more than one subgroup is the content of the "check" the same in each group?				
OUTCOME	Was at least one of the following outcomes included:				
Children (<18 y)	Missing teeth (M; m) Decayed teeth (D; d) Filled teeth (F; f) DMFT; dmft Periodontal disease Mucosal lesions[c] Need for orthodontic treatment Behavioural change				
Adults (≥18 y)	Untreated caries Filled teeth Number of teeth DMFT Periodontal disease				

continued

contd

	Oral cancer QoL or other patient centred outcome Mucosal lesions[c] Need for orthodontic treatment Behavioural change				
Date of data collection	Was the article based on data ≥1980 or published >1985?				

Notes: Please provide responses to all criteria as a record of reasons for inclusion/exclusion. Any "no" will result in exclusion of a study. In the case of a "can't tell" (CT) the author of the study will be contacted for the information before a decision is reached on inclusion/exclusion.

[a]Radiographic investigation and other interventions are allowed if provided in addition to a "routine dental check" as defined above. Checks performed by non-dental practitioners (e.g. hygienists) will be included in the review. The implications of including these data in the context of dental provision in the UK will therefore be discussed as necessary.
[b]Specified frequency in months/years; if population categorised as "regular/irregular attenders" or "attends when in pain" then definitions of the attendance frequencies making up these categories will be sought from contact with authors.
[c]Excluding oral cancer.

(B) QUALITY ASSESSMENT

Reviewer: CD/KE/RT

Ref ID: Author/ID .....
Date .....
Title .....

Study type: Controlled Trial/Cohort (prospective/retrospective)/Case control/Case series/Cross-sectional

CONTROLLED TRIALS			Y	N	CT	Comments
	Was the assignment to intervention groups really random?					
	Was treatment allocation concealed?					
	Were the groups similar at baseline in terms of prognostic factors?					
	On what modifying factors were the groups similar at baseline? (✔✘) (OHS = oral health status)	Age[a]				
		Sex[a]				
		OHS[a]				
		Access[a]				
		Diet[a]				
		Socio[a]				
		Fluoride[a]				
		Tobacco[a]				
		Ethnicity[a]				

continued

contd

	Were the eligibility criteria specified?				
	Were outcome assessors blinded to the intervention allocation?				
	Was the patient blinded to the intervention allocation?				
	Was the care provider blinded to the intervention allocation?				
[a]	Were groups treated equally except for the intervention?				
	Were point estimates and measures of variability presented for the primary outcome?				
	Did the analysis include an intention to treat analysis?				
[a]	Was follow-up long enough for outcomes to occur? (Please state outcome(s) and length of follow-up.)				

[a] *Questions added as considered relevant to the topic area of this review.*

COHORT			Y	N	CT	Comments
	Is there sufficient description of the groups and the distribution of prognostic factors?					
	Are the groups assembled at a similar point in their disease progression?					
	Is the intervention/treatment reliably ascertained?					
	Were the groups comparable on all important confounding variables?					
	On what modifying factors were the groups similar at baseline? (✔✘) (OHS = oral health status)	Age[a]				
		Sex[a]				
		OHS[a]				
		Access[a]				
		Diet[a]				
		Socio[a]				
		Fluoride[a]				
		Tobacco[a]				
		Ethnicity[a]				
	Was there adjustment for the effects of confounding variables?					

continued

contd

[a]	Were groups treated equally except for the intervention?				
	Was a dose-response relationship between intervention and outcome demonstrated?				
	Was outcome measurement blind to exposure status OR was outcome measurement objective?				
	What proportion of the cohort was followed up?				
	Was follow-up long enough for the outcome(s) to occur? (Please state outcome(s) and length of follow-up.)				
	Were drop-out rates and reasons for drop-out similar across intervention groups?				
[a]	Were point estimates and measures of variability presented for the primary outcome?				

[a]*Questions added as considered relevant to the topic area of this review.*

CASE CONTROL			Y	N	CT	Comments
	Is the case definition explicit?					
	Has the disease state of individuals been reliably assessed and validated?					
	Were comparison groups randomly selected from the same population?					
	How comparable are intervention groups with respect to potential confounding factors? (OHS = oral health status)	Age[a]				
		Sex[a]				
		OHS[a]				
		Access[a]				
		Diet[a]				
		Socio[a]				
		Fluoride[a]				
		Tobacco[a]				
		Ethnicity[a]				
	Was measurement of confounding factors, intervention(s) and outcomes assessed in the same way across intervention groups?					
[a]	Were groups treated equally except for the intervention?					
	How was the response rate defined?					

continued

contd

	Were non-response rates and reasons for non-response the same across intervention groups?				
	Is it possible that over-matching has occurred in that cases and controls were matched on factors related to exposure?				
	Was an appropriate statistical analysis used (matched or unmatched)?				
[a]	Were point estimates and measures of variability presented for the primary outcome?				

[a] *Questions added as considered relevant to the topic area of this review.*

CASE SERIES			Y	N	CT	Comments
	Is the study based on a representative sample selected from a relevant population?					
	Are criteria for inclusion explicit?					
	Did all individuals enter the survey at a similar point in their disease progression?					
	If comparisons of subseries are being made, was there sufficient description of the series and the distribution of prognostic factors?					
	Is there adequate description of potential confounding variables (series and subseries)? (OHS = oral health status)	Age[a]				
		Sex[a]				
		OHS[a]				
		Access[a]				
		Diet[a]				
		Socio[a]				
		Fluoride[a]				
		Tobacco[a]				
		Ethnicity[a]				
[a]	Were groups (subseries) treated equally except for the intervention?					
	Was follow-up long enough for the outcome(s) to occur? (Please state outcome(s) and length of follow-up.)					
	Were outcomes assessed using objective criteria or was blinding used?					
[a]	Was the intervention assessed using objective criteria?					

continued

contd

[a]	What proportion of the series was followed up?				
[a]	Were point estimates and measures of variability presented for the primary outcome?				

[a]*Questions added as considered relevant to the topic area of this review.*

[a]**CROSS-SECTIONAL**			Y	N	CT	Comments
	Is the study based on a representative sample selected from a relevant population?					
	Are criteria for inclusion explicit?					
	Is there adequate description of potential confounding variables? (OHS = oral health status)	Age[a]				
		Sex[a]				
		OHS[a]				
		Access[a]				
		Diet[a]				
		Socio[a]				
		Fluoride[a]				
		Tobacco[a]				
		Ethnicity[a]				
	Were groups treated equally except for the intervention?					
	Was the intervention assessed using objective criteria?					
	Were outcomes assessed using objective criteria or was blinding used?					
	Were point estimates and measures of variability presented for the primary outcome?					

[a]Quality check-list developed using methodological issues relevant more generally to observational studies.

(C) DATA EXTRACTION

POPULATION	**Group 1 (freq)**	**Group 2 (freq)**	**Group 3 (freq)**	**Group 4 (freq)**	**Comments**
Child (<18 y) Adult (≥18 y) Both					
Age (range/mean and SD)					
Source of sample(s)					
Country of origin of sample(s)					
Number in sample *n* (%)					
Sex (M:F)					
Diet					
Socio					
Fluoridated area (Y/N)					
Tobacco use					
Ethnicity					
Previous/current oral health status (e.g. previous caries experience)					
Medical conditions (Yes (which?)/No/NS)					
Access to intervention (dental check)[a]					
Exclusion criteria (specify)					

[a]Is there information on the population coverage/attendance? Is the service free at the point of use to some/all users? These data are regarded as a descriptor of the population and will be compared with dental attendance patterns in the UK for the purposes of the report.

Note: Please enter text/detail where available rather than ticking boxes.

INTERVENTION (dental check)		**Group 1 (freq)**	**Group 2 (freq)**	**Group 3 (freq)**	**Group 4 (freq)**	**Comments**
Frequency (/12)						
How were frequencies of check determined? (e.g. population policy or individualised) If individualised, based on what factors?						
Check performed by whom?						
Clinical exam. Please indicate if performed and details if available	Charting					
	Soft tissues					
	Perio.					
Advice Please indicate if performed and details if available						
Radiographic investigation Please indicate if performed and details if available						
Other Please indicate if performed and details if available						

OUTCOME (mean, SE, *p*, CI)		Group 1 (freq)		Group 2 (freq)		Group 3 (freq)		Group 4 (freq)		Comments
Decayed teeth (Please insert frequencies of follow-up in months)	D	/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
Decayed teeth	d	/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
Missing teeth	M	/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
Missing teeth	m	/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		

OUTCOME (mean, SE, *p*, CI)		**Group 1 (freq)**		**Group 2 (freq)**		**Group 3 (freq)**		**Group 4 (freq)**		**Comments**
Filled teeth (Please insert frequencies of follow-up in months)	F	/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
Filled teeth	f	/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
Decayed, missing, filled teeth (Note: record as proportion of individuals with DMFT >0)	DMFT	/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
decayed, missing, filled teeth	dmft	/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		

OUTCOME (mean, SE, *p*, CI)		Group 1 (freq)		Group 2 (freq)		Group 3 (freq)		Group 4 (freq)		Comments
Untreated caries (Please insert frequencies of follow-up in months)		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
Number of teeth (dentate individuals)		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
Oral cancer		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		

OUTCOME (mean, SE, *p*, CI)		**Group 1 (freq)**		**Group 2 (freq)**		**Group 3 (freq)**		**Group 4 (freq)**		**Comments**
Periodontal (Please insert frequencies of follow-up in months)	Probing depth	/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
	Attachment level	/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
	Other perio. outcome	/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
Behaviour change		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		

OUTCOME (mean, SE, *p*, CI)		Group 1 (freq)		Group 2 (freq)		Group 3 (freq)		Group 4 (freq)		Comments
QoL (Please insert frequencies of follow-up in months)		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
Adverse		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
Other outcome(s) reported		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
		/12		/12		/12		/12		
Follow-up time (Is it likely that modifying factors (risk factors or technology) will have changed over the period of the study?)										
Losses to follow-up (*n* (%))										

NOTES: Outcome measurement: Specify method of measurement used in comments, particularly regarding objectivity/standardised measurement.
For differences over time of the mean difference, SE, *p*, CI as available

Appendix 3

Full text articles retrieved for review of effectiveness but excluded, with reasons for exclusion

Articles excluded from the review of effectiveness

These are listed in *Table 1*, pp. 96–98.

Articles excluded from the review of previous economic evaluations

Three articles identified from the search strategy were excluded after detailed assessment:

Crowley SJ, Campain AC, Morgan MV. An economic evaluation of a publicly funded dental prevention programme in regional and rural Victoria: an extrapolated analysis. *Community Dent Health* 2000;**17**:145–51. (Preventive strategy based on sealants)

Downer MC, Jullien JA, Speight PM. An interim determination of health gain from oral cancer precancer screening: 3. Preselecting high risk individuals. *Community Dent Health* 1998;**15**:72–6. (Cost–utility modelling: opportunistic programmes being assessed)

Wang NJ, Riordan PJ. Recall intervals, dental hygienists and quality of dental care. *Community Dent Oral Epidemiol* 1995;**23**:8–14. (No resources or costs reported)

TABLE 1 *Full text articles retrieved for review of effectiveness but excluded, with reasons for exclusion*

Reference	Title	Reason for exclusion
Abidoye *et al.,* 1993[73]	Dietary habits and dental assessment of suburban and rural children in Nigeria	Population under study not subject to a dental check/dental check not subject of study
Axelsson *et al.,* 1991[53]	On the prevention of caries and periodontal disease. Results of a 15-year longitudinal study in adults	Content (as opposed to frequency) of dental check differs between comparison groups
Boggs and Schork, 1975[89]	Determination of optimal time lapse for recall of patients in an incremental dental care program	Date of the majority of data collection ≤1980
Brennan *et al.,* 2000[45]	Service provision patterns by main diagnoses and characteristics of patients	Population under study not subject to a dental check/dental check not subject of study
Curvers, 1989[76]	Dietary habits, attitudes toward dental health care and tooth-caries in children with a different cultural and socio-economic status	Population under study not subject to a dental check/dental check not subject of study
Davies *et al.,* 1998[84]	A longitudinal study of the dental care of adults in the General Dental Service in Scotland: the first 6 years, 1988–1994	No primary or secondary outcomes reported
Dawson and Smales, 1992[103]	The influence of examination frequency and changing dentist on dental treatment provision in an Australian defence force population	No primary or secondary outcomes reported
Deery *et al.,* 1999[80]	The dental caries status of Scottish adolescents reported to be regular attenders. Initial results from a primary dental care based research network	Comparison groups subject to dental checks of the same frequency
Downer *et al.,* 1998[106]	An interim determination of health gain from oral cancer and precancer screening: 3. Preselecting high risk individuals	Comparison groups subject to dental checks of the same frequency
Eerola *et al.,* 1998[99]	Oral health examination intervals among Finnish children and adolescents. Report of an expert group.	Review of literature with no reporting of primary data
Elderton, 1983[40]	Longitudinal study of dental treatment in the General Dental Service in Scotland	Population under study not subject to a dental check/dental check not subject of study
Feldman *et al.,* 1988[59]	The Rural Dental Health Program: long-term impact of two dental delivery systems on children's oral health	Content (as opposed to frequency) of dental check differs between comparison groups
Frame *et al.,* 2000[77]	Preventive dentistry: Practitioners' recommendations for low-risk patients compared with scientific evidence and practice guidelines	Population under study not subject to a dental check/dental check not subject of study
Guggenheimer *et al.,* 1989[101]	Factors delaying the diagnosis of oral and oropharyngeal carcinomas	Population under study not subject to a dental check/dental check not subject of study
Holst and Schuller, 2000[46]	Oral health changes in an adult Norwegian population: a cohort analytical approach	Population under study not subject to a dental check/dental check not subject of study

continued

TABLE 1 contd *Full text articles retrieved for review of effectiveness but excluded, with reasons for exclusion*

Reference	Title	Reason for exclusion
Hugoson *et al.*, 1986[63]	Oral health of individuals aged 3–80 years in Jonkoping, Sweden, in 1973 and 1983. I: A review of findings on dental care habits and knowledge of oral health	No primary or secondary outcomes reported
Jalevik *et al.*, 1999[47]	Evaluation of three years of dental care of adolescents in the Public Dental Service in west Sweden	Failure to contact authors concerning dental attendance frequencies under study
Klimm *et al.*, 1991[51]	[The oral health of an East German population of a large city. The basic research of the Dresden prevention study on 2500 16- to 35-year-olds]	Failure to contact authors concerning dental attendance frequencies under study
Klimm *et al.*, 1994[107]	[Preventive-curative dental care in a large East German urban population. The 4-year experiences of a Dresden prevention study with 16- to 35-year-old subjects]	Failure to contact authors concerning dental attendance frequencies under study
Lalloo and Solanki, 1994[79]	An evaluation of a school-based comprehensive public oral health care programme	Population under study not subject to a dental check/dental check not subject of study
Leclercq and Barmes, 1990[55]	International collaborative studies in oral health: a practical illustration of WHO research policy	Population under study not subject to a dental check/dental check not subject of study
Listgarten *et al.*, 1989[86]	Comparative longitudinal study of 2 methods of scheduling maintenance visits: 4-year data	Comparison groups subject to dental checks of the same frequency
Marcenes and Sheiham, 1992[75]	The relationship between work stress and oral health status	Failure to contact authors concerning dental attendance frequencies under study
Milen *et al.*, 1981[70]	Caries of primary teeth and regularity of dental check-ups	Date of the majority of data collection ≤1980
Nithila *et al.*, 1998[78]	WHO global data bank, 1986–96: an overview of oral health surveys at 12 years of age	Population under study not subject to a dental check/dental check not subject of study
Nuttall, 1984[95]	The cost of General Dental Service treatment for dentate adults in Scotland	No primary or secondary outcomes reported
Nuttall, 1996[104]	Correlates of dental health behaviour and outcome	Population under study not subject to a dental check/dental check not subject of study
Nuttall, 1997[96]	Review of attendance behaviour	No primary or secondary outcomes reported
Petersen, 1983[87]	Dental visits and self-assessment of dental health status in the adult Danish population	Date of the majority of data collection ≤1980
Petersen, 1983[69]	Dental visits, dental health status and need for dental treatment in a Danish industrial population	Date of the majority of data collection ≤1980

continued

TABLE 1 contd *Full text articles retrieved for review of effectiveness but excluded, with reasons for exclusion*

Reference	Title	Reason for exclusion
Petersen and Pederson, 1984[68]	Socioeconomic demand model for dental visits	Date of the majority of data collection ≤1980
Rosen *et al.*, 1999[81]	Effect of different frequencies of preventive maintenance treatment on periodontal conditions. 5-Year observations in general dentistry patients	Population under study not subject to a dental check/dental check not subject of study
Seppa *et al.*, 1991[52]	Effect of intensified caries prevention on approximal caries in adolescents with high caries risk	Content (as opposed to frequency) of dental check differs between comparison groups
Sgan-Cohen *et al.*, 1993[74]	Periodontal status among adult immigrants from rural Ethiopia	Population under study not subject to a dental check/dental check not subject of study
Smith and Nugent, 1994[102]	Social characteristics of Scottish adults in relation to dental registration and attendance	Population under study not subject to a dental check/dental check not subject of study
Tubert-Jeannin *et al.*, 1998[82]	Evaluation of a dental benefit plan for children conducted in Auvergne, France, since 1992	Content (as opposed to frequency) of dental check differs between comparison groups
Walker *et al.*, 1982[72]	Contrasting patterns of caries profile and dental treatment in pupils of 16-18 years in South African ethnic groups	Population under study not subject to a dental check/dental check not subject of study
Wang, 1994[105]	Variation in clinical time spent by dentist and dental hygienist in child dental care	Population under study not subject to a dental check/dental check not subject of study
Waurick *et al.*, 1985[66]	[The Leipzig ICS-I-Study. Dental care and selection of the random sample]	Population under study not subject to a dental check/dental check not subject of study
Wennstrom *et al.*, 1993[50]	Periodontal conditions of adult regular dental care attendants. A 12-year longitudinal study	Content (as opposed to frequency) of dental check differs between comparison groups
Widstrom, 1984[67]	Dental visiting patterns of Finns and Swedes in Sweden, 1976–1980	No primary or secondary outcomes reported

Appendix 4

Systematic review of effectiveness: additional outcomes reported by included studies

TABLE 11 *Deciduous dentition: caries treatment measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Extractions	Fillings	Pulpotomies	Root treatments
Ketomaki and Luoma, 1993[100(b)]	Retrospective cohort	***Total 901:***	***1–7 y***	***Dental checks:***	***Mean no./person/y over 6 y:***	***Mean no./person/y over 6 y:***		***Mean no./person/y:***
		569		≥ every 12/12	0	0.3		0
		134		< every 12/12; (3–5 checks over 6 y)	0	0.3		0
		86		< every 24/12; (2–3 checks over 6 y)	0	0.4		0
		112		Every 72/12 (1 check in 6 y)	0	1.2		0
Riordan, 1995[88]	Cross-sectional studies conducted yearly over 14 y; 12/14 years' data included		***6 y***	***Mean frequency of checks/y of study:***	***Extractions performed/1000 individuals:***	***Fillings performed/1000 individuals:***	***Pulpotomies performed/1000 individuals:***	
		121,406		7.1/12	179	900	142	
		137,324		6.9/12	128	800	122	
		151,206		6.6/12	90	645	40	
		160,083		7.9/12	82	560	35	
		187,337		8.8/12	80	525	33	
		191,641		9.9/12	76	500	32	
		215,484		10.6/12	80	450	32	
		222,767		10.9/12	83	440	33	
		224,830		11.4/12	84	445	32	
		230,871		12.0/12	90	450	32	
		239,438		12.7/12	82	430	30	
		240,145		12.8/12	81	430	31	

Tests of statistical significance were not reported and could not be calculated by the authors

TABLE 12 *Mixed deciduous and permanent dentition: caries treatment measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Extractions	Fillings			Pulpotomies	Root treatments
Ketomaki and Luoma, 1993[100(c)]	Controlled trial	***Total 1177:***		***Dental checks:***		***Mean no. 1-surface fillings/person/3 y:***	***Mean no. 2-surface fillings/person/3 y:***	***Mean no. fissure sealants/person/3 y:***		
		28	12	Every 12/12		0.29	0.21	0.79		
		100	11			0.31	0.08	1.07		
		90	10			0.28	0.22	0.37		
		123	9			0.15	0.23	0.13		
		122	8			0.31	0.34	0.19		
		118	7			0.34	0.24	0.81		
		81	6			0.32	0.33	1.47		
		46	3			0.35	0.09	0.02		
		708	3–12	Individualised according to caries risk (range 3–24/12)		0.29	0.23	0.59		
		67	12			0.31	0.06	0.66		
		72	11			0.35	0.03	0.61		
		76	10			0.52	0.12	0.51		
		71	9			0.49	0.23	0.21		
		57	8			0.79	0.14	0.38		
		49	7			0.51	0.08	0.82		
		37	6			0.65	0.30	1.43		
		40	3			0.20	0.03	0.18		
		469	3–12			0.48	0.12	0.56		

(NS), (NS), (NS), (NS), (NS), *, *, *, *, *

* $p \leq 0.05$ *between frequencies*
NS, no significant difference between frequency groups
Unless indicated in the table, tests of statistical significance were not reported and could not be calculated by the authors

TABLE 13 *Permanent dentition: caries treatment measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Extractions	Fillings	Pulpotomies	Root treatments	Fissure sealants
Ketomaki and Luoma, 1993[100(b)]	Retrospective cohort	***Total 1065:***	***15 y followed to 21 y***	***Dental checks:***	***Mean no./person/y:***			***Mean no./person/y:***	
		647		≥ every 12/12	<0.1			<0.1	
		162		< every 12/12; (3–5 checks over 6 y)	<0.1			<0.1	
		104		< every 24/12; (2–3 checks over 6 y)	<0.1			<0.1	
		152		Every 72/12 (1 check in 6 y)	<0.1			<0.1	
		Total 714:	***19 y followed to 25 y***						
		307		≥ every 12/12	<0.1			<0.1	
		163		< every 12/12; (3–5 checks over 6 y)	<0.1			<0.1	
		88		< every 24/12; (2–3 checks over 6 y)	0.1			≤0.1	
		156		Every 72/12 (1 check in 6 y)	0.2			0.1	
		Total 574:	***22–23 y followed to 28–29 y***						
		166		≥ every 12/12	<0.1			0.1	
		50		< every 12/12; (3–5 checks over 6 y)	<0.1			<0.1	
		57		< every 24/12; (2–3 checks over 6 y)	<0.1			<0.1	
		301		Every 72/12 (1 check in 6 y)	0.1			0.2	

continued

TABLE 13 contd *Permanent dentition: caries treatment measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	Extractions	Fillings			Pulpotomies	Root treatments	Fissure sealants
Nuttall, 1984[94]	Prospective cohort	***Total 504:***	***Adults ≥18 y:***	***Dental checks "attendance pattern":***	***Mean no. teeth extracted/person/5 y:***	***Average no. fillings/person/5 y:***					
						Total:	***New:***	***Refill:***			
		116	Mean 35.4	Frequent attender: ≥ check every 18/12	0.6	18.4	4.6	13.8			
		388	Mean 33.7	Infrequent: at least 1 dental check in 5 y (<60/12), but not as frequently as once every 18/12	1.4	9.5	3.7	5.9			
Riordan, 1995[88]	Cross-sectional studies conducted yearly over 14 y; 12/14 years' data included		***8–12 y:***	***Mean frequency of dental checks/y of study:***	***Extractions performed/1000 individuals:***	***Fillings performed/1000 individuals:***					***Fissure sealants performed/ 1000 individuals:***
		121,406	8–12	7.1/12	31	615					Not recorded
		137,324	8–12	6.9/12	29	610					Not recorded
		151,206	8–12	6.6/12	20	380					200
		160,083	8–12	7.9/12	18	280					320
		187,337	8–12	8.8/12	19	240					380
		191,641	8–12	9.9/12	18	205					480
		215,484	8–12	10.6/12	20	150					445
		222,767	8–15	10.9/12	24	140					420
		224,830	8–15	11.4/12	28	160					370
		230,871	8–15	12.0/12	26	160					380
		239,438	8–15	12.7/12	28	190					370
		240,145	8–15	12.8/12	26	180					300

Tests of statistical significance were not reported and could not be calculated by the authors

TABLE 14 *Deciduous dentition: general treatment measures*

Reference	Study design	*n*	Age	Intervention frequency (/12)	No. treatments	Time spent (minutes)
Ketomaki and Luoma, 1993[100(b)]	Retrospective cohort	***Total 901:***	***1–7 y***	***Dental checks:***	***Mean no./person/y:***	
		569		≥ every 12/12	1.8	
		134		< every 12/12 (3–5 checks over 6 y)	1.6	
		86		< every 24/12 (2–3 checks over 6 y)	1.2	
		112		Every 72/12 (1 check in 6 y)	3.6	
Wang *et al.*, 1992[37]	Controlled trial	***Total 58:***	***3–5 y***	***Dental checks:***		***Time spent (minutes) over 2 y: mean (SD):***
		27		Every 12/12		Examination time: 39 (5.7) Treatment time: 13 (28.1) Total time: 52 (30.2)
		31		Every 24/12		Examination time: 23 (6.3) * Treatment time: 18 (29.5) Total time: 42 (34.7) *

* $p \leq 0.05$ *between frequencies*
SD, standard deviation; NS, no significant difference between frequency groups
Unless indicated in the table, tests of statistical significance were not reported and could not be calculated by the authors

TABLE 15 *Mixed deciduous and permanent dentition: general treatment measures*

Reference	Study design	*n*	Age	Intervention frequency (/12)	No. treatments	Time spent (minutes)
Lunder, 1994[93]	Controlled trial	***Total 45***	***7 y, followed to 13 y***	***Dental checks:***		***Total time spent over 6 y (minutes):***
				Every 12/12		Examination 102 Risk assessment 12 Preventive treatment 86 Other treatment 26
				Every 18/12	(NS)	Examination 71 *** Risk assessment 14 Preventive treatment 82 Other treatment 15

continued

TABLE 15 contd *Mixed deciduous and permanent dentition: general treatment measures*

Reference	Study design	*n*	Age	Intervention frequency (/12)	No. treatments	Time spent (minutes)
Wang and Holst, 1995[90]	Prospective cohort	***Total 1885–2031: varied according to outcome measured:***	***4–18 y***	***Dental checks:***		***Time spent (minutes)/treatment course (examination and subsequent treatment, excluding orthodontics): mean (SD):***
		2031 2020		≤ every 12/12 Mean 12.5 (SD 3.6) Range 3/12–14/12		Dentist: 49 (55) Standardised to 12/12: 53 (67) Hygienist: 9 (17) Standardised to 12/12: 8 (18)
		Total 1885: dentist		***Individualised according to clinical judgement:*** ***No new decay, every 18/12*** ***New decay, low risk, every 2/12*** ***High risk, < every 12/12***		***Time spent (minutes)/treatment course (examination and subsequent treatment, excluding orthodontics): mean (SD):***
						Dentist: 44 (58) Standardised to 12/12: 45 (63)
		240		< every 11/12		54 (56)
		1187		Every 11–16/12		47 (63)
		391		Every 17–20/12		33 (40)
		67		> every 20/12		55 (67)
		Total 1885: hygienist				***Hygienist time (minutes): mean (SD):***
						Hygienist: 11 (16) Standardised to 12/12: 10 (21)
		240		< every 11/12		13 (20)
		1187		Every 11–16/12		9 (15)
		391		Every 17–20/12		8 (13)
		67		> every 20/12		5 (11)

* $p \leq 0.05$ *between frequencies*
*** $p \leq 0.01$ *between frequencies*
SD, standard deviation; NS, no significant difference between frequency groups
Unless indicated in the table, tests of statistical significance were not reported and could not be calculated by the authors

TABLE 16 *Permanent dentition: general treatment measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	No. treatments	Time spent (minutes): mean (SD)
Ketomaki and Luoma, 1993[100(b)]	Retrospective cohort	***Total 1065:***	***15 y, followed to 21 y***	***Dental checks:***	***Mean no./person/y:***	
		647		≥ every 12/12	3.3	
		162		< every 12/12 (3–5 checks over 6 y)	3.1	
		104		< every 24/12 (2–3 checks over 6 y)	2.3	
		152		Every 72/12 (1 check in 6 y)	3.5	
		Total 714:	***19 y, followed to 25 y***			
		307		≥ every 12/12	3.4	
		163		< every 12/12 (3–5 checks over 6 y)	3.2	
		88		< every 24/12 (2–3 checks over 6 y)	2.1	
		156		Every 72/12 (1 check in 6 y)	4.4	
		Total 574:	***22–23 y, followed to 28–29 y***			
		166		≥ every 12/12	4.5	
		50		< every 12/12 (3–5 checks over 6 y)	3.3	
		57		< every 24/12 (2–3 checks over 6 y)	2.8	
		301		Every 72/12 (1 check in 6 y)	6.2	

continued

TABLE 16 contd *Permanent dentition: general treatment measures*

Reference	Study design	*n*	Age (y)	Intervention frequency (/12)	No. treatments	Time spent (minutes): mean (SD)
Wang *et al.*, 1992[37]	Cross-sectional	***Total 127:***	***16–20 y:***	***Dental checks:***		***Time spent (minutes) over 2 y: mean (SD):***
		43	16–18	Every 12/12		Examination time: 49 (10.3) Treatment time: 32 (53.2) Total time: 89 (63.3)
		35	16–18	Every 24/12		Examination time: 28 (4.9) Treatment time: 31 (44.5) Total time: 71 (65.4)
		23	18–20	Every 12/12		Examination time: 57 (9.6) Treatment time: 22 (44.7) Total time: 81 (50.2)
		26	18–20	Every 24/12		Examination time: 30 (5.8) Treatment time: 20 (29.1) Total time: 51 (30.0)

* $p \leq 0.05$ *between frequencies*
SD, standard deviation; NS, no significant difference between frequency groups
Unless indicated in the table, tests of statistical significance were not reported and could not be calculated by the authors

Deciduous dentition: caries treatment measures

(extractions, fillings, pulpotomies, root treatments: *Table 11*)

Two studies investigated the relationship between dental check frequency and caries treatment measures in deciduous dentition. Neither study reported tests of statistical significance and so only limited conclusions can be drawn. One study reported a trend for an increasing number of fillings and one other reported a trend for a decrease in the number of fillings with a decrease in dental check frequency. One study demonstrated a trend for a decrease in the number of extractions and pulpotomies associated with a decrease in dental check frequency. However, the magnitude of the reduction in treatments in one study was not consistently related to the magnitude of change in dental check frequency, suggesting that external factors were influencing treatment practice over the 14 years that the study was conducted.

Mixed dentition: caries treatment measures

(fillings, fissure sealants: *Table 12*)

One study investigated the relationship between dental check frequency and caries treatment measures in mixed dentition. A significant increase in the number of one-surface fillings, a significant decrease in the number of two-surface fillings, and a significant decrease in the number of fissure sealants performed in 11-year-olds was demonstrated with individualised compared with a blanket 12-month dental check recall policy.

Permanent dentition: caries treatment measures

(fillings, extractions, root treatments, fissure sealants: *Table 13*)

Three studies investigated the relationship between dental check frequency and caries treatment measures in permanent dentition. None reported tests of statistical significance, so only limited conclusions can be drawn.

One study demonstrated a trend for an increase in extractions with a decrease in dental check frequency, while another demonstrated a decrease followed by an increase in extractions with a decrease in dental check frequency. Two demonstrated a trend for a decrease in the number of fillings performed with a decrease in check frequency. Two studies reported inconsistent findings in relation to the number of root treatments performed, and the number of fissure sealants performed with a decrease in dental check frequency.

Deciduous dentition: general treatment measures

(examination time, number of treatments performed: *Table 14*)

Two studies investigated the relationship between dental check frequency and general treatment measures in deciduous dentition. One demonstrated a significant decrease in examination time and total professional time, but no significant difference in treatment time with a decrease in dental check frequency from 12 to 24 months. One study reported a trend of uncertain statistical significance for a decrease in the number of treatments performed when check frequency was decreased from 12 to 24 months, followed by a rise in the number of treatments performed with a further reduction in dental check frequency from 24 to 72 months.

Mixed dentition: general treatment measures

(examination time, risk assessment time, prevention time, treatment time: *Table 15*)

Two studies investigated the relationship between dental check frequency and general treatment measures in mixed dentition. One demonstrated a significant decrease in examination time but no significant change in time taken for risk assessment, preventive treatment or other treatment measures with a decrease in dental check frequency from 12 months to 18 months. One study showed a significant decrease in the mean time spent on treatment by dentists, but a significant increase in the time spent on treatment by hygienists, with an individualised compared with a blanket 12-month dental check recall policy.

Permanent dentition: general treatment measures

(examination time, total time, number of treatments performed: *Table 16*)

Two studies investigated the relationship between dental check frequency and general treatment measures in permanent dentition. One demonstrated a significant decrease in examination time and total time spent (treatment and examination) but no significant decrease in treatment time with a decrease in dental check frequency from 12 to 24 months. One study showed a trend for a decrease in the number of treatments performed with a decrease in dental check frequency from 12 to 24 months, followed by a rise in treatments performed with a further reduction in dental check frequency from 24 to 72 months. However, this result is of uncertain significance.

Appendix 5

Sensitivity analyses for economic modelling

Note: In the main text, *Tables 41* and *42* (pp. 64–65) fall between *Tables 24* and 25 (pp. 110–111) and between *Tables 32* and *33* (pp. 118–119).

TABLE 24 *Results for deciduous dentition (hazard rate = 0.3, 100% restoration survival over 6 y)*

Frequency of dental checks	Cost/patient over 6 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
36-monthly	23.70	17.98
24-monthly	26.60	18.35
18-monthly	30.90	18.53
12-monthly	40.60	18.71
6-monthly	71.80	18.91
3-monthly	136.00	19.03
Manual and fluoridated:		
36-monthly	20.70	18.49
24-monthly	24.70	18.68
18-monthly	29.40	18.79
12-monthly	39.50	18.91
6-monthly	71.10	19.05
3-monthly	135.40	19.13
Non-manual and non-fluoridated:		
36-monthly	19.70	18.66
24-monthly	24.00	18.81
18-monthly	28.80	18.89
12-monthly	39.00	18.99
6-monthly	70.70	19.10
3-monthly	135.20	19.17
Non-manual and fluoridated:		
36-monthly	17.90	18.95
24-monthly	22.70	19.03
18-monthly	27.80	19.08
12-monthly	38.20	19.14
6-monthly	70.10	19.21
3-monthly	134.70	19.25

TABLE 25 *Results for deciduous dentition (hazard rate = 0.3, 50% restoration survival over 3 y)*

Frequency of dental checks	Cost/patient over 6 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
36-monthly	29.70	17.98
24-monthly	32.90	18.35
18-monthly	37.10	18.53
12-monthly	46.40	18.71
6-monthly	76.90	18.91
3-monthly	140.70	19.03
Manual and fluoridated:		
36-monthly	25.20	18.49
24-monthly	29.70	18.68
18-monthly	34.40	18.79
12-monthly	44.30	18.91
6-monthly	75.50	19.05
3-monthly	139.60	19.13
Non-manual and non-fluoridated:		
36-monthly	23.60	18.66
24-monthly	28.50	18.81
18-monthly	33.40	18.89
12-monthly	43.40	18.99
6-monthly	74.90	19.10
3-monthly	139.10	19.17
Non-manual and fluoridated:		
36-monthly	21.00	18.95
24-monthly	26.40	19.03
18-monthly	31.50	19.08
12-monthly	41.90	19.14
6-monthly	73.70	19.21
3-monthly	138.20	19.25

TABLE 26 *Results for deciduous dentition (hazard rate = 0.15, 100% restoration survival over 6 y)*

Frequency of dental checks	Cost/patient over 6 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
36-monthly	17.00	19.10
24-monthly	21.70	19.21
18-monthly	26.70	19.26
12-monthly	37.20	19.31
6-monthly	69.30	19.36
3-monthly	133.90	19.38
Manual and fluoridated:		
36-monthly	16.00	19.28
24-monthly	20.90	19.34
18-monthly	26.10	19.37
12-monthly	36.70	19.41
6-monthly	68.90	19.44
3-monthly	133.60	19.45
Non-manual and non-fluoridated:		
36-monthly	15.60	19.35
24-monthly	20.60	19.40
18-monthly	25.80	19.42
12-monthly	36.40	19.44
6-monthly	68.70	19.47
3-monthly	133.40	19.48
Non-manual and fluoridated:		
36-monthly	14.90	19.47
24-monthly	20.10	19.49
18-monthly	25.30	19.51
12-monthly	36.00	19.52
6-monthly	68.30	19.53
3-monthly	133.10	19.54

TABLE 27 *Results for deciduous dentition (hazard rate = 0.15, 50% restoration survival over 6 y)*

Frequency of dental checks	Cost/patient over 6 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
36-monthly	18.60	19.10
24-monthly	23.30	19.21
18-monthly	28.40	19.26
12-monthly	38.80	19.31
6-monthly	70.80	19.36
3-monthly	135.40	19.38
Manual and fluoridated:		
36-monthly	17.20	19.28
24-monthly	22.30	19.34
18-monthly	27.40	19.37
12-monthly	38.00	19.41
6-monthly	70.10	19.44
3-monthly	134.80	19.45
Non-manual and non-fluoridated:		
36-monthly	16.70	19.35
24-monthly	21.80	19.40
18-monthly	27.10	19.42
12-monthly	37.70	19.44
6-monthly	69.90	19.47
3-monthly	134.60	19.48
Non-manual and fluoridated:		
36-monthly	15.80	19.47
24-monthly	21.10	19.49
18-monthly	26.40	19.51
12-monthly	37.10	19.52
6-monthly	69.40	19.53
3-monthly	134.10	19.54

TABLE 28 *Results for deciduous dentition (hazard rate = 0.15, 50% restoration survival over 3 y)*

Frequency of dental checks	Cost/patient over 6 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
36-monthly	19.70	19.10
24-monthly	24.60	19.21
18-monthly	29.70	19.26
12-monthly	40.10	19.31
6-monthly	72.10	19.36
3-monthly	136.70	19.38
Manual and fluoridated:		
36-monthly	18.10	19.28
24-monthly	23.30	19.34
18-monthly	28.60	19.37
12-monthly	39.20	19.41
6-monthly	71.40	19.44
3-monthly	136.00	19.45
Non-manual and non-fluoridated:		
36-monthly	17.50	19.35
24-monthly	22.80	19.40
18-monthly	28.10	19.42
12-monthly	38.80	19.44
6-monthly	71.00	19.47
3-monthly	135.70	19.48
Non-manual and fluoridated:		
36-monthly	16.40	19.47
24-monthly	21.90	19.49
18-monthly	27.30	19.51
12-monthly	38.00	19.52
6-monthly	70.40	19.53
3-monthly	135.10	19.54

TABLE 29 *Results for deciduous dentition (hazard rate = 0.45, 100% restoration survival over 6 y)*

Frequency of dental checks	Cost/patient over 6 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
24-monthly	31.90	17.46
18-monthly	35.00	17.82
12-monthly	44.00	18.13
6-monthly	74.20	18.49
3-monthly	137.70	18.73
Manual and fluoridated:		
36-monthly	25.50	17.68
24-monthly	28.40	18.05
18-monthly	32.70	18.23
12-monthly	42.20	18.43
6-monthly	73.10	18.69
3-monthly	136.90	18.87
Non-manual and non-fluoridated:		
36-monthly	23.50	18.00
24-monthly	27.20	18.30
18-monthly	31.80	18.40
12-monthly	41.50	18.60
6-monthly	72.60	18.80
3-monthly	136.60	18.90
Non-manual and fluoridated:		
36-monthly	20.50	18.51
24-monthly	25.20	18.60
18-monthly	30.10	18.68
12-monthly	40.20	18.78
6-monthly	71.70	18.93
3-monthly	135.10	19.03

TABLE 30 *Results for deciduous dentition (hazard rate = 0.45, 50% restoration survival over 6 y)*

Frequency of dental checks	Cost/patient over 6 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions:
Manual and non-fluoridated:		
24-monthly	37.40	17.46
18-monthly	40.20	17.82
12-monthly	48.50	18.13
6-monthly	78.00	18.49
3-monthly	140.90	18.73
Manual and fluoridated:		
36-monthly	29.60	17.68
24-monthly	32.70	18.05
18-monthly	36.80	18.23
12-monthly	46.00	18.43
6-monthly	76.30	18.69
3-monthly	139.80	18.87
Non-manual and non-fluoridated:		
36-monthly	26.90	18.00
24-monthly	31.00	18.30
18-monthly	35.40	18.40
12-monthly	44.90	18.60
6-monthly	75.60	18.80
3-monthly	139.30	18.90
Non-manual and fluoridated:		
36-monthly	23.10	18.51
24-monthly	28.20	18.60
18-monthly	33.10	18.68
12-monthly	43.10	18.78
6-monthly	74.30	18.93
3-monthly	138.30	19.03

TABLE 31 *Results for deciduous dentition (hazard rate = 0.45, 50% restoration survival over 3 y)*

Frequency of dental checks	Cost/patient over 6 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
24-monthly	41.90	17.46
18-monthly	44.50	17.82
12-monthly	52.60	18.13
6-monthly	81.50	18.49
3-monthly	144.10	18.73
Manual and fluoridated:		
36-monthly	32.40	17.68
24-monthly	36.00	18.05
18-monthly	40.20	18.23
12-monthly	49.30	18.43
6-monthly	79.30	18.69
3-monthly	142.50	18.87
Non-manual and non-fluoridated:		
36-monthly	29.40	18.00
24-monthly	34.00	18.30
18-monthly	38.50	18.40
12-monthly	48.00	18.60
6-monthly	78.40	18.80
3-monthly	141.90	18.90
Non-manual and fluoridated:		
36-monthly	24.90	18.51
24-monthly	30.50	18.60
18-monthly	35.60	18.68
12-monthly	45.60	18.78
6-monthly	76.70	18.93
3-monthly	140.70	19.03

TABLE 32 *Results for permanent dentition (hazard rate = 0.37, 50% restoration survival over 6 y)*

Frequency of dental checks	Cost/patient over 68 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
18-monthly	293.20	16.33
24-monthly	306.50	15.04
12-monthly	309.10	16.90
36-monthly	372.50	11.94
6-monthly	388.70	17.04
3-monthly	577.90	17.26
Manual and fluoridated:		
24-monthly	261.70	16.32
18-monthly	264.50	16.79
36-monthly	271.70	14.72
12-monthly	286.80	16.99
6-monthly	369.70	17.13
3-monthly	562.70	17.45
Non-manual and non-fluoridated:		
24-monthly	263.30	16.28
18-monthly	265.70	16.78
36-monthly	274.90	14.61
12-monthly	287.80	16.98
6-monthly	370.60	17.12
3-monthly	563.40	17.44
Non-manual and fluoridated:		
36-monthly	223.10	16.17
24-monthly	233.00	16.78
18-monthly	241.50	16.96
12-monthly	266.80	17.06
6-monthly	353.20	17.27
3-monthly	550.20	17.68

TABLE 33 *Results for permanent dentition (hazard rate = 0.37, 50% restoration survival over 24 y)*

Frequency of dental checks	Cost/patient over 68 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
24-monthly	147.70	15.04
18-monthly	153.30	16.33
36-monthly	165.10	11.94
12-monthly	181.20	16.90
6-monthly	278.00	17.04
3-monthly	483.90	17.26
Manual and fluoridated:		
36-monthly	128.30	14.72
24-monthly	132.30	16.32
18-monthly	143.60	16.79
12-monthly	173.60	16.99
6-monthly	271.50	17.13
3-monthly	478.70	17.45
Non-manual and non-fluoridated:		
36-monthly	129.50	14.61
24-monthly	132.90	16.28
18-monthly	144.00	16.78
12-monthly	173.90	16.98
6-monthly	271.80	17.12
3-monthly	478.90	17.44
Non-manual and fluoridated:		
36-monthly	110.30	16.17
24-monthly	122.20	16.78
18-monthly	135.60	16.96
12-monthly	166.60	17.06
6-monthly	265.80	17.27
3-monthly	474.30	17.68

TABLE 34 *Results for permanent dentition (hazard rate = 0.185, 50% restoration survival over 6 y)*

Frequency of dental checks	Cost/patient over 68 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
36-monthly	193.30	16.75
24-monthly	200.00	17.04
18-monthly	207.40	17.15
12-monthly	232.00	17.32
6-monthly	322.50	17.75
3-monthly	526.50	18.20
Manual and fluoridated:		
36-monthly	168.60	17.03
24-monthly	179.60	17.20
18-monthly	189.40	17.33
12-monthly	216.60	17.55
6-monthly	311.30	17.99
3-monthly	518.40	18.38
Non-manual and non-fluoridated:		
36-monthly	169.60	17.02
24-monthly	180.50	17.19
18-monthly	190.10	17.32
12-monthly	217.30	17.53
6-monthly	311.80	17.98
3-monthly	518.80	18.38
Non-manual and fluoridated:		
36-monthly	149.00	17.24
24-monthly	162.70	17.40
18-monthly	174.50	17.55
12-monthly	204.00	17.78
6-monthly	302.20	18.20
3-monthly	511.70	18.53

TABLE 35 *Results for permanent dentition (hazard rate = 0.185, 50% restoration survival over 12 y)*

Frequency of dental checks	Cost/patient over 68 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
36-monthly	133.20	16.75
24-monthly	141.90	17.04
18-monthly	152.70	17.15
12-monthly	181.00	17.32
6-monthly	278.00	17.75
3-monthly	486.20	18.20
Manual and fluoridated:		
36-monthly	118.30	17.03
24-monthly	129.90	17.20
18-monthly	142.20	17.33
12-monthly	172.10	17.55
6-monthly	271.60	17.99
3-monthly	481.70	18.38
Non-manual and non-fluoridated:		
36-monthly	118.90	17.02
24-monthly	130.50	17.19
18-monthly	142.60	17.32
12-monthly	172.50	17.53
6-monthly	271.90	17.98
3-monthly	481.90	18.38
Non-manual and fluoridated:		
36-monthly	106.40	17.24
24-monthly	120.00	17.40
18-monthly	133.50	17.55
12-monthly	164.80	17.78
6-monthly	266.40	18.20
3-monthly	477.90	18.53

TABLE 36 *Results for permanent dentition (hazard rate = 0.185, 50% restoration survival over 24 y)*

Frequency of dental checks	Cost/patient over 68 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
36-monthly	99.10	16.75
24-monthly	110.30	17.04
18-monthly	123.40	17.15
12-monthly	154.40	17.32
6-monthly	255.10	17.75
3-monthly	466.10	18.20
Manual and fluoridated:		
36-monthly	89.70	17.03
24-monthly	102.90	17.20
18-monthly	116.90	17.33
12-monthly	148.90	17.55
6-monthly	251.20	17.99
3-monthly	463.30	18.38
Non-manual and non-fluoridated:		
36-monthly	90.10	17.02
24-monthly	103.20	17.19
18-monthly	117.20	17.32
12-monthly	149.20	17.53
6-monthly	251.30	17.98
3-monthly	463.40	18.38
Non-manual and fluoridated:		
36-monthly	82.20	17.24
24-monthly	96.60	17.40
18-monthly	111.50	17.55
12-monthly	144.40	17.78
6-monthly	248.00	18.20
3-monthly	461.00	18.53

TABLE 37 *Results for permanent dentition (hazard rate = 0.555, 50% restoration survival over 6 y)*

Frequency of dental checks	Cost/patient over 68 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
12-monthly	363.70	16.00
18-monthly	393.50	13.20
6-monthly	434.50	17.00
24-monthly	476.90	10.90
3-monthly	621.30	17.00
Manual and fluoridated:		
18-monthly	324.40	15.46
12-monthly	333.80	16.66
24-monthly	348.30	13.69
6-monthly	414.40	16.99
3-monthly	602.50	17.08
Non-manual and non-fluoridated:		
18-monthly	326.70	15.38
12-monthly	335.00	16.64
24-monthly	352.50	13.57
6-monthly	415.30	16.99
3-monthly	603.40	17.07
Non-manual and fluoridated:		
24-monthly	263.30	16.28
18-monthly	265.70	16.78
36-monthly	274.90	14.61
12-monthly	287.80	16.98
6-monthly	370.60	17.12
3-monthly	563.40	17.44

TABLE 38 *Results for permanent dentition (hazard rate = 0.555, 50% restoration survival over 12 y)*

Frequency of dental checks	Cost/patient over 68 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
12-monthly	255.10	16.00
18-monthly	257.60	13.20
24-monthly	300.00	10.90
6-monthly	341.30	17.00
3-monthly	539.60	17.00
Manual and fluoridated:		
18-monthly	219.60	15.46
24-monthly	227.50	13.69
12-monthly	238.80	16.66
6-monthly	330.10	16.99
3-monthly	529.10	17.08
Non-manual and non-fluoridated:		
18-monthly	220.90	15.38
24-monthly	229.90	13.57
12-monthly	239.50	16.64
6-monthly	330.60	16.99
3-monthly	529.50	17.07
Non-manual and fluoridated:		
36-monthly	191.50	14.12
24-monthly	192.40	15.66
18-monthly	199.10	16.44
12-monthly	225.90	16.89
6-monthly	319.30	17.03
3-monthly	519.60	17.18

TABLE 39 *Results for permanent dentition (hazard rate = 0.555, 50% restoration survival over 24 y)*

Frequency of dental checks	Cost/patient over 68 y (£)	Effectiveness (no. teeth free from decay, fillings or extractions)
Manual and non-fluoridated:		
18-monthly	185.00	13.20
12-monthly	198.60	16.00
24-monthly	203.60	10.90
6-monthly	293.30	17.00
3-monthly	498.70	17.00
Manual and fluoridated:		
18-monthly	185.00	13.20
12-monthly	198.60	16.00
24-monthly	203.60	10.90
6-monthly	293.30	17.00
3-monthly	498.70	17.00
Non-manual and non-fluoridated:		
24-monthly	163.10	13.57
18-monthly	164.30	15.38
12-monthly	189.80	16.64
6-monthly	287.00	16.99
3-monthly	492.60	17.07
Non-manual and fluoridated:		
36-monthly	135.20	14.12
24-monthly	140.90	15.66
18-monthly	151.60	16.44
12-monthly	181.80	16.89
6-monthly	280.20	17.03
3-monthly	486.60	17.18

Appendix 6

Calculation of average transition costs

Cost per transition: deciduous dentition

This section attempts to make an estimate of the average cost of transition from a state when dmft is 0–1, or 1–2 etc., in deciduous teeth in children.

The General Dental Service statement of remuneration (Amendment 87, April 2001; item 4401)[34] allows payment of a fee of £6.30 for the restoration of deciduous teeth at the beginning of a course of treatment. Deciduous restorations are usually covered by the capitation fee and not subject to fee-for-item claims. No information is publicly available about the numbers of deciduous restorations that are undertaken in children under capitation arrangements, and, because no claim is involved, the Dental Practice Board will not hold this information. It is expected that the fee quoted above is calculated as a realistic cost and will therefore be used as a proxy.

Cost per transition: permanent dentition

This section attempts to make an estimate of the cost of transition from a state where decayed or unsound teeth increase by 1, from 0 to 1, or from 1 to 2, in permanent teeth in adults. The General Dental Service statement of remuneration (Amendment 87, April 2001)[34] allows the following payments for restorations (includes a patient charge element for non-exempt patients):

1401	One surface amalgam filling	£6.80
1402	Two or more surfaces amalgam filling	£10.10
1403	Two or more surfaces amalgam filling (includes mesio-occlusal or disto-occlusal)	£13.30
1404	Three or more surfaces amalgam filling (includes mesio-occlusal or disto-occlusal)	£17.60
1421	Composite fillings	£12.85

Other fees are possible for restorative treatment, but the above codes are used because they are probably the most common.

The average cost of a filling is not known, so the possible cost of a transition from one state to the next is estimated by the average of the above fees (i.e. £12.13). A simple extraction of a single tooth (code 2101) is £6.30 with £5.15 allowed for each extraction visit. Consequently, a simple extraction at £11.45 would be slightly cheaper than restoration. Some teeth would require additional costs for surgical extraction and some would require increased fees for root filling, crowns etc. It would seem that using the estimate of £12.13 would be the minimum cost of transition.

Summary

Estimated cost per transition state in children	£6.30
Estimated cost per transition state in adults	£12.13

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We look forward to hearing from you.

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