Dental Recall: recall interval between routine dental examinations
Second Draft

National Collaborating Centre for Acute Care

29 April 2004

Acknowledgements

Guideline Development Group

Professor Nigel Pitts	Chair, Dental Health Services Research Unit, University of Dundee
Dr Paul Batchelor	British Association for the Study of Community Dentistry
Dr Jan Clarkson	Cochrane Oral Health Group
Dr Clare Davenport	West Midlands Health Technology Assessment Collaboration
Mr Ralph Davies	British Dental Association
Miss Karen Elley	Sandwell Primary Care Trusts
Mr Stephen Fayle	Faculty of Dental Surgery, Royal College of Surgeons of England
Mrs Eleanor Grey	Patient Representative, Lay Advisory Group, Faculty of General Dental Practitioners, UK
Miss Kathryn Harley	Faculty of Dental Surgery, Royal College of Surgeons of England
Miss Sara Hawksworth	Patient Representative, Age Concern England
Professor Mike Lewis	University of Wales College of Medicine
Mr Peter Lowndes	Faculty of General Dental Practitioners
Mr Mike Mulcahy	Faculty of General Dental Practitioners
Mr Derek Richards	Centre for Evidence Based Dentistry
Mr Richard Seppings	British Dental Association
Dr Graham Smart	Faculty of Dental Surgery
Mrs Elaine Tilling	British Dental Hygienists Association
Mr Peter Wilkins	Faculty of General Dental Practitioners
Professor Helen Worthington	Cochrane Oral Health Group

Staff who worked on the guideline:

Dr Paul Beirne	Research Fellow, Oral Health Services Research Centre, University College Cork
Dr Jacqueline Dutchak	Director, NCC-AC
Dr Ian Needleman	International Centre for Evidence-Based Periodontal Health, Department of Periodontology, Eastman Dental Institute, University College London
Ms Guldem Okem	Health economist, NCC-AC
Mr Carlos Sharpin	Information scientist and reviewer, NCC-AC
Ms Louise Thomas	Research Associate, NCC-AC
Mr David Wonderling	Health economist, NCC-AC

Conflict of interests

The Guideline Development Group were asked to declare any possible conflict of interest and none that could interfere with their work on the guideline were declared. All documentation is held by the National Collaborating Centre for Acute Care.

Acknowledgements

The development of this guideline was greatly assisted by the following people: Jennifer Wood (Office Administrator, NCC-AC), Gerry Cooney (medical writer), the Cochrane Oral Health Group, the Oral Health Services Research Centre (University Dental School and Hospital, Cork), Jane Cowl (Patient Involvement Unit).

Stakeholder involvement

The following stakeholders commented on draft versions of these guidelines:

[Most up to date list to be inserted after consultation].

Abbreviations used in Guideline

AIDS	-	Acquired Immune Deficiency Syndrome
BPE	-	Basic Periodontal Examination
CDS	-	Community Dental Service
CEA	-	Cost Effectiveness Analysis
COHG	-	Cochrane Oral Health Group
DMF	-	Decayed Missing Filled
DMFS	-	Decayed Missing Filled Surfaces
DFS	-	Decayed Filled Surfaces
DMFT	-	Decayed Missing Filled Teeth
DPB	-	Dental Practice Board
DT	-	Decayed Teeth
DS	-	Decayed Surfaces
EBV	-	Epstein Barr Virus
FGDP	-	General Dental Practitioners
FT	-	Filled Teeth
GDG	-	Guideline Development Group
GDS	-	General Dental Service
GP	-	General Practitioner
GPP	-	Good Practice Point
HPV	-	Human Papilloma Virus
HSV	-	Herpes Simplex Virus
HTA	-	Health Technology Assessment
ICD	-	International Classification of Diseases
NCC-AC	-	National Collaborating Centre for Acute Care
HEED	-	Health Economic Evaluations Database
NHS	-	National Health Service
HMIC	-	Health Management Information Consortium
NICE	-	National Institute for Clinical Excellence
NeLH	-	National electronic Library for Health
NHANES III	-	The Third National Health and Nutrition Examination Survey
NHS	-	National Health Service
NHS HEED	-	NHS Economic Evaluations Database
NZGG	-	New Zealand Guidelines Development Group
OFT	-	Office of Fair Trading
OHA	-	Oral Health Assessment
OHR	-	Oral Health Review
OR	-	Odds Ratio
OSMF	-	Oral Submucous fibrosis
PDS	-	Personal Dental Service
PCT	-	Primary Care Trusts
RCT	-	Randomised Control Trial
SHA	-	Strategic Health Authorities
SIGN	-	Scottish Intercollegiate Guideline Network
SIGLE	-	System for Information on Grey Literature in Europe
SOHSI	-	Subjective Oral Health Status Indicators
UK	-	United Kingdom

1 Introduction

1.1 Background

Analysis of dental attendance patterns using the Dental Practice Board's longitudinal data has demonstrated that attendance behaviour in NHS primary dental care is variable and that many patients attend less frequently than six monthly. However, six monthly dental check-ups have been customary in the General Dental Service (GDS) in the United Kingdom since the inception of the National Health Service (NHS). Although a recall interval of six months is not explicitly recommended by the NHS, current regulations implicitly recognise this practice by remunerating dental practitioners for providing six-monthly check-ups. In addition, registration with an NHS dentist lapses if the interval between check-ups is greater than 15 months (Davenport et al. 2003).

In recent years there has been significant debate over the timing of recall intervals for dental check-ups. In the strategy document '*Modernising NHS Dentistry – Implementing the NHS Plan*' (Department of Health 2000) it was argued that a blanket six-monthly recall policy was too rigid and that patients should be recalled at intervals matching their individual needs more closely. Furthermore, the government explicitly stated its intention to examine the evidence for changing working practices '*including more flexible recall intervals for routine examinations, to ensure the most appropriate treatment and care for patients*' (Department of Health 2000). This view has been reiterated in a more recent assessment of primary care dental services by the Audit Commission, which suggested that evidence-based criteria should be introduced to determine the best check-up attendance interval for each individual patient (Audit Commission 2002).

The 'recall interval debate' has also coincided with an important period of change in the NHS dental services in England and Wales. The strategy document "NHS Dentistry: Options for Change" (Department of Health 2002) and subsequent legislation are bringing about changes in the organisation of dental services, the remuneration of dentists and the way in which oral health is assessed. The new proposed 'gateway to NHS dentistry' is through a standard Oral Health Assessment (OHA) available to all. Under the new arrangements a comprehensive Oral Health Assessment will comprise three elements: diagnosis, prevention and initial treatment planning.

These changes are collectively intended to encourage the transition from a restorative-centred approach to the delivery of dental care towards a more preventive-oriented and clinically effective way of meeting patient needs (Pitts 2003). The recommendations contained in this guideline are intended to complement the latter approach and as such should be seen as an integral part of the evolution of NHS Dentistry.

Taking into account these new arrangements, this guideline has adopted the term 'Oral Health Review' (OHR) to refer to the reassessment of the oral

health status of an individual following a specified time interval after either i) an Oral Health Assessment if no treatment is needed or ii) the completion of an agreed journey of care. This guideline focuses on providing guidance for clinicians on assigning recall intervals between Oral Health Reviews.

Unfortunately, there is a paucity of reliable scientific evidence in relation to this area of dental practice. A report published by the West Midlands Health Technology Assessment Collaboration (hereafter referred to as the HTA Report) systematically reviewed the effectiveness of routine dental checks of different recall frequencies in adults and children (Davenport et al. 2003). The authors found limited evidence of poor overall quality and concluded that there was no high quality evidence to either support or refute the current practice of encouraging six-monthly dental checks in children and adults. An 'update' of this review (presented in Chapter Two of this guideline) also highlights the lack of high quality research to inform clinical practice on assigning recall intervals.

Further primary research is warranted in order to assess the relative effectiveness of different recall intervals for dental check-ups. However, in the absence of such evidence, it has been suggested that the period between check-ups should be based on a professional assessment of an individual patient's risk of or from oral disease (Health Development Agency 2001).

For many years, it has been argued in the scientific literature that a risk-based assessment of an individual patient's dental history and oral health status is an important prerequisite for treatment planning and the delivery of appropriate preventive care and advice. This risk assessment is an important part of contemporary dental practice and is a process that dental professionals typically engage in every day of their working lives when examining patients, albeit in a somewhat informal and intuitive fashion. This guideline capitalises on clinicians' efforts to tailor care to meet the needs of patients by advocating the adoption of a formal risk-based procedure for determining recall intervals for individual patients at a specific point in time. In the traditions of evidence-based practice, this process incorporates the best available scientific evidence, the individual clinical judgement and expertise of dental personnel and takes into consideration the values and expectations of patients.

The recommendations contained in this guideline are intended to assist clinicians in selecting recall intervals between Oral Health Reviews (OHRs) that are appropriate to the needs of individual patients. Patients should be informed that a single 'set' recall interval for their entire lives may not be deemed appropriate and that the recall interval may vary over time to take into account any changes in their level of risk of or from oral disease.

1.2 What is a guideline?

Guidelines are recommendations for the care of individuals in specific clinical conditions or circumstances – from prevention and self-care though primary and secondary care to more specialised services. Clinical guidelines are based on the best available evidence, and are produced to help health care professionals and patients make informed choices about appropriate health care. While guidelines assist the practice of healthcare professionals, they do not replace their knowledge and skills.

Clinical guidelines for the NHS in England and Wales are produced as a response to a request from the Department of Health and the Welsh Assembly Government. They select topics for guideline development and before deciding whether to refer a particular topic to the National Institute for Clinical Excellence (NICE) they consult with the relevant patient bodies, professional organisations and companies. Once a topic is referred, NICE then commissions one of seven National Collaborating Centres to produce a guideline. The Collaborating Centres are independent of government and comprise partnerships between a variety of academic institutions, health profession bodies and patient groups.

1.3 Remit of the Guideline

The following remit was received from the Department of Health and the Welsh Assembly Government in May 2002 as part of the Institute's 7th wave programme of work:

"To prepare guidance for the NHS in England and Wales on the clinical and cost-effectiveness of a dental recall examination for all patients at an interval based on the risk from oral disease"

The recommendations in this guideline were arrived at following careful consideration of the available evidence. Where the scientific evidence needed to answer key clinical questions was either of poor quality, inconsistent or non-existent, recognised methods for developing consensus were used.

1.4 What the guideline covers

The guideline includes recommendations for the optimal recall frequency for routine dental checks for patients of all ages (both dentate and edentulous patients) and covers primary care received from NHS dental staff (dentists, independent contractors contracting within the NHS, dental hygienists and therapists) practicing in England and Wales. The guideline takes into account the potential of the patient and the dental team to improve or maintain the quality of life and to reduce morbidity associated with oral and dental disease.

In arriving at recommendations, the impact of dental checks on patients' well-being, general health and preventive habits; caries incidence and avoiding restorations; periodontal health and avoiding tooth loss; and avoiding pain and anxiety have been considered.

1.5 What the guideline does not cover

The guideline does not cover intervals between dental examinations that are not routine dental recalls; that is, intervals between examinations related to ongoing courses of treatment, or part of current dental interventions.

The guideline does not cover emergency dental interventions, or intervals between episodes of specialist care.

The guideline does not cover the prescription and timing of dental radiographs. Guidance on selection criteria for dental radiographs has been developed in the UK by the Faculty of General Dental Practitioners (Faculty of General Dental Practitioners 1998) and is currently being updated.

This guideline does not consider recall intervals for routine scale and polish treatments. Although the provision of a scale and polish following a recall examination is common practice in primary dental care settings, the frequency of dental check-ups does not have to be directly linked to the frequency of scaling and polishing. A systematic review of this area is currently being conducted by the Cochrane Oral Health Group (COHG).

Finally, although this guidance is focussed at the level of the individual patient, it is important that efforts should continue to promote broader population-based strategies for preventing dental disease and improving oral health, an area outside the scope for this guideline.

1.6 Who developed the guideline?

A multidisciplinary Guideline Development Group (GDG) comprising professional group members (including several practising dentists) and consumer representatives of the main stakeholders developed this guideline (see Acknowledgements). The National Institute for Clinical Excellence funds the National Collaborating Centre for Acute Care and thus supported the development of this guideline. The GDG was convened by the National Collaborating Centre for Acute Care (NCC-AC) and Chaired by Professor Nigel Pitts. In accordance with the NICE guideline development process (National Institute for Clinical Excellence 2001), all guideline development group members have made and updated any declarations of interest. The Group met on a monthly basis during development of the guideline.

Staff from the NCC-AC, the COHG (Manchester), and the Oral Health Services Research Centre (University College Cork, Ireland) provided methodological support and guidance for the development process, undertook systematic searches, retrieval and appraisal of the evidence and drafted the guideline. Staff were also assisted by the Director of the International Centre for Evidence-Based Periodontal Health at the Eastman Dental Institute, University College London.

The Glossary to the guideline contains definitions of terms used by staff and the GDG.

1.7 Guideline Methodology

1.7.1 Outline of methods used

There were several steps involved in the development of these guidelines:

- Systematic review of the literature – to 'update' the previous Health Technology Assessment review on the clinical effectiveness and cost-effectiveness of routine dental checks (Davenport et al. 2003)
- Review of background literature relating to oral diseases, patient views and the effectiveness of oral health promotion. Modelling of cost-effectiveness of different recall intervals
- Use of formal and informal consensus methods for a variety of tasks, including clarifying questions addressed by the guideline andmaking guideline recommendations

1.7.2 Questions addressed in developing the guideline

The GDG established that, for the purposes of developing the guideline, two groups of questions would need to be examined: key clinical questions specifying the populations, interventions, comparisons and outcomes of interest; and background and epidemiology questions including: rate of progression of oral diseases, advice and preventive measures against oral diseases and patient views and expectations of their dentist and dental treatment. Please see Appendix A for a full list of these questions.

1.7.2.1 Key Clinical Questions

In relation to the key clinical questions, an update of the HTA Report was undertaken. The aim of this update was to review any additional evidence published between February 2001 (the date of completion of the HTA search) and July 2003 (the date of completion of NCC-AC search) judged to be of relevance in addressing the original questions posed in the HTA review, namely:

(a) 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?

(b) 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?

The updated review sought to replicate the methods adopted in the original HTA review. In this context, similar study populations, interventions, comparators and outcomes of interest were specified.

1.7.3 Systematic Review Methods for Key Clinical Questions

1.7.3.1 Types of study population

The populations considered (in both the HTA Report and our updated review) were children and adults. These populations were further sub-divided according to dentition type: deciduous dentition, mixed dentition, permanent dentition and edentulous. The updated review explicitly recognised edentulous patients as a population category.

1.7.3.2 Types of interventions

The intervention considered was a 'routine dental check' as defined in the NHS General Dental Service Statement of Remuneration: "Clinical examination, advice charting (including monitoring of periodontal status) and report. In practice it proved impossible to apply the intervention inclusion criteria (in both the HTA Report and our updated reviews) as 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.' In describing the results of this updated review the term 'dental check' has been used throughout to embrace these different terms.

1.7.3.3 Types of comparators

The comparator was 'no routine dental check' (as defined above) or routine dental check of different frequency.

1.7.3.4 Types of Outcomes

The outcomes of interest were divided into:

- Primary Outcomes: Caries, periodontal disease, oral cancer and quality of life
- Secondary Outcomes: Mucosal lesions, behaviour change, need for orthodontic treatment.

In the updated review, erosion and tooth surface loss were included as secondary outcomes of interest. However, we found no relevant studies that reported these particular outcome measures.

1.7.3.5 Types of Studies

There was no restriction on study design and all observational epidemiological study designs were included.

1.7.3.6 Literature Search

The literature review for our guideline was designed to find references published since the completion of searching for the HTA Report in February 2001. The search terms used in the HTA Report and some additional key words were used to form the basis of the search strategy. Search filters for systematic reviews, randomised controlled trials and other observational studies were combined with this to retrieve quality studies. No language

restrictions were applied to the search. The search strategies of the following databases are included in Appendix B.

- Medline (Ovid) 2001 - 17 July 2003
- Embase (Ovid) 2001 - week 29 2003
- The Cochrane Library 2001 up to Issue 3, 2003
-

We searched the System for Information on Grey Literature in Europe (SIGLE) and Health Management Information Consortium (HMIC) for reports, and we searched for guidelines and consensus documents on the guideline web sites listed below. Bibliographies of identified reports and guidelines were also checked to identify relevant literature.

- Canadian Medical Association Infobase (http://mdm.ca/cpgsnew/cpgs/)
- National Institute of Clinical Excellence (NICE) (http://www.nice.org.uk)
- National electronic Library for Health (NeLH) (http://www.nelh.nhs.uk/)
- National Institutes of Health Consensus Development Program (http://www.consensus.nih.gov)
- New Zealand Guidelines Development Group (NZGG) (http://www.nzgg.org.nz/)
- Scottish Intercollegiate Guideline Network (SIGN) (http://www.sign.ac.uk)
- US National Guideline Clearing House (http://www.guidelines.gov)

1.7.3.7 Selecting studies

Two reviewers independently scanned the titles and abstracts of the observational studies in order to identify potentially relevant studies. They excluded papers that were considered definitely irrelevant. We obtained full publications for any studies identified by one or both reviewers as being of potential relevance to the review or where there was insufficient information from the title and abstract to make a decision. Two reviewers applied the inclusion criteria to all potentially relevant studies and any disagreements were resolved by discussion. No formal analysis of agreement between the reviewers was performed.

1.7.3.8 Data extraction

One reviewer carried out the data extraction process. Data extracted from each study regarding the patient population, intervention, comparators and outcomes were used to construct two summary tables: a ‘Key Study Characteristics’ table and an ‘Effectiveness table.’

1.7.3.9 Quality Assessment

Two reviewers carried out the quality assessment of eligible studies using similar appraisal checklists to those used in the HTA Report (Davenport et al. 2003). The checklists were specific to study design with a view to capturing design-specific biases. Attempts to control for selection biases through adjustment for potential confounders were assessed.

As this guideline is intended to inform practice in the NHS in England and Wales, the external validity of the results of studies carried out in settings other than the UK was also considered as part of the assessment.

1.7.4 Hierarchy of evidence

There are many different methods of ranking the evidence and there has been considerable debate about what system is best. A number of initiatives are currently under way to find an international consensus on the subject, but until a decision is reached on the most appropriate system, for the NICE guidelines the Institute advises the National Collaborating Centres to use the system for evidence shown in Table 1.

Table 1: Levels of evidence for intervention studies*

Level of evidence	Type of evidence
1++	High-quality meta-analyses, systematic reviews of RCTs, or RCTs with a very low risk of bias
1+	Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias
1-	Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias
2++	High-quality systematic reviews of case–control or cohort studies High-quality case–control or cohort studies with a very low risk of confounding, bias, or chance and a high probability that the relationship is causal
2+	Well-conducted case–control or cohort studies with a low risk of confounding, bias, or chance and a moderate probability that the relationship is causal
2-	Case–control or cohort studies with a high risk of confounding bias, or chance and a significant risk that the relationship is not causal
3	Non-analytic studies (for example, case reports, case series)
4	Expert opinion

*Reproduced with kind permission of the Scottish Intercollegiate Guidelines Network

1.7.5 Health economics methods

It is important to investigate whether dental health services are clinically effective and also cost-effective (that is, value for money). If, hypothetically, frequent Oral Health Reviews (OHRs) were found to yield little health gain, relative to the resources used, then we would be better off by having less frequent OHRs and re-deploying resources to other activities that yield greater health gain.

1.7.5.1 Literature review

We obtained published economic evidence on different recall intervals for OHR from a systematic search of the following databases:

- Medline (Ovid) (2001-2003)

- Embase (2001-2003)
- Health Economic Evaluations Database (HEED)
- NHS Economic Evaluations Database (NHS EED)

We also identified and reviewed relevant references in the bibliographies of reviewed papers including those from the HTA Report. We did not conduct original searches of Medline and Embase prior to 2001 as this would duplicate the systematic searches of the HTA Report.

The strategy was designed to find any applied economic study related to different dental recall intervals. The health economist reviewed abstracts and database reviews of papers, and discarded those that appeared not to contain any original data on cost or cost-effectiveness and where the analysis was not incremental (and was not described adequately to allow incremental analysis).

1.7.5.2 Cost-effectiveness modelling

The cost-effectiveness analysis contained in the HTA Report was the most relevant to this guideline because it estimated both incremental cost and incremental health gain for a number of different recall intervals from a UK NHS perspective. The model represented a promising start to research in this area, but it did have three major limitations:

- the report does not state what assumptions / data were used in the model that would lead to oral health being greater with narrower recall intervals
- it considered only dental caries prevention and no other aspects of oral health
- the outcome used for health gain in dental caries prevention (in the model for adults it was number of DMFT-free teeth at age 80) was not ideal.

On the basis of this guideline's systematic review a modified model was constructed that would improve on limitations one and three. However, the incorporation of other aspects of oral health (limitation two) was not possible because of the lack of suitable data and also the absence of an overall measure of health outcome.

1.7.6 Forming and grading the recommendations

NICE guideline recommendations are graded according to the strength of the supporting evidence, which is assessed from the design of each study (see Table 1). The grading system currently used is presented in Table 2.

The Guideline Development Group was presented with the summaries (text and evidence tables) of the best available research evidence to answer their questions. Recommendations were based on, and explicitly linked to, the evidence that supported them.

The Group worked, where possible, on an informal consensus basis. Formal consensus methods (modified Delphi techniques or nominal group technique) were employed if required (for example, agreeing recommendations and audit

criteria). The recommendations were then graded according to the level of evidence upon which they were based.

Table 2 Grading of recommendations**

Grade	Evidence
A	• At least one meta-analysis, systematic review, or RCT rated as 1++, and directly applicable to the target population, or • A systematic review of RCTs or a body of evidence consisting principally of studies rated as 1+, directly applicable to the target population, and demonstrating overall consistency of results
B	• A body of evidence including studies rated as 2++, directly applicable to the target population, and demonstrating overall consistency of results, or • Extrapolated evidence from studies rated as 1++ or 1+
C	• A body of evidence including studies rated as 2+, directly applicable to the target population and demonstrating overall consistency of results, or • Extrapolated evidence from studies rated as 2++
D	• Evidence level 3 or 4, or Extrapolated evidence from studies rated as 2+
NICE	Evidence drawn from NICE guidelines, technology appraisals, or guidance and advice on interventional procedures
Good practice point (GPP)	Recommended good practice based on the clinical experience of the Guideline Development Group
**Adapted with kind permission of the Scottish Intercollegiate Guidelines Network	

2 Clinical effectiveness and cost-effectiveness of routine dental checks (HTA update)

In order to inform the guideline development process, the GDG decided that it was essential to identify and assess systematically the evidence for the clinical effectiveness of routine dental checks of different recall frequencies. As a systematic review addressing this issue had recently been carried out and published as a Health Technology Assessment (HTA) Report (Davenport et al. 2003), it was decided that an 'update' of this Report should be undertaken. The aim of this exercise was to review any additional evidence published since the date of completion of the HTA search judged to be of relevance in addressing the original clinical effectiveness questions posed in the HTA Report, namely:

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?

The updated review sought to replicate the methods adopted in the HTA Report. In this context, similar study populations, interventions, comparators and outcomes of interest were specified. The methods used are described in chapter one.

2.1 Characteristics of the Included Studies

2.1.1 Characteristics of the study settings and study design

See Appendix C for further details.

Thirteen studies were included in our updated review. Of these, there were three cohort/longitudinal studies (Chavers et al. 2002; Locker 2001; Thomson 2001), two case-control studies (Bullock et al. 2001; Lissowska et al. 2003), seven cross-sectional studies (Boehmer et al. 2001; Campus et al. 2001; Carvalho et al. 2001; Freire et al. 2002; Petersen et al. 2001; Ugur et al. 2002; Ullah et al. 2002) and one study that was described by the authors as a 'case study,' based on consecutive patients' responses to a dental health questionnaire administered over a six month period (Richards et al. 2002).

The included studies were conducted in a variety of different populations and settings. Only two studies (Bullock et al. 2001; Richards et al. 2002) were conducted in general dental practice settings in England and Wales. One of these studies (Bullock et al. 2001) was conducted in a mixed private/NHS practice in Stoke-on-Trent, North Staffordshire. The other study (Richards et al.

2002) was conducted in a general dental practice in an urban area of Swansea, South Wales.

Of the remaining studies, four were conducted in European countries (Campus et al. 2001; Carvalho et al. 2001; Lissowska et al. 2003; Ugur et al. 2002), two in the United States (Boehmer et al. 2001; Chavers et al. 2002), one in Brazil (Freire et al. 2002), one in Canada (Locker 2001), one in Southern Thailand (Petersen et al. 2001), one in New Zealand (Thomson 2001) and one in Bangladesh (Ullah et al. 2002).

Ten studies used a 'subjective' measure of dental check frequency and relied on reported attendance by participants, obtained either from self-administered questionnaires, questionnaires completed by parents/guardians or structured interviews (Boehmer et al. 2001, Campus et al. 2001, Carvalho et al. 2001, Chavers et al. 2002, Freire et al. 2002, Lissowska et al. 2003, Petersen et al. 2001, Thomson 2001, Ugur et al. 2002, Ullah et al. 2001). Only three studies used an 'objective' measure of dental check frequency and directly consulted clinical records to provide evidence of frequency of dental checks or gleaned information on patients' attendance patterns from their dentists (Bullock et al. 2001; Locker 2001; Richards et al. 2002).

2.1.2 Characteristics of the Participants

See Appendix C for further details.

The effects of dental check frequency were examined in a diverse range of age groups. The most common age group considered was 12-year olds, who formed the study population in four studies (Campus et al. 2001; Carvalho et al. 2001; Petersen et al. 2001; Ullah et al. 2002). In the remaining studies the participants varied in age from 13 (Ugur et al. 2002) to 80 (Lissowska et al. 2003) years. All the studies found looked at people with permanent dentition.

Access to dental care for the population under investigation was not stated in eight studies (Boehmer et al. 2001; Chavers et al. 2002; Freire et al. 2002; Lissowska et al. 2003; Locker 2001; Petersen et al. 2001; Ugur et al. 2002; Ullah et al. 2002). In only two studies (Bullock et al. 2001; Richards et al. 2002) could the participants and settings be assumed to be representative of the population groups and health care settings covered by this guideline. In both studies, participants were recruited opportunistically as they presented themselves at general dental practices. In the remaining studies where access was described (Campus et al. 2001; Carvalho et al. 2001; Thomson 2001), the dental health-care system was not comparable with that in England and Wales.

2.1.3 Characteristics of the Intervention and Comparisons

There was little information included in the studies on what a 'dental check' actually entailed (or could be presumed to entail). In most studies it was not clear

whether the relationship between frequency of dental checks or frequency of dental treatment and/or dental checks and oral health outcomes was being investigated. Where 'dental visiting' or 'dental attendance' patterns were being studied it proved impossible to distinguish between prevention oriented/motivated visits (for asymptomatic check-up) and treatment oriented/motivated visits for a specific problem, infection *etc.*

There was a diverse range of comparisons made in the included studies. The most common comparison made in studies was between the oral health status of 'regular' and 'irregular' attenders. However, different studies used different definitions of what was deemed to be 'regular' or 'irregular' attendance. The diversity of some of these definitions are illustrated in Table 3 below:

Table 3: Comparisons between 'regular' and 'irregular' attenders made in selected studies from the 'updated' HTA review

Study ID	"Regular Attenders"	"Irregular Attenders"
Bullock and co-workers, 2001	Attended for at least two dental examinations in past two years ('regular attender')	No dental attendance in past two years and who had attended in response to a dental problem ('casual attender')
Chavers and co-workers, 2002	Respondent described approach to dental care as "I go to a dentist occasionally, whether or not I have a problem" or "I go to a dentist regularly"	Respondent described approach to dental care as "I never go to a dentist" or "I go to a dentist when I have a problem or I know I need to get something fixed"
Richards and Ameen, 2002	Last attendance within the last two years	Last attendance more than two years ago
Ugur and Gaengler, 2002	Respondents reported regular visits every year to have their teeth examined	Respondents reported only going to the dentist if there was a 'tooth problem'
Ullah and co-workers, 2002	Respondent reported visiting the dentist more than once a year	Respondent reported visiting the dentist less than once a year

The 'irregular' category was thus used to encapsulate 'casual' or 'problem-oriented attenders.' The differing definitions of regular and irregular attendance used in the studies constituted another source of heterogeneity making comparisons between studies difficult.

See Appendix C for details of the comparisons made in the remaining included studies.

2.1.4 Outcomes

The 13 studies reported a diversity of clinical status outcomes for dental caries, periodontal disease and oral cancer, including: mean number of teeth present, mean DMFS, mean DFS increment, mean DMFT, decayed coronal surfaces, root caries, caries severity, dentinal caries on bitewing radiography, visual caries causing cavitation, periodontal treatment need, presence or absence of mobile teeth, oral hygiene, mean number of periodontally involved teeth, plaque scores, mucosa scores, oral cavity and pharynx cancer. Three studies used oral health related quality of life outcome measures (Chavers et al. 2002; Locker 2001; Richards et al. 2002).

Although a number of studies used the same outcome measures, because of poor reporting, it could not be assumed that the diagnostic criteria used in the studies were the same. The majority of studies reported outcomes in terms of mean changes in measures. A minority of studies reported changes in the proportion or number of individuals exhibiting a certain outcome.

2.1.5 Quality Assessment

We assessed the 13 included studies for internal and external validity. There was a preponderance of cross-sectional studies included in the updated review that are particularly susceptible to selection biases and confounding. The quality assessment of all studies focussed on various potential sources of bias, specifically selection bias, performance bias, attrition bias and measurement bias. All of the included studies were judged as having some threat to validity.

2.1.6 Data synthesis and analysis

We deemed quantitative pooling as inappropriate due to the considerable methodological and clinical heterogeneity of the 13 studies included in this updated review. The problems with defining the intervention, the range of dental check frequencies studied, the diverse comparisons made and the range of outcome measures used, precluded the provision of anything other than a narrative summary of the findings. No sensitivity analysis was undertaken in this updated review.

2.2 Results

In order to interpret the results of this updated review, the included studies must be considered in the context of the 28 studies included in the HTA Report (Davenport et al. 2003). In the sections that follow, the results of the HTA Report are first summarised narratively, the results of the updated review are then presented and a brief commentary is added as to whether the latter results have any impact on the conclusions of the former. The updated review only found studies concerning permanent teeth, consequently, the results are compared with the HTA Report results for permanent teeth only. Due to the considerable study heterogeneity, emphasis has been placed on the consistency of the direction of outcome of study results. There are obvious limitations associated with presenting the results of studies in this manner. In particular, it fails to reflect important differences between studies such as the different frequencies being compared for each single outcome and does not take into account salient aspects of study design. Nevertheless, such an approach can be used to summarise results of a group of observational studies and gives some indication (albeit a crude indication) of the consistency or lack of consistency of results.

Where the term ‘significant’ has been used in the following passages, it pertains only to the question of statistical significance and does not allude to the clinical significance or otherwise of the findings.

2.2.1 Outcome Measure: Number of teeth present

2.2.1.1 Results of the original HTA Report

Sixteen studies investigated the relationship between dental check frequency and number of teeth present. No study 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), 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 and three studies reported no significant difference between the number of teeth/surfaces and frequency of dental checks. (The term 'uncertain statistical significance' was used in the HTA Report where tests of statistical significance were not performed in individual studies and could not be calculated from available data.).

2.2.1.2 Results of updated review

The three studies reporting the mean number of teeth present demonstrated no consistency in the direction of outcomes. One study (Boehmer et al. 2001) reported a significant decrease in the number of teeth with a decrease in dental check frequency. One study (Bullock et al. 2001) reported no difference in the number of teeth present according to dental check frequency. One study (Richards et al. 2002) reported a significant increase in the number of teeth with a decrease in dental check frequency.

These studies, when considered in the context of the results of the HTA review, do not impact on the overall consistency of findings, namely that there was generally a decrease in the number of teeth present with a decrease in dental check frequency (Davenport et al. 2003).

2.2.2 Outcome Measure: DMFT/DMFS

2.2.2.1 Results of the original HTA Report

Eleven studies 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. Four reported a decrease in DMFT with a decrease in dental check frequency (two of which were significant differences) and two were of uncertain significance. Five studies reported no significant difference between DMFT and frequency of dental attendance.

2.2.2.2 Results of updated review

One study (Campus et al. 2001) reported no significant difference in DMFS scores according to dental check frequency (see list above for comparisons made), while another (Carvalho et al. 2001) reported a significant increase in mean DMFS score in symptomatic (appointment on pain) versus asymptomatic attenders. The latter study reported no significant differences between those who

reported a control visit once a year versus those who did not report a control visit once a year.

Petersen and co-workers reported a significant increase in mean DMFT in those who reported an annual dental visit versus those who reported no annual dental visit (Petersen et al. 2001), while Thomson reported that problem-oriented attenders had significantly higher mean DMFS and DFS increment scores compared with those who attended for a check-up (Thomson 2001).

Finally, one study reported no significant difference in mean DMFT comparing regular (more than once a year) versus irregular (less than once a year) attenders (Ullah et al. 2002). However, those who attended a dentist either regularly or irregularly, had significantly higher mean DMFT scores compared with those who reported never having attended a dentist.

2.2.3 Outcome Measure: Decayed Teeth (DT)/ Decayed Surfaces (DS)

2.2.3.1 Results of the original HTA Report

Fifteen studies investigated the relationship between dental check frequency and decay. Twelve reported an increase in decay with a decrease in dental check frequency (eight of which were significant differences and four of which were of uncertain significance). Two studies reported no significant difference between decay and frequency of dental checks. One study reported a significant association between dental check frequency and decay but the direction of the relationship was not given.

2.2.3.2 Results of updated review: Dental Caries

There was no consistency in the direction of outcomes in the four studies using these outcome measures.

One study reported no significant difference in the mean number of decayed coronal surfaces (comparing those who attended during last year with those who attended between one and two years ago) (Boehmer et al. 2001). However, both of the latter groups had significantly fewer decayed coronal surfaces compared with those who reported a last visit as two or more years ago.

One study reported no significant difference in the mean number of decayed surfaces according to dental check frequency across the four dental check frequency groups compared (Campus et al. 2001) (Appendix C for details of comparisons made) whilst another study reported a significant increase in the number of decayed teeth with a decrease in the dental check frequency (Ugur et al. 2002).

One study reported no significant differences in the mean number of decayed teeth between regular and irregular attenders (Ullah et al. 2002). However, those who reported attending either regularly or irregularly had significantly more

decayed teeth compared to whose who never attended a dentist (see Table 3 above for definitions of 'regular' and 'irregular' used in this study).

2.2.4 Outcome Measure: Filled Teeth (FT)

2.2.4.1 Results of the original HTA Report

The studies investigating the relationship between dental check frequency and filled teeth reported inconsistent findings. 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. Three studies reported no significant difference between filled teeth/surfaces and frequency of dental checks.

2.2.4.2 Results of updated review

One study reported no significant difference in the mean number of filled surfaces in the four dental check frequency groups compared (Campus et al. 2001) (see Appendix C for details of comparisons made), while another reported that irregular attenders had significantly fewer filled teeth when compared with regular attenders (Ugur et al. 2002) (see Table 3 for definitions of 'regular' and 'irregular').

2.2.5 Other caries outcome measures used in our updated review

2.2.5.1 Root Caries

One study reported significantly fewer untreated root caries lesions in those who reported attending the dentist during the last year compared with those who attended between one and two years ago and two or more years ago (Boehmer et al. 2001).

There were no significant differences in the mean number of untreated plus filled root caries lesions according to dental check frequency.

2.2.5.2 Missing teeth

One study found a significantly higher proportion of 'problem-oriented attenders' had more than one missing tooth due to caries by age 26 compared with 'routine attenders' (Thomson 2001) (see 'Appendix C for details of comparisons made). Similarly, Ugur and Gaengler reported significantly fewer missing teeth in regular attenders compared with irregular attenders (Ugur et al. 2002).

2.2.5.3 Visual Caries Causing Cavitation

One case-control study, comparing regular attenders with casual attenders, reported a significant increase in the proportion of subjects with visual caries causing cavitation with a decrease in dental check frequency (Bullock et al. 2001). The same study reported a significant increase in the proportion of subjects with dentinal caries on bite-wing radiographs with a decrease in dental check frequency. These differences persisted after adjusting for age, gender, social class and smoking.

2.2.5.4 Caries Severity

One study reported an increased risk of having a high caries severity among those who attended the dentist mainly when in trouble compared with those attending mainly for check-ups (Freire et al. 2002). Adolescents who reported never being to the dentist had a lower risk of high caries severity compared with those attending mainly for check-ups, although the numbers reporting no dental visits was very small.

Considering all dental caries outcomes included in the updated review in the context of the original HTA Report findings, there is no consistency in the direction of outcomes and no meaningful inferences can be drawn from the available data.

2.2.6 Periodontal Disease Outcomes

2.2.6.1 Results of the original HTA Report:

Nine observational studies investigated the relationship between dental check frequency and periodontal disease in the permanent dentition. The main findings are as follows:

Three studies investigating the relationship between dental check frequency and bleeding reported no consistency in the direction of outcomes. One study investigated the relationship between attachment level and dental check frequency and reported a significant decrease in the proportion of individuals with an attachment level of >3mm with an overall decrease in dental check frequency. Six studies investigated the relationship between probing depth/pockets and dental check frequency and reported no consistency in the direction of outcomes. Three studies investigated the relationship between plaque or calculus and dental check frequency and reported no consistency in the direction of outcomes. Two studies investigated the relationship between bone score and dental check frequency and reported no consistency in the direction of outcomes. Three studies investigated the relationship between the presence of gingivitis and frequency of dental checks and reported no consistency in the direction of outcomes. Three studies investigated the relationship between dental check frequency and periodontal health (the absence of gingivitis, periodontitis and calculus) and reported no consistency in the direction of outcomes.

2.3 Results of our updated review

One study reported a significantly increased mean periodontal treatment need for those who reported time since last dental visit as between one to two years ago, when compared with those who reported a visit during the last year (Boehmer et al. 2001). No significant difference in periodontal treatment need was found in this study when comparing those who reported their last dental visit between one and two years ago and those who reported that their last visit was two or more years ago.

Bullock and co-workers reported that a significantly greater proportion of casual attenders had >30% tooth bone loss and mobile teeth compared with regular attenders (see Table 3.1 above for definitions of 'regular' and 'casual') (Bullock et al. 2001) while Thomson reported a significant increase in mean plaque score in problem attenders versus those who reported that their usual reason for attending the dentist was for a check-up (Thomson 2001). One study reported that irregular attenders had significantly more periodontally involved teeth compared with regular attenders (Ugur et al. 2002).

Two studies, using different measures of periodontal disease, found no difference in outcomes with varying dental check frequency (Campus et al. 2001; Ullah et al. 2002).

In the updated review a number of studies used different outcomes to those included in the original HTA review. There was no consistency in the direction of outcomes.

Considering these results in the context of the original results of the HTA review does not alter the principal finding of the latter, namely that the results of studies investigating the relationship between dental check frequency and measures of periodontal disease in permanent dentition provide conflicting results.

2.3.1 Oral Cancer

2.3.1.1 Results of the original HTA Report

One study demonstrated a significant relationship between time since last dental check and tumour size at diagnosis, but it remained unclear whether there was a consistent (or linear) trend in outcome with decreasing dental check frequency. One study found no significant relationship between the presence or absence of a cancerous or potentially malignant lesion at examination and time since last dental check (< or = 12 months to >12 months).

2.3.1.2 Results of the updated review

One case control study found a significant association of risk with frequency of dental check-ups (Lissowska et al. 2003). Subjects who never had dental check-ups had an oral cancer risk almost 12 times elevated (Odds Ratio (OR) 11.89) compared with subjects visiting a dentist at least every year for a check-up. There was a wide confidence interval reported around this estimate (3.33 – 42.51). The reported Odds Ratios and confidence intervals for a) subjects who attended for a dental check every two-five years and b) subjects who attended for a dental check less than once every 5 years were 1.94 (0.7 – 5.34) and 4.67 (1.56 – 14.01) respectively. The odds of oral cancer thus increased as the frequency of dental check-ups decreased.

2.3.2 Quality of Life

2.3.2.1 Results of the original HTA report

One study 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. However, there were no studies identified linking empirical measures of quality of life associated with oral health and dental check frequency.

2.3.2.2 Results of the updated review

In our update, we identified three studies all using different measures of quality of life as it pertains to oral health ('oral disadvantage,' 'oral health self-rating' and 'subjective oral health status indicators'. In one study it was reported that those making one or more dental visits over the three year period of the study were more likely to report that their oral health had improved when compared with those making no visits ('oral health self-rating') (Locker 2001). In another study, Richards and Ameen reported that 'regular attenders' had significantly improved oral health related quality of life (measure of oral health derived from the Subjective Oral Health Status Indicators (SOHSI) compared with 'irregular attenders' (Richards et al. 2002). In the final study regular attenders reported significantly lower rates of oral disadvantage due to disease/tissue damage and function compared with irregular attenders (Chavers et al. 2002). There was no significant difference in oral disadvantage due to pain between regular and irregular attenders.

2.4 Cost-effectiveness

A health economist identified and reviewed a total of 351 abstracts. Sixty papers were ordered and five economic studies on different recall intervals for OHR were selected (Davenport et al. 2003; Dawson et al. 1992; Lunder 1994; Wang et al. 1992; Wang et al. 1995). Four of these studies were reviewed in the HTA Report and the other was an economic model developed for the HTA Report itself.

The model reported in the HTA Report (Davenport et al. 2003) was unique in each of the following respects:

- It explicitly evaluated a range of different recall intervals
- It was an incremental cost-effectiveness analysis (it estimated *both* health gain and resource cost for each recall interval)
- It had a UK NHS setting and considered a broad range of patients.

The other studies analysed resource implications of various intervals for dental check-ups. Table 4 and Table 5 show the methodological summaries and results of these studies.

2.4.1 The HTA Report model

The HTA Report model aimed to assess the cost-effectiveness of 3, 6, 12, 18, 24 and 36 monthly routine dental checks. Cohort simulations (Markov models) were constructed to estimate for each recall interval:

- The total cost of OHRs and the cost associated with the treatment of decay (filling deciduous and permanent dentition) per patient
- and number of teeth free from decay, extraction or fillings for deciduous teeth (dmft) and permanent teeth (DMFT).

Separate models were constructed for a cohort between the ages of one and six and for another cohort between the ages of 12 and 80. Separate analyses were undertaken for different risk subgroups according to socio-economic background (manual versus non-manual) and water fluoridation. For each risk group, the outcome of the model was cost per tooth free from decay, fillings or extraction at the end of the model simulation.

They defined the risk factor group manual/nonfluoridated as the base case. For the base case analysis, the rate of progression of decay experience (from DMF-free to DMF) is 0.3 teeth per year in deciduous dentition and 0.37 teeth per year in permanent dentition. Caries progression was assumed to be 14.6% lower in fluoridated areas and 20.7% lower for non-manual socio-economic groups.

They found that, as the recall interval decreases, overall costs are increased but there are more DMF-free teeth. The increased effectiveness was highest in non-fluoridated and manual socio-economic classes. As recall intervals moved step by step from 36 months to three months the incremental cost per additional dmf-free tooth gained became greater and greater. Moving from six months to three months intervals was considered to be not cost-effective, however given that the threshold of cost per DMF-free tooth is not known, such a conclusion is largely conjecture. The results were not sensitive to changes in hazard rate and restoration survival rate. However, not all model parameters were tested in the sensitivity analysis – the biggest omission being the clinical effectiveness of dental check-ups, an assumption that was not made explicit in the report.

The model had the following limitations:

- The report incorporated only dental caries and not periodontal diseases and mucosal abnormalities. (Patients with mixed-dentition and edentate patients were also omitted. Different risk factors other than social class and water fluoridation were not taken into account).

- The assumptions about the effectiveness of dental check-ups were not explicit, (that is, no mention was made of sensitivity and specificity of dentists' identifying enamel caries nor of the effectiveness of prevention).
- The outcome measure DMFT at the end of the model simulation does not fully incorporate the health gain associated with caries prevention and treatment.
- The calculation of the cost of treatment was restricted to the cost of OHR and fillings. The cost of radiography, scaling and polishing, extractions, crowns, bridges, etc. were not included.
- Although, the model suggests that reduced dental recall intervals are not good value for money, the outcome measure chosen does not allow comparison with a standard threshold or with other studies. Hence, it can't be concluded which interval is optimal in terms of cost-effectiveness.

2.4.2 Other studies

One cost analysis (Dawson et al. 1992) and three resource impact analyses (Lunder 1994; Wang et al. 1992; Wang et al. 1995) were selected for tabulation (Table 4 andTable 5). All four had been reported in the HTA Report.

According to the results of Dawson and Smales (Dawson et al. 1992), extending recall intervals reduced the number of restorations received and restoration survival but these results were not statistically significant. The other three studies suggested that extending recall intervals could save some resources through reduction in dentist's time but may have an adverse effect on the level of dental health (measured in terms of DMFS) (Lunder 1994; Wang et al. 1992; Wang et al. 1995).

These studies may not be generalisable because:

- The main focus of these studies was on children or military personnel.
- The studies were set in locations with different oral health systems and different levels of oral hygiene and oral health. We would expect the impact of dental recall intervals on the number of restorations to be influenced by the oral health system. For example, in systems where dentists receive a fee per restoration and where these fees are set at a relatively high level, the incentives are such that we could see the number of restorations increasing with narrower recall intervals – a phenomenon known as 'supplier induced demand'.
- The studies had relatively short periods of observation (from 2 years to 10 years) and variable sample size (from 46 to 2750).
- The measure of the impact of change in recall intervals on dental health is restricted to DMFS/ DMFT or decline in number of new decayed teeth. This would not capture all of the health gain attributable to the OHR.

2.5 Conclusions

The studies included in this updated review are methodologically and clinically heterogenous, restricting comparisons between studies and limiting generalisability to the UK context. All studies were judged to have some threat to validity and a major limitation of a number of studies was the method used to measure the frequency of the intervention. The majority of studies used a subjective measure of dental check frequency, which compromised the validity of the data collected. It is reasonable to assume that attendance frequency is 'over-estimated' in questionnaire/interview type surveys and there is some empirical evidence to support this assumption.

Due to the study designs employed it is impossible to determine whether observed differences between comparison groups are due to differences in the frequency of provision of the intervention (dental check) or whether these differences can be attributed to the presence of other known or unknown potential confounding factors not controlled for in the analysis.

Overall, there was no consistency observed across studies in the direction of effect of different dental check frequencies on measures of caries and periodontal disease. There appears to be some weak evidence from three studies that regular attendance is associated with improved quality of life as it pertains to oral health. Due to the heterogeneity of populations, interventions, comparisons and outcome measures used in these studies, this finding should be interpreted cautiously.

There were no economic comparisons of dental recall intervals published since the HTA report. Those studies that were included in the HTA report were based on specific populations and were not based on rigorously controlled trials. The model that was developed for the HTA report itself was the only study to compare costs and health outcomes for a number of different recall intervals in a UK context but it too had major limitations (referred to previously in this chapter).

Considered in the context of the HTA Report, the results of this updated review fail to alter the conclusions of the original review:

- There is little evidence to either support or refute the practice of encouraging 6 monthly dental checks in adults or children
- There is little evidence to suggest an optimal dental check frequency for any of the outcomes considered
- There remains uncertainty in how patients value their oral health
- Further primary research is needed in order to assess the relative clinical effectiveness and cost-effectiveness of different frequencies of dental check in terms of impact on caries, periodontal disease, oral cancer and quality of life.

Table 4. ORAL HEALTH REVIEW ECONOMICS PAPERS – CHARACTERISTICS OF STUDIES

Study	**Comparison**	**Target group**	**Type of the study**	**Effectiveness Measure**	**Cost/ Resource**	**Method**
Davenport et al., 2003, UK	3 , 6, 12, 18, 24, 36 months	1-6 years of age with only deciduous dentition, 12-80 years of age with only permanent dentition according to: -manual/non-fluoridated -manual-fluoridated -non-manual/non-fluoridated -non-manual/fluoridated	Cost Effectiveness Analysis (CEA)	Number of teeth free from decay, extraction or fillings for deciduous (dmft) and permanent (DMFT)	Average cost of OHR and cost associated with the treatment of decay (filling deciduous and permanent dentition)	Markov Decision Analysis
Dawson and Smales, 1992, Australia	6 vs. 12 months	Aircrew (n=24) and Groundcrew (n=76) from Australian defence force	Cost Impact Analysis	Average number of restorations and Restoration survival	Average cost of treatment + examination	10 year Retrospective
Wang et al., 1992, Norway	12 vs. 24 months	185 children, **3-5 year old** 12 months (n=27) 24 months (n=31) **16-18 year old** 12 months (n=43) 24 months (n=35) **18-20 year old** 12 months (n=23) 24 months (n=26)	Resource Use	Increment in decayed, missing, filled and sound tooth surfaces (DMFS)	Mean total time (minutes) for examination and treatment	2 year RCT
Wang and Holst, 1995, Norway	12.5 (mean) months vs. 13.7 (mean) months	children aged 3-18 years of age (approx.2750)	Resource Use	Decline in number of new decayed teeth	Mean Clinical time (min) (examination+ treatment) spent per patient- excluding orthodontic treatment	2 year cohort
Lunder, 1994, Norway	12 vs. 18 months	46 high school children	Resource use	Increment in DMFS	Overall mean time/patient Examination mean time/patient	7 year Current study (ecological)

Table 5. ORAL HEALTH REVIEW ECONOMICS PAPERS

Study	Comparison	Effectiveness	Cost or Resource used			Incremental Cost-Effectiveness
Davenport et al., 2003, UK		**Decay-free teeth (DMFT/dmft)** **age 80 age 6** 3 vs. 6 0.2 0.1 6 vs. 12 0.1 0.2 12 vs. 18 0.6 0.2 18 vs. 24 1.3 0.2 24 vs. 36 3.1 0.4	**Incremental cost (£)** **age 80 age 6** 200 64 75 31 15 9 21 4 2 3			**Incremental cost per extra decay free tooth at (£) (manual, non-flouridated)** **age 80 age 6** 907 533 538 154 27 52 17 23 1 8
Dawson and Smales, 1992, Australia	6 vs. 12 months	**Decrease in number of restorations** 0.1* **Decrease in restoration 75% survival** 1.23*	**Incremental cost of treatment and examination** -$AUS36			-Average cost of treatment was significantly related to the frequency of examination. -Restoration longevity/the number of restorations received were not significantly influenced by recall frequency. -More frequent attenders received more expensive treatments rather than more treatment.
Wang et al., 1992, Norway	12 vs. 24 months **Age Group** 3-5 years 16-18 years 18-20 year	**DMFS Increment*** 0.9 1.2 0.5	**Difference in Examination time (min)** -16 -21 -27	**Difference in Treatment time* (min)** -5 -1 -2	**Difference in Total time (min)** -10 -18 -30	- The longer interval was associated with greater DMFS but this was not statistically significant. - There was no significant relationship between the length of interval and the treatment time. - Examination time and total time were significantly shorter for patients examined every 24 months than for patients examined every 12 months. -30% reduction in clinical time was obtained due to less time being spent on examinations.
Wang and Holst, 1995, Norway	12.5 vs. 13.7 months	**Decline in number of decayed teeth** 0.06	**Difference in Clinical time (min) (examination+treatment)** -8			-Dental health in children did not change after extending recall intervals. - 10% increase in interval length corresponds to a 14% reduction in dentists equivalent time.
Lunder, 1994,	12 vs. 18 months	**DMFS increment**	**Overall mean**	**Examination mean**		-

Norway		0.8	**time/patient** -45 minutes	**time/patient** -31 minutes	

*Not statistically significant

3 The Context of Dental Recall

As noted in the previous Chapter, based on a systematic review of the evidence on the effectiveness of routine dental checks of different recall frequencies, there is a lack of good quality, directly applicable research with which to inform clinical practice on assigning appropriate recall intervals. This absence of evidence complicated the task of fulfilling the original remit given by the Department of Health and the Welsh Assembly Government, namely: "*To prepare guidance for the NHS in England and Wales, on the clinical and cost-effectiveness of a dental recall examination for all patients at an interval based on the risk from oral disease*" (our emphasis). The GDG decided that, in order to fulfil this remit, further literature (other than that directly relevant to addressing the Key Clinical Questions detailed in the previous Chapter) would have to be explored. Specifically, the GDG felt that the concept of risk as applied to provision of dental care and the possibility of developing a 'risk-based recall interval' should be explored.

Risk is the probability of an event occurring in a specific time (Reich et al. 1999). Applied to a health event, risk is the probability of an individual developing a given disease or experiencing a health status change over a specified period. Extending the definition of risk to the term 'risk factor' implies that there are certain factors associated with an increased probability of an individual developing a disease or experiencing a health status (Beck 1990). The premise underpinning the application of these concepts to the selection of an appropriate recall interval for an individual patient is that the frequency and type of oral health supervision needed by an individual patient can be based on a patient's risk of developing future disease or of existing disease progressing. Thus, the operating premise of a risk based recall interval between Oral Health Reviews (OHRs) is that patients deemed to be at increased risk may benefit from more frequent OHRs and patients deemed to be at low risk may need to be recalled less frequently. The rationale for reducing the interval between Oral Health Reviews for patients deemed to be at increased risk is that the OHR affords an opportunity for primary prevention (the prevention of oral disease before it occurs) and secondary prevention (limiting the progression and effect of oral diseases at as early a stage as possible after onset).Based on these premises and assumptions the GDG decided to examine the literature surrounding clinical, behavioural and etiological factors that could be used by clinicians to determine a patient's risk of acquiring new disease or the risk of existing disease progressing. The GDG further considered that aspects of the natural history of oral diseases should also be examined, in particular the rate of progression of disease of oral diseases. The GDG also wished to ensure that the guideline would be grounded in the principles of modern preventive management of oral diseases and would reflect the evolution of NHS dentistry from a restorative-centred approach towards a more preventive-oriented and clinically effective way of meeting patient needs. In addition, it was also considered important to examine the literature surrounding patients' satisfaction with the current NHS dental services and factors influencing dental attendance.

In order to explore these issues, the GDG formulated appropriate contextual questions relating to risk factors for dental caries, periodontal disease and oral cancer, the rate of progression of oral diseases and the early detection and preventive management of oral diseases. In developing and prioritising the contextual questions to be addressed, two issues were considered:

a) the relevance and usefulness of these questions in developing the guideline

b) the work reasonably achievable in the limited time available

Many of the contextual questions posed by the GDG, in and of themselves, could have provided the focus for a separate systematic review. However, it was agreed by the GDG that, for the purposes of developing this guideline, a systematic review of the evidence in relation to each of these questions was neither appropriate nor feasible. In relation to each question, it was agreed that a search would be made for existing systematic reviews or other high quality and reliable evidence. Members of the GDG with expertise in that particular topic area were also consulted for references to pertinent literature for each question.

The literature reviewed in order to address the contextual questions posed by the GDG is presented in the subsequent sections in this Chapter. The GDG also considered the issues of longevity of dental restorations, the accuracy of basic diagnostic methods used by clinicians for detecting carious lesions in primary and permanent teeth, and the epidemiology of dental caries of children (Appendix F).

3.1 Dental Caries

For some of the background dental caries questions, the review team were able to draw upon a series of systematic reviews presented at the National Institute of Health Consensus Development Conference on the diagnosis and management of dental caries throughout life (March 26 – 28, 2001). Some of the questions addressed at this Conference using systematic review methods were particularly relevant to this guideline (for example, what are the best indicators for an increased risk of dental caries?).

3.1.1 Caries Risk Assessment

3.1.1.1 Summary of the Literature Reviewed

- The most consistent predictor of caries risk is past caries experience (clinical evidence of previous disease)
- Caries risk assessment for individual patients can be carried out by the clinician using information readily obtained at an oral health review
- The clinical judgment of the dentist and their ability to combine risk factors, based on their knowledge of the patient and clinical and socio-

demographic information is as good as, or better than, any other method of predicting caries risk
- The following should be considered when assessing caries risk for an individual patient: Medical History; Social History; Dietary Habits; Use of Fluoride; Clinical Evidence; Oral Hygiene; Salivary flow rate
- Assessment of caries risk should be repeated every time a patient attends for an oral health review

Over the past four decades, changes have been observed in the prevalence of dental caries and in the distribution and pattern of the disease in the UK. Although overall caries levels have declined significantly, this improvement has not been uniformly experienced throughout the population. Epidemiological studies have demonstrated that the distribution of dental caries is skewed, with most of the disease being concentrated in a minority of the population. There is also considerable geographic variation in caries experience across England and Wales on a regional and county basis. Generally lower levels of mean caries prevalence (DMFT <1 (12 year olds) have been reported in the south, the west and the midlands compared with the rest of England, Wales and the Isle of Man (mean DMFT levels between 1.01 and 1.50).

Contemporary changes in the pattern and distribution of dental caries have led to increasing research interest in caries risk assessment and in identifying 'high risk' susceptible individuals who can be targeted for preventive intervention. The aim of caries risk assessment is to predict future disease and disease progression. However, the precise estimation of future caries risk is difficult as dental caries is an etiologically complex and multi-factorial disease process and there are many factors that can impinge on an individual patient's caries risk. Nevertheless, caries risk assessment can be regarded as an important part of planning for prevention and provides a basis for the provision of dental care as well as planning recall appointments (Adelaide University et al. 1999).

In reviewing the caries risk assessment literature, the Guideline Development Group decided to examine 1) the predictive validities of currently available multivariate caries risk assessment strategies and 2) to ascertain the best indicators for an increased risk of dental caries.

We found one recent systematic review (Zero et al. 2001) evaluating the degree to which various combinations of risk indicators could predict dental caries (*that is,* the predictive validity of the test) in primary and permanent teeth. The authors of this review emphasised the paucity of randomised longitudinal studies available to inform clinical practice. Of all the models reviewed, none of those graded as being of good quality reached the desirable combined level of sensitivity and specificity (160%). On the basis of the available evidence it was concluded that, in general, the best indicators of caries risk could easily be obtained from dental charts and did not require additional testing (*for example,* microbiological examinations). Previous caries experience was also found to be an important predictor in most models tested

for primary, permanent and root surface caries. Two of the longitudinal studies reviewed (graded as being of 'good quality') found that predicted caries by the clinician, using routinely available clinical and socio-demographic information, was an important predictor and as good as, or better than, other methods for predicting caries risk (Evidence Grade 2++).

In identifying the best indicators of increased caries risk we drew upon the findings of a number of systematic reviews that were used in developing a National Institutes of Health Consensus Statement on the Diagnosis and Management of Dental Caries Throughout Life (National Institutes of Health 2001). The conclusions of these reviews can be summarised as follows:

- There is evidence of matrilinear transmission of mutans streptococci in early childhood. Hence, the presence of caries in mothers and siblings is an indicator of increased caries risk for an individual child.
- Low socio-economic status is associated with elevated caries levels. Low socio-economic status may be associated with reduced access to care, reduced oral health aspirations and health behaviours that may enhance caries risk.
- Regular brushing with a fluoride containing toothpaste reduces caries risk.
- Conditions that may compromise the long-term maintenance of good oral hygiene are positively associated with caries risk. These include the presence of multiple restorations and oral appliances and physical and mental disabilities which may result in a decreased ability to perform effective oral hygiene.
- Fermentable carbohydrate consumption is associated with caries, particularly in the absence of fluoride. The frequency, amount and consistency of sugar containing foods and drinks consumed may impact on a patient's caries risk. Long-term regular doses of medications containing glucose, fructose or sucrose may also increase caries risk. The relationship between sugar consumption and caries is much weaker in the modern age of fluoride exposure than it used to be.
- Certain medical conditions (for example, Sjogrens syndrome), pharmacological agents with xerostomic side-effects (for example, anti-cholinergics, tricyclic antidepressants) and head and neck radiation therapy, can lower salivary flow rates to levels that will dramatically elevate a patient's risk of caries

All of the above factors, together with clinical evidence of previous disease, should be considered in assessing a patient's caries risk. As an individual's caries risk status may change over time, risk assessment must be an ongoing process and should be carried out every time a patient attends for an oral health review.

A patient's caries risk should be reviewed in the light of each new clinical examination and any relevant change in their dental, medical and social history and any alteration in their diet and oral hygiene practices.

3.1.2 Rate of Progression of Dental Caries

3.1.2.1 Summary of the Literature Reviewed

- Literature examining the rate of progression of dental caries has to be interpreted cautiously due to the limited quantity and variable quality of the available evidence and considerable study heterogeneity
- On an individual patient basis, progression rates are very variable
- There is evidence that the rate of progression of caries can be more rapid in children and adolescents than in many older persons
- There is a paucity of evidence on: lesion progression in older adults, the rate of progression of occlusal caries, dentine lesions, free smooth surface lesions and root surface lesions

Most of the available information on caries progression emanates from radiographic studies of approximal lesion progression in the permanent teeth of children and young adults. There is sparse information on lesion progression in older adults and on the rate of progression of occlusal caries, dentine lesions, free smooth surface lesions and root surface lesions. There is also a paucity of data available on caries progression in primary teeth and many of these studies are confounded by the presence of preventive regimes (Tinanoff et al. 2001). Reviews of the caries progression literature illustrate the different populations, settings, treatment variables and measurement variables used in different studies (Mejàre et al. 2003Kay et al. 1995; Pitts 1983). Comparisons of data from these studies are rendered problematic by variations in diagnostic criteria, examiner inconsistencies and external factors influencing the natural history of lesion dynamics (for example, varying exposures of the populations under investigation to fluoride). The limited quantity and variable quality of the available evidence, and the considerable study heterogeneity, renders it difficult to draw anything other than the following very broad and general conclusions from this body of literature:

- On an individual patient basis, progression rates are very variable and differ between individuals as well as between lesions within an individual
- For the majority of individuals, the progression of approximal carious lesions in permanent teeth is a slow process and large numbers of lesions can remain apparently unchanged for long periods (Pitts 1983)
- The time for which caries remains confined to the enamel radiographically varies considerably. A mean time of 3 to 4 years has been reported (Pitts 1983)
- Caution should be exercised in the interpretation of ‘mean time’ figures as the rate of progression is more rapid in ‘high risk’ or ‘caries active’ individuals (Shwartz et al. 1984)
- The rate of progression through the enamel in permanent teeth appears to be relatively faster in young children (< 12 years) when compared with adolescents and adults (Mejare et al. 2000, Shwartz et al. 1984)
- The rate of progression through enamel is slower in populations and individuals with adequate fluoride exposure (Lawrence et al. 1997)
- The limited data available on lesion progression in primary teeth suggest that the rate of progression is faster than in permanent teeth

- The limited data available on the rate of progression in dentine, suggest that progression rates are faster than in enamel (Mejare et al. 1999; Pine et al. 1996)
- From the limited data available, lesion progression in adults does not appear to be related to age and there are no major differences in the rate of progression between younger and older adults (Berkey et al. 1988; Foster 1998)
- The exact range of rates of progression of free smooth surface lesions is not known
- The natural history of root caries is largely unknown as is the rate of progression through root surface cementum (Banting 2001; Leake 2001).

3.1.3 Threshold for intervention

3.1.3.1 Summary of the Literature Reviewed

- Early caries lesions can be arrested or even reversed thus justifying consideration of the use of remineralising procedures (preventive intervention) for such lesions as opposed to automatic restorative intervention.
- Contemporary emphasis is placed on cavitation (a break in the continuity of the enamel surface) as a threshold for restorative intervention rather than dentine involvement (depth of the lesion)
- Operative intervention of cavitated lesions is generally indicated to restore the integrity of the tooth surface and allow for plaque removal by the patient
- Progressive hidden dentinal lesions can sometimes be found in sites that appear clinically sound ('hidden' or 'occult' caries). These lesions should be scheduled for operative care
- Radiographic findings must be considered with all other available clinical information on a patient when planning care.

Over the past four decades the approach to the provision of dental care in many developed countries is considered to have undergone a progressive shift from a 'restorative phase,' where the detection of caries lesions was promptly followed by lesion excision and restoration placement, to a less interventive 'preventive phase,' where the emphasis is on primary and secondary prevention and where restorations are provided when a certain threshold of lesion severity has been exceeded (Murray et al. 1997). This change in practice has been influenced by number of factors including an improved understanding of the caries process, contemporary changes in the epidemiology of dental caries and an alteration in the rate of progression of the disease. In particular, a slowing in the rate of progression of early caries lesions through the enamel and the fact that early lesions can be arrested or even reversed justifies consideration of the use of remineralising procedures (preventive intervention) for such lesions as opposed to automatic restorative intervention.

In terms of the clinical management of caries and for successful treatment decisions to be made, it is important to know at what stage a carious lesion is

likely to progress, irrespective of efforts to arrest it by common preventive means and, hence, when restorative intervention is warranted. There is a continuing debate in Europe on precisely where this restorative threshold should lie. Increasing emphasis has been placed on cavitation (a break in the continuity of the enamel surface) as a threshold for restorative intervention, rather than dentine involvement (depth of the lesion), *per se* (Pitts 2001). The threshold for intervention may also vary depending on the tooth surface affected by caries.

3.1.4 Occlusal surface caries

In general the limit for arresting occlusal caries is considered to be clinical cavitation. A number of studies have found that when an occlusal lesion is cavitated the dentine is always involved in the process, the lesion contains many micro-organisms and can generally be considered as an 'active' lesion (Ekstrand et al. 1995; Ekstrand et al. 1997; Ekstrand et al. 1998b; Espelid et al. 1994; van Amerongen et al. 1992). The opinion that cavitated lesions inevitably progress provides the basis for considering operative treatment of such lesions a necessity (Lunder et al. 1996). This inevitable progression is attributed to the impossibility of a thorough plaque removal once cavitation has occurred and operative intervention is generally indicated in order to restore the integrity of the tooth surface and allow for appropriate cleaning. However, it is also important to appreciate that operative intervention for occlusal surface lesions may be required before cavitation has taken place. The decision when to intervene and restore an occlusal surface lesion is complicated by an apparent change in the presentation of caries in recent decades, particularly with the widespread availability of fluoride, in which cavitation appears to occur at a later stage. It is now recognised that progressive, hidden dentinal lesions can sometimes be found in sites that appear clinically sound ('hidden' or 'occult' caries). Cavitated occlusal lesions into dentine should be scheduled for operative care. Occlusal surfaces with a suspicion of hidden dentine caries should be investigated carefully.

3.1.5 Caries on contacting approximal surfaces

The restorative threshold for contacting approximal surfaces is probably reached when frank clinical cavitation occurs. As these surfaces are generally inaccessible to visual examination, the clinician usually has to rely on the use of radiographs as an aid to diagnosis. However, although radiographs can provide an estimate of the depth of lesion penetration towards the pulp, they are unable to provide direct and unambiguous evidence about cavitation at approximal sites. Traditionally, dental practice has adopted the criterion that restorations should be placed when an approximal radiolucency has reached the junction of the enamel and the dentine (Tyas et al. 2001). However, a problem with adopting this criterion is that it cannot be assumed that all radiolucencies that have reached this point represent cavitation.

Several clinical studies have related radiographic appearance with cavitation in permanent teeth. Where a radiolucency has reached the inner half of dentine, the probability of cavitation is high (Mejàre et al. 2003) and

restorative intervention is warranted. However, when radiolucency is confined to the outer half of dentine, cavitation may or may not be present and clinical judgment should be used to determine when restorative intervention, rather than preventive maintenance and monitoring, is warranted. This clinical decision is facilitated by research which suggests that cavitation is more likely in 'high risk' patients and where the adjacent gingival papilla is inflamed (Ekstrand et al. 1998a; Lunder et al. 1996; Ratledge et al. 2001). Radiographic findings must thus be considered jointly with all other available clinical information on a patient when planning care.

3.1.6 Restorative threshold of free smooth surface lesions

The accessibility of free smooth surface lesions means that they may be amenable to preventive regimes, even when cavitated. In this context, adequate plaque removal, exposure to fluoride and appropriate dietary modification may provide an environment conducive to the arrest of cavitated carious lesions on free smooth surfaces. Similar arguments apply to active lesions on root surfaces which can be rendered inactive by daily plaque removal and adequate exposure to fluoride (Nyvad et al. 1986; Nyvad et al. 1997). The ability to remove plaque is critical in order to arrest active carious lesions. If a patient is unable to access such lesions and remove plaque adequately, operative intervention is necessary.

For all of the above lesions, the threshold for intervention will also be influenced by the values and preferences of the patient for treatment and outcomes, which may be different from those of the clinician.

3.2 Periodontal Diseases

3.2.1 Summary of the Literature Reviewed

- The main risk factors for the development of periodontal disease include the presence of plaque, smoking and diabetes
- There is a paucity of data investigating the impact of gingivitis on oral health and well being
- Untreated periodontal disease is likely to progress faster than treated periodontal disease

Epidemiological studies of periodontal diseases are complicated by the diversity of measures used to describe and quantify them and the lack of consensus as to a uniform definition and classification (Kingman et al. 2002). This is reflected in the estimates given by the World Health Organisation Global Data Bank (World Health Organisation 2004) which state the prevalence of moderate severity disease occurs in 2 to 67% of individuals and that advanced disease occurs in 1 to 79% of the population.

Tooth loss might be the true clinical outcome for periodontal disease but can occur for other reasons, even in those with established destructive periodontitis (Nunn 2003). Consequently, alternatives such as probing depth

and attachment level are often used as surrogate outcomes, particularly to determine treatment need or response. Hujoel provides some evidence for the validity of these measures (Hujoel et al. 1999). The effect of these uncertainties may over- or underestimate treatment need. For the patient, the impact of disease on their quality of life and well-being is also important but few studies have yet investigated the effect of periodontal status on these measures.

3.2.2 Gingivitis

Gingivitis is an inflammation of the superficial gum tissues. It is caused by the accumulation of bacterial plaque at the gum line (Loe et al. 1965; Thielade 1986). Gingivitis can be recognised by the signs of bleeding from the gums (for instance following tooth brushing), a change from pink to red colouration and mild tenderness from the edges of the gum. These signs are often missed or thought to be normal changes. Thorough and regular removal of plaque by methods such as tooth brushing and flossing will allow health to be re-established with no irreversible effects to the gums.

Gingivitis is highly prevalent in most populations and at most ages (Albandar 2002b; Corbet et al. 2002; Sheiham et al. 1986) with global values ranging from 50-90% of populations. The fact that gingivitis can be a precursor to more severe periodontal disease (periodontitis) has traditionally been regarded as its greatest significance. However, there has been surprisingly little research looking at the effect of this condition on future oral health and wellbeing. Since the condition affects the majority of people such information is critical to the development of policy on managing gingivitis.

We decided to examine the impact of gingivitis on the well being and oral health of an individual. Three areas of interest were considered: the impact of gingivitis on quality of life, the impact of gingivits on oral diseases, and the impact of gingivitis on restorations, for example restoration longevity or the integrity of the restoration margin. No studies were found that directly investigated gingivitis and the quality of life on an individual. However, some studies looked at the impact of periodontal health in general (Jones et al. 2001; Needleman et al. 2004; Peek et al. 2002). The data suggest that there is an effect although it is not possible to discriminate the impact of gingivitis alone from all periodontal diseases. While gingivitis has shown to be a risk factor for periodontitis (Schatzle et al. 2003) and may be a risk indicator for caries (Ekstrand et al. 1998a), there are no data for gingivitis as a risk factor for other aspects of oral health. No studies were found researching the impact of gingivitis on restorations.

3.2.3 Risk factors

The accumulation of dental plaque at the gingival margin is considered to be the primary aetiological factor for the development of periodontal diseases (Socransky et al. 2003). Risk factors are considered to be those exposures, genetic influences or behaviours which modify the effect of plaque on the gingival tissues.

Although poor oral hygiene and plaque accumulation have been shown to correlate positively with gingivitis and the prevalence and severity of periodontal disease on a population level, oral hygiene is a much weaker predictor of periodontal tissue loss at the individual level (Albandar 2002a). Such a paradox might be explained by the contribution of risk factors which will vary substantially between individuals.

One readily assessable marker of risk is gingival bleeding. Lang and co-workers have shown that continuous absence of bleeding is a reliable predictor for the maintenance of periodontal health (Lang et al. 1990) that is, health gingival tissues predict further periodontal health. It is not clear whether this relationship holds true for both smokers and non-smokers.

A review by Nunn concludes smoking is "probably the most significant modifiable risk factor for periodontal disease (Nunn 2003). In the United States The Third National Health and Nutrition Examination Survey (NHANES III) estimates that more than half the cases of periodontitis affecting adults may be due to smoking with 41.9% (6.4 million) cases of periodontitis due to current smoking and 10.9% (1.7 million) cases of periodontitis due to former smoking (Tomar et al. 2000). Albandar reports on several cross-sectional studies that show a strong association between the various types and intensity of smoking on gingival tissue, periodontal tissue loss and the severity of periodontitis. Smokers are shown to have between a two and seven fold increase in risk for having periodontitis and/or periodontal tissue loss than non-smokers. Heavy cigarette smoking is associated with more severe periodontal disease than light smoking and the number of smoking years significantly associated with tooth loss and periodontal disease, irrespective of other social and behavioural factors (Albandar 2002a). There is no evidence to suggest a safe level of smoking on periodontal health.

Nunn reports strong evidence for a direct relationship between diabetes and periodontitis (Nunn 2003). Both type I (insulin dependent) and type II (non-insulin dependent) diabetics appear to be at a higher risk than non-diabetics. However, certain sub-groups appear to be at particularly high risk. These include diabetics with poor oral hygiene and/or poor diabetic control and diabetic complications (Kinane 2001). Evidence has begun to emerge suggesting a bidirectional relationship between both types of diabetes and periodontal disease (Taylor 2001).

Albandar reports that studies show aggressive periodontitis to occur in families and suggests that genetic factors are partly responsible for the increased susceptibility to this disease (Albandar 2002a). Several other factors have only limited evidence of or a variable association with periodontal diseases. These are osteoporosis, rheumatoid arthritis, hormonal changes in the body associated with puberty and pregnancy, smokeless tobacco, low vitamin C or calcium intake, high alcohol intake, socioeconomic status, psychosocial factors such as stress, age, gender, race, and tooth or local factors such as occlusal discrepencies or tooth position (Albandar 2002a; Nunn 2003)

3.2.4 Rates of Progression

The guideline development group was interested in a comparison of the rates of progression of treated and untreated chronic periodontitis. However, few studies investigated the rates of progression of periodontal disease for both treated and untreated subjects in the same study. As a surrogate for this, we looked at the data for treated periodontitis where the subjects are randomised to receive adequate maintenance care compared to inadequate care (Axelsson et al. 1981). The treatment group represents a treated and best case sample and the control group represent individuals where periodontitis is allowed to re-establish (a proxy for untreated and if anything, a modest estimate as the subjects have received some care). The results indicate that the percent of sites with at least 2mm loss of attachment over six years was 1% for subjects receiving adequate maintenance care and between 52% to 65% depending on the type of tooth (incisors, canines and molars) for those with inadequate maintenance care.

Cobb reviewed several studies to determine mean annualised rates of progression of untreated periodontal diseases determined by clinical probing depth and clinical attachment loss, or radiographic measurement of alveolar bone loss (Cobb 1996). Adjusting for one study that appeared to have some individuals with much greater progression than most populations (0.8mm per year) the range is 0 to 0.3mm per year.

However, annualised rates are highly problematic and tend to underestimate true disease progression. They are generally calculated across all sites in the mouth (whether per patient or across all sites of the study group rather than grouped per patient). The result is the inclusion of large numbers of non-progressing and healthy sites. Since progressing sites are less common than non-progressing sites the effect could be to underestimate disease progression of the sites that are progressing, often called ‘loser’ sites. Loser sites could be more common on teeth lost during follow-up. If the effect of the loss of sites on extracted teeth is not assessed, diseased or progressing sites will be preferentially lost from the data set, introducing a bias. Studies that report on rates of progression of ‘loser’sites only indicate that much greater rates can occur (Cobb 1996; Haffajee et al. 1991; Lindhe et al. 1989).

Converting this information into the Basic Periodontal Examination (BPE) suggests a mean annualised rate of progression of between 0.0 and 0.3mm per year for patients with no history of periodontitis and a BPE code of 0 (no residual pockets and no gingivitis and no calculus or overhangs), 1 or 2 (gingivitis or calculus/overhangs but no pockets) and for patients with a history of periodontitis and a BPE code of 0. For patients with a history of periodontitis and a BPE code of greater than 0 the data suggests a maximum annualised rate for progression of 3mm per year.

3.3 Oral Cancer

3.3.1 Summary of the Literature Reviewed

- On average about four people a day die from oral cancer in the UK
- The poor survival rate from oral cancer (50%) is generally attributed to the late diagnosis of oral cancer at an advanced stage when nodal involvement and neck metastases have occurred
- The incidence of oral cancer increases with age in both males and females, typically peaking in the seventh to eight decades of life. An increasing incidence in younger age groups (35-64 years) has been recently reported
- It has been consistently reported that there is a prognostic advantage associated with early detection of oral cancer. Early diagnosis allows for treatment with less aggressive therapies that are associated with less morbidity
- The incidence of oral cancer in males is around twice that in females in virtually all age groups. An exception to this has been reported in those under the age of 40 years where the usual male dominance does not appear to hold
- Tobacco use (both smoking and smokeless tobacco) and excessive consumption of alcohol are the principal risk factors for oral cancer
- Cases of oral cancer have been reported in young persons (below the age of 45 years) with little or no exposure to tobacco or alcohol
- The use of toluidine blue dye as a screening tool in primary care should be discouraged
- Oral cancer often apparently arises de novo from clinically normal mucosa. The percentage of oral cancers arising from precursor lesions is not accurately known
- Potentially malignant lesions include leukoplakia and erythroplakia of varying clinical presentations. The incidence and prevalence of oral leukoplakia and erythroplakia in the UK are not known.
- The reported rates of malignant transformation of oral leukoplakia in the international literature range from 0.3 to 17.5%
- Lesions of leukoplakia on the floor of the mouth, lateral tongue and lower lip are most likely to show dysplastic or malignant changes
- Erythroplakia has a high potential for malignant transformation
- Clinicians should maintain a high index of suspicion for mucosal lesions that appear unusual
- Clinicians should maintain a high index of suspicion for all intra-oral areas that appear unusual, even in patients with histologically confirmed diagnosis of oral lichen planus. This vigilance is especially important for isolated lesions occurring in locations at higher risk for the development of squamous cell carcinoma, such as the lateral and ventral surfaces of the tongue and the floor of the mouth.

3.3.2 Epidemiology

Quoted incidence rates for oral cancer in the UK vary from 3.4 to 4.5 per 100,000 per annum (National Screening Committee: unpublished data 2001). In 1998, there were 4,081 cases of oral cancer diagnosed in the UK and in the

year 2000, there were 1,649 deaths from the disease. On average about four people a day die from oral cancer in the UK. Oral cancer is also associated with significant morbidity arising as a consequence of the disease process itself and the therapy provided to oral cancer patients. Oral cancer associated morbidities include: psychosocial disability in terms of appearance, self-esteem and withdrawal from familial and other social interactions, functional disabilities (difficulty in maintaining oral hygiene, swallowing and maintenance of nutritional status, difficulties in speaking), therapy-specific morbidities (related to neck dissection and radiotherapy) including thyroid and parathyroid dysfunction, xerostomia (dry mouth), osteo-necrosis of facial bones and the side-effects of chemotherapy (Rosati 1994).

As with all neoplasms, it is believed that oral cancer results from cumulative damage to epithelial cells over a period of time (Quinn et al. 2004). Hence, the incidence of the disease increases with age in both males and females, typically peaking in the seventh to eighth decades of life. Oral cancer is extremely rare below the age of about 40 years with approximately 4 – 6 % of oral cancers occurring below this age (Llewellyn et al. 2001). The incidence of oral cancer in males is around twice that in females in virtually all age groups. An exception to this has been reported in those under the age of 40 years, where the usual male dominance of the condition does not appear to hold (Llewellyn et al. 2001).

The overall age-standardised incidence of oral cancer has risen gradually since the 1990s and an increasing incidence in younger age groups (35 – 64 years) has been reported. In the 35 – 64 year age group, the incidence of tongue, mouth and oropharyngeal cancer rose from 3.61 per 100,000 per annum (1962 – ’66) to 5.52 (1982 – ’86) in males and from 1.85 to 2.19 in females (Hindle et al. 1996). More recently, Quinn and coworkers have reported a 40% increase in the incidence rate of lip, mouth and pharyngeal cancer in males aged 55 – 64 years in England and Wales between 1971 and 1997 and a 25% increase in the incidence rates in females of the same age group (Quinn et al. 2004).

In England and Wales the incidence or oral cancer exhibits marked regional variation with above average rates in the North of England and in Wales (Greenwood et al. 2003). The regional pattern in mortality is similar to that for incidence. It has been suggested that this difference may be related, at least in part, to material deprivation (O'Hanlon et al. 1997).

There is limited evidence available relating to ethnic variations in the incidence of oral cancer in England and Wales. Incidence rates appear to be higher in Asian immigrants (*that is,* immigrants from India, Pakistan, Bangladesh, Nepal and Sri Lanka). These ethnic differences have been attributed to tobacco use and tobacco chewing habits (specifically betel quid chewing) and to possible dietary factors, genetic predisposition, socio-economic differences and lack of awareness about the risk factors. Research into the incidence of oral cancer in specific ethnic groups in the UK is hampered by the fact that entry of ethnic group for an incident case only became part of the contract minimum data set in 1993 (Warnakulasuriya et al. 1999).

The overall five-year survival rate for oral cancer in England and Wales generally remains poor at an average of 50%. There has been little reported improvement in survival rates from oral cancer since the 1960s despite improvements in surgery and radiotherapy. This poor survival is generally attributed to the late diagnosis of most oral cancers at an advanced stage when nodal involvement and neck metastases have occurred (British Dental Association 2000; Epstein et al. 2002; Silverman 2001).

It has been consistently reported that there is a prognostic advantage associated with early detection of oral cancer. There is some evidence from studies of therapy for early stage oral cancer, that five-year survival is better for Stage I (where tumour diameter is 2cm or less and there is no nodal involvement and no metastases) than Stage II (where tumour diameter is >2cm but <4cm in diameter and there is no nodal involvement and no metastases). Hawkins and co-workers reviewed nine studies (published between 1980 and 1997) reporting data from retrospective reviews of patient charts (Hawkins et al. 1999). The only measure provided in all studies was the five-year survival rate: for Stage I five-year survival ranged from 57% to 90% and for Stage II, from 41% to 72%. However, all of these studies were case-series studies where a group of patients received an intervention and outcomes were assessed (there was no comparison group). The influence of lead-time bias was not considered in the statistical analysis of these data. This evidence is insufficient to establish with confidence whether earlier detection improves the prognosis in patients with oral cancer. Nevertheless, early diagnosis is considered to be of importance in improving the outcome of therapy – diagnosis at earlier stages allows for treatment with less aggressive therapies that are associated with less morbidity (Epstein et al. 1997).

It should also be noted that small tumours may not necessarily be ‘early’ in the chronological sense – some small tumours may be very aggressive and at an advanced stage at presentation even though they are 2cm or less in their greatest dimension.

3.3.3 Risk factors for oral cancer

Tobacco use (both smoking and smokeless tobacco [*that is,* chewing tobacco, chewing tobacco with betel quid, snuff]) and excessive consumption of alcohol are recognised risk factors in the development of oral cancer (British Dental Association 2000; Conway et al. 2002; Horowitz et al. 2001; Rosati 1994). Both factors are associated with oral cancer in a dose response fashion and have a synergistic effect when combined (Moss S, Melia J, Rodrigues V, Tuomainen H: unpublished data 1997). There is some controversy over the precise role of alcohol as an independent risk factor for oral cancer. Nevertheless, the epidemiological evidence suggests that all forms of alcoholic drink are dangerous if heavily consumed. In this context there is evidence for the role of beer, wine and spirits as risk factors for oral cancer. In many studies only high levels of alcohol consumption (for example, >20oz/week or >55 drinks/week) have indicated significant increases in risk. Due to the tendency in self-reporting to underestimate alcohol intake, particularly high levels of intake, the effect of alcohol may be stronger than the studies suggest (Shah et al. 2003). Current UK recommendations are that men should not drink more than 21-28

units per week and women should not drink more than 14-21 units. One in four men and one in ten women in the UK are believed to be drinking over the recommended limits, with the number of habitual heavy drinkers estimated at 4 million (British Dental Association 2000).

In young persons (below the age of 45 years) who develop oral cancer, there is mixed evidence of the role of alcohol and tobacco as risk factors. Several studies have reported that the risk factors of smoking and alcohol consumption were present to varying degrees in younger people with oral cancer. However, many authors also reported a complete lack of the usual aetiological factors associated with older patients *that is,* cases of oral cancer have been reported in young people who have had little or no exposure to tobacco or alcohol (Llewellyn et al. 2003).

A strong association between betel quid chewing and oral cancer and various potentially malignant lesions and conditions (primarily leukoplakia and oral submucous fibrosis) has been established. The addition of tobacco to the quid significantly increases the risk of oral cancer (Moss S, Melia J, Rodrigues V, Tuomainen H: unpublished data 1997; Thomas et al. 1993).

The habit of betel quid chewing is extremely common in India and South East Asia, Eastern Melanasia and the East African Coast. There is evidence that this habit remains prevalent in UK immigrants from these areas (Farrand et al. 2001). In the UK it has been reported that 19% of Bangladeshi men and 26% of women use some form of 'chewed tobacco' (Department of Health 2001). Other authors have reported that this may be as high as 39% and 82% respectively, in some areas (Bedi et al. 1995). Between 2% and 6% of UK Indian and Pakistani community members use some form of chewed tobacco.

Certain dietary deficiencies have been shown to play a role in oral carcinogenesis. Case control studies have consistently shown that oral cancer patients have histories of diets low in fruit and vegetables (*that is,* a diet low in Vitamin A and C has been associated with an increased risk of oral cancer) (Moss S, Melia J, Rodrigues V, Tuomainen H: unpublished data 1997). Iron deficiency anemia in combination with dysphagia and esophageal webs (Plummer-Vinson syndrome) is associated with an elevated risk for development of carcinoma.

It is well established that outdoor workers (for example, those involved in farming, fishing and postal delivery) are at greater risk from lip cancer because of long-term exposure to ultra-violet light. The risk of developing cancer of the lip increases with both the duration and frequency of exposure to ultraviolet radiation and is cumulative over time (Casiglia et al. 2001).

3.3.3.1 Other risk factors for oral cancer

Other factors have been associated with an increased risk for oral cancer but evidence is not conclusive on whether the relationship is causal. These factors include:

- Previous carcinoma
- Bacterial and viral infections

- Genetics
- Occupational risk
- Poor oral hygiene
- Mouthwashes with a high alcohol content
- Immune Deficiency

3.3.4 The accuracy of clinical oral examinations in detecting oral cancer and potentially malignant conditions

The sensitivity and specificity of screening for oral cancer by clinical examination depend on such factors as the training of the individual performing the examination, and on the criteria used to determine which lesions are counted as 'positive' and warrant referral for further investigation. The yield and positive predictive value depend on the population screened (Rodrigues et al. 1998).

There have been a number of population-based studies of screening by clinical oral examination for oral cancer. These studies have generally found a relatively high specificity between 81 to 99%. However, the sensitivity has varied widely from 59 to 85%. The positive predictive values have varied from 31 to 87 % depending on the prevalence of oral cancer. Consequently, due to the low prevalence of oral cancer in developed countries, two significant issues for screening programmes are a low yield in the general population and a high proportion of false positive referrals (Hawkins et al. 1999).

In the UK, screening by clinical examination of the oral cavity has been reported to have a sensitivity ranging from 71 to 81% and a specificity of 99% or more when screening was carried out by general dental practitioners, with dental specialists' diagnosis as the gold standard (Rodrigues et al. 1998). A recent meta-analysis of measures of performance reported in oral cancer and precancer screening studies concluded that systematic visual examination of the oral mucosa has a high discriminatory ability (Moles et al. 2002). In the latter study a weighted pooled average for sensitivity was calculated as 0.796. The corresponding value for specificity was 0.977

3.3.5 Toluidine blue dye

The use of toluidine blue dye has been suggested as an adjunct to visual examination in the identification and management of oral cancer since the 1960s and Toluidine blue dye oral cancer screening kits have been marketed to General Dental Practitioners in the UK. However, a recent systematic review of the evidence found wide variation in the sensitivity and specificity of the test (Sensitivity 1.0 to 0.4 and 0.31 to 0.92) (Gray et al. 2000). The authors of this review concluded that although toluidine blue might pick up additional cancers in high risk patients in secondary care, there was no evidence to support the use of toluidine blue as an adjunct to screening in primary care. The policy implications of this systematic review are that the use of toluidine blue dye as a screening tool in primary care should be discouraged.

3.3.6 Potentially malignant lesions and conditions

Although oral cancer often apparently arises *de novo* from clinically normal mucosa, there are also a number of clinically identifiable precursor lesions,

which constitute a detectable pre-clinical phase (Downer 1997). The percentage of oral cancers which arise from precursor lesions is not accurately known, but has been estimated as more than 75% in India (a high incidence region for oral cancer). Although there are suggestions that the percentage of oral cancer cases arising *de novo* from clinically normal mucosa is greater in the Western world as compared to India, it has been argued that there are insufficient data to provide firm evidence particularly in countries such as the UK (Moss S, Melia J, Rodrigues V, Tuomainen H: unpublished data 1997).

Clinically identifiable precursor lesions are a heterogenous group of (usually) asymptomatic oral pathological entities with malignant potential. This broad group is generally classified under 'lesions' and 'conditions' – the latter are more generalised and widespread with significant systemic involvement. There is a paucity of data on the prevalence and incidence of potentially malignant lesions and conditions in the UK. Potentially malignant lesions include *leukoplakia* and *erythroplakia* of varying clinical presentations (such as homogenous, verrucous, nodular or speckled) and mixed lesions.

3.3.6.1 Leukoplakia

Leukoplakia is usually defined as an adherent white patch that cannot be diagnosed as any other disease process. Leukoplakia is thus a clinical diagnosis of exclusion – if an oral white patch can be diagnosed as some other condition (*for example,* candidiasis, lichen planus, *etc*) then the lesion should not be considered to be an example of leukoplakia. As there have been somewhat unsatisfactory definitions and changes in the definitions of leukoplakia over time, there has been a wide range of figures for prevalence and incidence reported in the international literature. Leukoplakia is the most common potentially malignant condition. The incidence and prevalence of oral leukoplakia in the UK are not known. However, outside the UK the prevalence has been estimated to range from 0.2 to 11.7%. The variation in prevalence between studies is likely to be due to varying methodology and clinical criteria used in the identification of leukoplakia as well as population differences in risk factor prevalence.

Data on malignant transformation of leukoplakia are limited and difficult to interpret because of variable follow up, disease definitions, diagnostic criteria and treatment interventions. Several clinical studies have been conducted in Europe and the US to assess the potential for malignant transformation of oral leukoplakia. The reported rates of malignant transformation in the international literature range from 0.3 to 17.5% (Rodrigues et al. 1998). Most of the earlier studies have reported a risk of malignant transformation in the range of 3.6 to 6 per cent. However, several more recent studies have reported malignant transformation rates ranging from 8.9 to 17.5 percent. Although the reason for these results is unclear, it may be due to a more restrictive definition of what is considered clinical leukoplakia and further underscores the seriousness of 'true leukoplakia' (Neville et al. 2002). Estimates of the percentage of leukoplakias that regress to normal vary between 4.6% per year in India to 28.6% in the USA.

The most common oral sites for leukoplakia are the buccal mucosa, alveolar mucosa, and lower lip. The location of leukoplakia has a significant correlation with the frequency of finding dysplastic or malignant changes at biopsy. Lesions on the floor of the mouth, lateral tongue, and lower lip are most likely to show dysplastic or malignant changes (Neville et al. 2002). Some leukoplakias occur in combination with adjacent red patches or erythroplakia. If the red and white areas are intermixed, the lesion is called a speckled leukoplakia or speckled erythroplakia. Speckled leukoplakia or mixed leukoplakia/erythroplakia are at greatest risk for showing dysplasia or carcinoma.

The risk of malignant transformation is also reported to vary with gender (higher among women), type of leukoplakia (higher among those that are idiopathic, non-homogenous, of a long duration), presence of Candida albicans, and presence of epithelial dysplasia. Leukoplakias in non-smokers are also more likely to undergo malignant transformation than leukoplakias in patients who do smoke. This should not be interpreted to detract from the well-established role of tobacco in oral carcinogenesis but may indicate that non-smokers who develop leukoplakia do so as a result of more potent carcinogenic factors (van der Waal et al. 1997).

3.3.6.2 Erythroplakia

Erythroplakia is a term used analogously to leukoplakia to designate oral mucosal lesions that present as red areas and cannot be diagnosed as any other definable lesion (Shah et al. 2003). The prevalence of erythroplakia is not known but it is less common than leukoplakia. Studies in India and Burma have found a prevalence of 0.02 and 0.1% respectively (Shah et al. 2003). Oral erythroplakia occurs most frequently in older men (sixth and seventh decades) and appears as a red macule or plaque with a soft, velvety texture which may be slightly depressed below the level of the oral mucosa. The floor of the mouth, lateral tongue, retromolar pad and soft palate are most common sites of involvement. There are no studies reporting follow-up of series of cases of erythroplakia, perhaps due to its relatively low prevalence or due to its more active management. The rate of malignant transformation is high: most studies of biopsied cases of erythroplakia have found that the majority show areas of epithelial dysplasia, carcinoma in situ or invasive cancer, leading most authors to conclude that erythroplakia has a high potential for malignant transformation. However, the role of erythroplakia as a precursor lesion, as opposed to an early sign of carcinoma in situ or invasive cancer, is not clear (Rodrigues et al. 1998).

3.3.6.3 Oral Lichen Planus

Lichen planus is a relatively common mucocutaneous disorder estimated to affect 0.5% to 2% of the general population. Lichen planus affects primarily middle-aged adults and the prevalence is greater among women. The classic skin lesions of the cutaneous form of lichen planus can be described as purplish, polygonal, planar, pruritic papules and plaques. These skin lesions commonly involve the flexor surfaces of the legs and arms, especially the wrists. Given that 30 – 50% of patients with oral lesions also have cutaneous

lesions, the presence of these characteristic cutaneous lesions can aid in the diagnosis of oral lichen planus.

The malignant potential of oral lichen planus has been the subject of controversy for some time (Shah et al. 2003). Some studies indicate an increased risk of squamous cell carcinoma in patients with oral lichen planus lesions. This increased risk appears most common with the erosive and atrophic forms and in cases of lesions of the lateral border of the tongue. Other studies suggest that in some cases of purported malignant transformation, the malignancy may not have developed from true lesions of oral lichen planus but may instead have arisen from areas of dysplastic leukoplakia with a secondary lichenoid inflammatory infiltrate. The role of oral lichen planus as a true precursor lesion remains unclear (Rodrigues et al. 1998).

3.3.6.4 Oral Submucous Fibrosis

Oral Submucous fibrosis (OSMF) is a chronic disease of the oral mucosa which manifests as a unique generalised fibrosis of the oral soft tissues. The condition is most frequently seen in South-East Asia, particularly in the Indian subcontinent and is strongly associated with the habit of betel quid chewing. Sporadic cases have been reported among non-Asians (Europeans).

3.4 Effectiveness of Dental Health Education and Oral Health Promotion

3.4.1 Summary of the Literature Reviewed

- Dental health education advice should be provided to individual patients at the chairside as this intervention has been shown to be beneficial (in the short term).
- The effectiv elivering dental health education and oral health p despite its importance, some issues have been p e are design challenges around the use of rand
- Although ev on whether it changes behaviour, dentists arg ation to deliver good oral hygiene, dietary and e to patients.

3.4.2 General otion

We found two recent general systematic reviews on the effectiveness of health promotion and dental education on improving oral health. A report commissioned by Health Promotion Wales concluded that there is clear evidence that oral health education can change people's knowledge and improve their oral health (Sprod et al. 1996). However, it also concluded that while one-to-one oral health education is capable of reducing plaque levels, evidence strongly suggests that the changes achieved are short-term and unsustainable.

The authors of the second review were able to reach few definitive conclusions given the paucity of rigorous, well-designed studies in this area (Kay et al. 1998). From the studies that *were* rigorous and well-designed, Kay and Locker (Kay et al. 1998) were able to conclude that:

- Health promotion that leads to use of fluoride containing agents results in caries reduction
- Simple instruction in oral hygiene could altar people's behaviour in the short term
- School based health education aimed at improving oral hygiene has not been shown to be effective. One-to-one interventions are effective but *likely* expensive due to professional costs (few studies looked at cost-benefit ratios or sustainability of programmes)
- There is no evidence that mass media programmes significantly alter any oral health related outcomes

It should be noted that only studies published in English were included in this study thus the results may be subject to publication bias. Although Kay and Locker reviewed each paper separately, they also aggregated the results. The papers included in the review differed on intervention, design, population and outcomes and thus it could be argued that it was inappropriate for Kay and Locker to pool the results as they did.

3.4.3 Smoking Cessation

Recent UK-based guidelines conclude that health professionals can play a significant role in helping smokers to give up the habit (West et al. 2000). More specifically, a recent Cochrane review concluded that smoking cessation counselling delivered on an individual basis can assist smokers to quit (Lancaster et al. 2002). Although few studies have examined the role of dental professionals in this role, Watt and Daly suggest their success rates could be comparable with those in other primary care settings (Watt et al. 2003a). The key conclusions on efficacy from the recent UK guidelines (West et al. 2000) on offering smoking cessation advice to patients are:

- Brief advice (less than 5 minutes) can result in 1 to 3% of smokers quitting smoking each year
- The cessation rate increases to 6% if advice is up to 10 minutes and nicotine replacement therapy is utilized.

With regard to implementation, the recent UK guidelines recommend ascertaining a patient's smoking status at least once a year and the provision of GP advice to current smokers, during routine consultations, to stop smoking at least once a year. Smokers may be more receptive to advice if it is linked with an existing medical condition. The smoker must be ready to quit and once an attempt to quit has been made, then follow-up should occur. There is no suggestion of when first follow-up should be made and how often

additional follow-ups should occur. Additionally, these guidelines assume that people will be visiting their GP once a year, which may not be the case.

However, as noted earlier, these conclusions are based on studies looking at health professionals outside of dentistry. While Watt and Daly suggest the recommendations may be applied to health professionals in dentistry (Watt et al. 2003a), authors of a recent study (Rikard-Bell et al. 2003) suggest that more research is needed to determine whether smoking cessation advice delivered by dentists is indeed effective. They cite only one well-designed study that demonstrated significant results in smoking cessation following advice from a dentist, and three well-designed studies that failed to demonstrate successful results.

Rikard-Bell et al's own study in this area focused on patient views of dentist-delivered smoking cessation advice in Australia. They found that while only a minority (23%) agreed that dentists should not provide smoking cessation advice, less than one-third of all smokers would try to quit upon advice from their dentist. Furthermore, over one-third of patients had little confidence in their dentist's knowledge of helping smokers quit.

3.4.4 Dietary Advice

Kay and Locker (Kay et al. 1998) reviewed a number of studies that looked at modifying the consumption of food and drink that contained sucrose. However, all studies used behavioural intentions or reported behaviour as outcome measures rather than those of oral health. Watt and McGlone (Watt et al. 2003b) found little evidence on dietary interventions delivered in primary dental care settings, and thus could not conclude whether giving dietary advice is effective.

3.5 Factors Affecting Dental Attendance and Satisfaction with the Current Service

3.5.1 Summary of the Literature Reviewed

- People will attend the dentist either for an Oral Health Review ('check-up') or for relief of symptoms. However, it is not clear from the literature reviewed here what the distribution of the population between these categories is, nor how stable it is.
- One study reported that regular attendees cited keeping their teeth as their main reason for their more frequent attendance. A larger body of literature on irregular attendees reported that people overwhelmingly cited a lack of perceived need to explain their symptomatic attendance pattern. Additional reasons commonly cited by patients for non-attendance were fear, cost and time. The attendance pattern of dependant groups (children and dependant adults) is determined by the motivations and priorities of their parents, guardians or carers.
- People are generally satisfied with their NHS dental service and consider interpersonal skills to be the most important quality of their dentist.

This chapter summarises the most recent and comprehensive literature on public views of NHS dentistry, specifically motivations for visiting the dentist, factors that affect attendance patterns and satisfaction with the current service. Our literature search found no evidence regarding the public's views on specific recall intervals or whether people follow their dentist's recommendations about when to return for a check-up. Due to substantial variation internationally in the provision of, and payment for, dental care, we limited the scope to studies conducted in England and Wales.

3.5.2 Motivation for visiting the dentist

As the patterns of dental attendance vary substantially in England and Wales, it was important to query a broad spectrum of the population on their motivation for visiting the dentist. Therefore, we included NHS registered patients, in addition to users of NHS dentistry who are not currently registered. This latter group may be regular attendees but having not attended for over 15 months, will have been deregistered. It is important to note that first, there may be a group of patients included in these studies who may not know their registration status and second, that all of the studies obtained findings from the self-reported attendance of patients and not their attendance from dental records.

Broadly speaking, there are two reasons a person will present to the dentist: either for an oral health review ('check-up') or for symptomatic relief. Their attendance *pattern*, however, can vary substantially and many studies have sought to classify different patterns. The most widely known terms in the UK for describing attendance are 'regular attendees', 'occasional attendees' and people who only attend when experiencing oral problems. These terms originated in the National Dental Health Survey 1968 but have different inclusion criteria from study-to-study (Newsome et al. 1999). Several authors however, have described the inadequacy of these terms. Newsome and coworkers for example, report that the terms 'regular' and 'occasional check-up' refers to both the frequency *and* reason for the visit, while the latter term refers only to the reason. As an alternative, the categories 'symptomatic attendee' and 'asymptomatic attendee' have recently been used to describe dental attendance. Asymptomatic attendees are defined as those people who have attended for a check-up at least twice in three years, although this definition can vary.

While information about self-reported attendance is collected through surveys such as the Office of Fair Trading (OFT), the ratio between symptomatic attendees and asymptomatic attendees will be more accurately reported using results from the dental records, as there will inevitably be some discrepancy between perceived self-reported attendance patterns versus real attendance. Within both of these sources however, there is an important issue with the stability of these categories; some people for example, will maintain a pattern of asymptomatic attendance before lapsing into larger periods of symptomatic attendance (Bullock et al. 2001).

3.5.3 Factors influencing the frequency with which NHS patients see their dentist

There was good evidence concerning factors influencing symptomatic attendance. However, obtaining factors that prompted asymptomatic people to attend the dentist was more difficult. In terms of factors that affect the dental attendance of the general population, Bullock and coworkers reports results from a case control study set in a General Dental Practice in Stoke-on-Trent (Bullock et al. 2001). Two hundred patients, were divided into regular attendees (patients 18 yrs or over who had attended for two dental examinations in the last 2 years) and causal attendees (patients 18 or over who had not attended for a dental examination for the past 2 years and who attended at time of questionnaire in response to a dental problem) each completing a self-administered questionnaire. The most frequent reason cited by regular attendees for their asymptomatic attendance was 'to keep my teeth' (96%), followed by a concern with the early diagnosis of problems and the cosmetic appearance of teeth, the avoidance of pain and to encourage their children to attend the dentist regularly. Fifty six per cent of irregular attendees reported a fear or a dislike of dental treatment, followed by concerns about cost (41%) and time (32%). The OFT survey however, reported the primary reason for not being registered with a dentist was overwhelmingly lack of perceived need (43%), in a similar cohort of patients. Fear or dislike of dentists was much less frequently reported (2%). This discrepancy over the primary reason for non-attendance could possibly be explained by exploring the circumstances in which the research took place; questionnaires in the Bullock and coworkers study were completed in the dentists waiting room, which may have exacerbated any fears of the dentist/ dental treatment (Bullock et al. 2001).

The results of several studies that focus on attendance of specific demographic groups report similar results in many instances. A sub-group analysis of older people within the Bullock and co-workers study, revealed that the prime reason for non-attendance was lack of perceived need (Bullock et al. 2001). A study on non-attending dentate older adults conducted within three areas of Britain by Steele and co-workers also reported a perception that there was no need to attend as the most common factor for non-attendance. A significant proportion of respondents also had concerns over the high financial cost (22-37.5%) and a fear or dislike of the treatment (23.6-38.2%) (Steele et al. 1996). I In another study of expectant mothers (Rogers et al. 1991), the main factor for non-attendance was the same although fear was reported more frequently () than the other reports, which again, could have been exacerbated as the research was conducted in a clinical setting (Rogers et al. 1991).

Studies that focus on dependent groups (children, adults with disabilities and frail older people) demonstrate the way in which their dental attendance depends on other individuals. Hendricks and co-workers for example, reported that asymptomatic dental attendance among children is based on the tension in the relationship between the mother's positive attitude towards preventative care versus the fear and dislike of pain or discomfort caused to their children (Hendricks et al. 1990). Mothers' past experience of dentistry

also influenced attendance patterns, in addition to a lack of confidence or issues of trust. Newsome and co-workers also outlined however, the way in which childhood dental anxiety can also negatively impact on attendance (Newsome et al. 1999). In a study on reported barriers to dental care for dependent older adults by Lester and co-workers, responses by both carers and patients themselves were recorded and compared (Lester et al. 1998). While patients most frequently reported lack of perceived need and cost as the most influential factors affecting their attendance, the carers of this same group of patients cited transport, health, cost and lack of escort as the most significant reasons.

3.5.4 Satisfaction with NHS dental services in England and Wales

The scope of this search was limited to people who believed they were currently registered with an NHS dentist (although there may be a sub-set of these who were unknowingly deregistered) and to their satisfaction with the NHS dental service. It did not cover access to NHS dental services. In addition, it was important that the views of a nationally representative sample of the population were sought as findings from regional studies may be misleading as service provision varies within England and Wales.

The most recent and comprehensive survey that considered the satisfaction of the public with NHS dentistry was conducted by the Office of Fair Trading (OFT) in 2003. The Consumer's Experience of Dental Services (Office of Fair Trading 2003) comprises nearly 4,000 interviews with adults over 18 years of age, nearly 2,000 of whom said they were registered with an NHS dentist. Newsome and co-workers also provides a review of studies from 1980 to 1997 that look at patient satisfaction, although it is not apparent if these studies were restricted to the NHS service (Newsome et al. 1999). Two additional reports published recently, Calnan and co-workers (Calnan et al. 1999) and Hancock and co-workers (Hancock et al. 1999), were conducted on a much smaller scale and there is substantial overlap in conclusions.

The OFT study concluded that NHS patients are generally positive about quality of service they receive, information provided, advice and value for money (Office of Fair Trading 2003) although with the exception of value of money, private patients rated their dentists significantly higher. Calnan at al's work on NHS dental patients reported that there was some evidence to suggest that older people value the service slightly higher compared with the younger population, although the effect is small (Calnan et al. 2003). Related to this, there is also an overall confidence in dentists, which seems to increase with age. Both private and NHS patients aged 15-24 are significantly less confident than any age group, while those aged 65 and over have the highest mean score for confidence (in their dentists). In terms of areas of patients dissatisfaction, only 6% of both private and NHS patients in the OFT survey said that they had cause to complain. The most common grievance was bad treatment, followed by incompetence and pain and infection. Although only 3% of all patients actually did complain, it should be noted that 70% of NHS patients who had not complained, were not aware of the procedure to do so. There was also a low satisfaction among NHS patients regarding how the complaint was handled (Office of Fair Trading 2003).

While the general trends reported by the OFT study are reliable, the design of such surveys are limited by their lack of flexibility in possible responses, the potential for poor interpretation of the questions/ answers and their intention, which may create suspicion by respondents. The review by Newsome and co-workers for example, recognised that studies seeking to explore patient satisfaction with NHS dentistry often explore patient's perceptions of various service quality attributes (Newsome et al. 1999). For instance, although some patients may acknowledge instances in which they have received poor treatment, it is unlikely that they will be able to assess all levels of clinical competence in dentistry, yet the OFT survey cited 'bad treatment' as being the strongest determinant of dental satisfaction. This illustrates how impressions of the service are usually formed from a number of other features. The Newsome and co-workers review suggests that interpersonal factors (including provision of information, a caring attitude and discussion with the patient over treatment options) are consistently reported by patients to be the most important factors in a dentist. Furthermore, the cost of treatment per se, is not a source of contention with patients who are within the NHS system, but the *communication about fee (for example,* ignorance of charge until after the treatment or anger about the way in which the final bill was presented etc).

In conclusion, patients are generally satisfied with their NHS dental service and they view interpersonal factors with the dentist as the most important aspect of this satisfaction.

4 Economic Modelling

4.1 Methods

Currently, the most relevant published study of the cost-effectiveness of dental recall intervals is the model contained in the HTA Report. However, this study had a number of limitations, including the following:

- The HTA Report does not state what assumptions/data were used in the model that would lead to oral health being greater with shorter recall intervals
- It considered only dental caries prevention and not other aspects of oral health
- The outcome used for health gain in dental caries prevention (in the model for adults it was number of DMFT at age 80) was not ideal.

Using evidence from this Guideline's systematic review we decided to construct a modified model that would improve on limitations one and three. However, the incorporation of other aspects of oral health (limitation two) was not possible because of the lack of suitable data and also the absence of an overall measure of health outcome.

Despite these modifications, the model presented in this guideline (see Appendix D) is highly constrained by data availability and therefore cannot be used to decide optimal recall intervals. Its primary purpose is to explore the possible patterns of cost-effectiveness, identify the main parameters driving cost-effectiveness and highlight gaps in the evidence-base such that cost-effectiveness of recall intervals can be more adequately addressed in the future.

The new model took the following characteristics from the HTA Report model:

- The objective was to estimate the relative cost-effectiveness of different recall intervals between 3 months and 36 months (based on caries risk)
- The target population was a cohort of general population of England and Wales aged 12 at baseline.[1]
- A cohort simulation (Markov model) estimated oral health and the number of both Oral Health Reviews (OHR) and caries treatment episodes over the lifetime of the patients to age 80.

4.2 Conclusions

With the evidence base as it stands, we are currently a long way from determining the optimal dental recall intervals on the basis of cost-effectiveness. If we are to assess this in the future then research is needed that will:

Give a more precise definition of the components of and duration of an oral health review.

[1] The HTA Report also conducted a model for children with deciduous dentition, however because of the lack of precision in the model parameters, we have restricted our analysis to the 12-80 age range.

Further the development of outcome measures (such as the quality-adjusted tooth-year) that capture the most important aspects of oral health by weighting different health states according to people's preferences.

Estimate the rate of transmission over time between these different health states (e.g. between decayed and filled or between decayed and missing). Ideally this should be estimated separately for different risk subgroups

Evaluate how different recall intervals affect the transmission rates, preferably in the context of a well-conducted clinical trial. (Ideally this should be stratified by risk subgroups)

For the chosen health outcome measure, determine a cost-effectiveness threshold, beyond which the clinical improvement would be considered too small to justify the cost.

The model presented in Appendix 4 represents a starting point from which more sophisticated models based on good quality data should be developed.

5 Recommendations

The recommendations in this guideline are designed to assist dentists in using their clinical judgment to assign recall intervals that are appropriate to the needs of individual patients. These recommendations are based on a review of the scientific literature that was considered by the Guideline Development Group in the context of its collective clinical expertise and views on patient preferences.

This Chapter is divided into two parts (Part I and Part II). Part I contains the Clinical Recommendations. Part II discusses how the clinical recommendations can be implemented in practice. A 'checklist' is provided that will assist clinicians in the process of assigning a recall interval for an individual patient. The contents of the 'checklist' and the manner in which it should be used when assessing a patient's risk of or from dental disease are outlined. A diagram is then provided that illustrates and summarises for clinicians the process of selecting, agreeing and reviewing appropriate recall intervals. Lastly in Part II, a series of clinical scenarios are presented to illustrate how recall interval selection will work in practice when the guidance is followed.

This guidance is evidence-based and the grading scheme (A, B, C, D, GPP) used for the following recommendations is that described in Chapter One. A recommendation's grade may not necessarily reflect the importance attached to the recommendation. For example, the Guideline Development Group felt that the principles underlying the individualisation of recall intervals advocated in this guideline are particularly important. However, most of the related recommendations receive a D or good practice point (GPP) grading.

5.1 Part I: Clinical Recommendations

1. The recommended interval between oral health reviews should be determined specifically for each patient on the basis of disease levels and risk of or from dental disease. (Grade D)
This interval may vary over time depending on the state of the patient's oral health, their risk of or from dental disease, increasing understanding about the appropriateness of previously used intervals and the preference of the patient. In deciding on an appropriate interval dentists should consider the modifying factors in the 'checklist' presented in section 5.2 of this Chapter.

2. During an Oral Health Assessment or Oral Health Review, the dental team (as led by the dentist) should ensure that comprehensive histories are taken, examinations conducted and initial preventive advice is given. This will allow the dental team and the patient (or parent/guardian of the patient) to discuss, where appropriate:

- The effects of oral hygiene, diet, fluoride use, tobacco and alcohol on oral health. (Grade B)
- The risk factors (in the 'checklist') that may potentially impact on a patient's oral health and the implication these will have for deciding the appropriate time interval for their next routine visit (Grade B)
- The outcome of previous care episodes and the suitability of previously recommended intervals (GPP)
- The patient's ability/desire to visit the dentist at the interval indicated by their individualised risk factors and by the clinical judgment of the dental team (GPP)
- The monetary cost to the patient of the Oral Health Assessment or Review and any subsequent treatments (GPP)

3. The interval before the next Oral Health Review (or Assessment) should be chosen, agreed and recorded. This choice of interval should be made either at the end of an Oral Health Review (or Assessment) if no further treatment were indicated, or at the completion of a specific treatment journey. (GPP)

4. The recommended shortest and longest intervals between Routine oral health reviews are as follows.

The shortest interval between oral health reviews for all patients should be 3 months. (GPP)

The Guideline Development Group considered that a recall interval of less than 3 months was outside the scope of a 'routine dental recall'. The Guideline Development Group acknowledged that there may be circumstances where a patient may need to be seen more frequently. However, this would usually be for a specific reason or reasons (*for example,* actual disease management, part of current dental interventions, intervals between examinations related to ongoing courses of treatment, emergency dental interventions, intervals between episodes of specialist care) rather than for an Oral Health Review as such.

The longest interval between Oral Health Reviews for people below 18 years of age should be 12 months. (GPP)

There is evidence that the rate of progression of dental caries can be more rapid in children and adolescents than in many older persons. The rate of progression appears to be faster in primary teeth than in permanent teeth. The latter may be due to anatomical differences between primary and permanent teeth, specifically the thinner enamel and dentine in primary teeth and their broader proximal contacts (See Chapter Three, Section 3.1.2).

Recall intervals of no longer than 12 months afford clinicians the opportunity to deliver and reinforce preventive advice and to raise awareness of the importance of good oral health. The GDG consider that this is particularly important in young children who are at a stage in their personal development when all the foundations for life-long dental health are laid down (*that is,* dietary habits, oral hygiene practices *etc*.).

Periodic developmental assessment of the dentition is required in children.

The longest interval between Oral Health Reviews for people 18 years old and over should be 24 months. (GPP)

The Guideline Development Group considered that recall intervals for patients who repeatedly demonstrated that they can maintain oral health can be extended over time up to an interval of 24 months. However, it was felt that intervals beyond 24 months could unacceptably diminish the professional relationship between dentist and patient. In addition, given that patients' lifestyles may change, it was considered undesirable to extend recall intervals beyond this period.

5. The specific recommended interval between routine Oral Health Reviews for an individual patient at a specific point in time should be tailored to meet their needs on the basis of an assessment of disease levels and risk of or from dental disease. This assessment should incorporate the best available scientific evidence, the individual clinical judgement and expertise of dental personnel and take into consideration the values and expectations of the patient. (GPP)

The Guideline Development Group has prepared examples of how this process can best be achieved and communicated to patients and the dental team, these examples are set out in Part II of this Chapter.

6. tients should be assigned (at a particular po al of 3, 6, 9, or 12 months if they are below 18 ye 5, 18, 21 or 24 months if they are 18 years or mo

7. d the assigned recall interval within the cu tem, as well as the patient's agreement or dis)

8. agreed and assigned will be reviewed again, at the next Oral Health Review, to learn from the patient's responses to the oral care provided and the health outcomes achieved. This feedback and the findings of the Oral Health Review will be used to adjust the next recall interval chosen. (GPP)

5.2 Part II: Implementing the Clinical Recommendations: selecting the appropriate recall interval for an individual patient

5.2.1 Introduction

The selection of an appropriate recall interval for an individual patient is a multifaceted clinical decision that is difficult, if not impossible, to evaluate mechanistically. In making that decision, clinicians must integrate their own clinical expertise (the proficiency and judgment they have acquired through clinical experience and clinical practice) with the best available clinically relevant scientific evidence relating to a patient's oral and general health. This guideline aims to assist clinicians in this decision-making process by:

- advocating that clinicians should carry out a risk assessment for each individual patient
- identifying specific factors that form an integral part of this risk assessment and that should be taken into account when assigning a recall interval for each individual patient.

The risk assessment process and its application to the selection of recall intervals is founded on the premise that the frequency and type of oral health supervision needed by an individual patient depends on the likelihood that specific diseases or conditions may develop. When carrying out a risk assessment for a patient, clinicians should examine the patient for a) risk factors that may have a negative impact on oral health and b) protective factors that may promote oral health. By carrying out a risk assessment for each individual patient every time they attend for an oral health review the dental professional will be better positioned to make specific preventive and treatment recommendations and to assign a recall interval for that patient that is particular to their individual needs (Bright Futures 1996).

A number of factors that may modify the choice of recall interval and that feed into the risk assessment process are identified in the form of a 'checklist' presented on the following pages. It should be noted that this 'checklist' is merely intended as a guide to assist the clinician and the dental team when carrying out a risk assessment. It is by no means intended to be an exhaustive list encompassing all of the factors that may influence the choice of a recall interval for an individual patient. Furthermore, it should be noted that there is insufficient evidence to assign a 'weight' to individual factors included in the 'checklist' and dentists must use their clinical judgment to weigh the risk and protective factors for each individual patient.

In addition, although the Guideline Recommendations are firm, we recommend further research to explore the most effective and practical mechanisms for implementing the key recommendations contained in this guideline in general dental practice. Any proposed delivery mechanism, such as the 'checklist', must be rigorously piloted and evaluated. We have

presented this ‘checklist’ and the accompanying text as a preliminary guide to assist clinicians in assigning recall intervals. We would also consider it appropriate for patients to receive a copy of their ‘checklist’ on request.

The ‘checklist’ outlined overleaf is followed by an explanatory text which clarifies each individual heading and entry in the’checklist’. In this explanatory text the medical history is discussed first and a Table is then presented which provides details of the remaining factors included in the checklist. References are given in this Table to preceding sections of this guideline where these factors have been considered in greater detail. A further section then explains how this ‘checklist’ should be used as part of a risk assessment process for each individual patient.

Checklist of Modifying Factors

Patient's Name: ..... Date of Birth: .....

Oral Health Review Date:	Date		Date		Date	
Medical History	Yes	No	Yes	No	Yes	No
Conditions that potentially put the patient's general health at increased risk if they should develop dental disease/infection (e.g. cardiovascular disease, bleeding disorders, immunosuppression)	☐	☐	☐	☐	☐	☐
Conditions that increase a patient's risk of developing dental disease (e.g. diabetes, xerostomia, long term intake of medications containing sugar, epilepsy {phenytoin therapy and gingival overgrowth}, acid reflux leading to tooth surface loss)	☐	☐	☐	☐	☐	☐
Conditions that may complicate the provision of dental treatment or may compromise the patient's ability to maintain their oral health (e.g. special needs patients, cleft lip/palate, severe malocclusion, anxious./nervous/phobic patients)	☐	☐	☐	☐	☐	☐
Social History						
High caries in mothers and siblings	☐	☐	☐	☐	☐	☐
Tobacco use	☐	☐	☐	☐	☐	☐
Excessive alcohol use	☐	☐	☐	☐	☐	☐
Family history of chronic or aggressive (early onset/juvenile) periodontitis	☐	☐	☐	☐	☐	☐
Dietary Habits						
High sugar intake	☐	☐	☐	☐	☐	☐
Exposure to Fluoride						
Use of fluoride toothpaste	☐	☐	☐	☐	☐	☐
Other sources of fluoride *eg* live in a water fluoridated area	☐	☐	☐	☐	☐	☐
CLINICAL EVIDENCE/DENTAL HISTORY						
Recent and Previous Caries Experience						
New lesions since last check-up	☐	☐	☐	☐	☐	☐
Anterior caries or restorations	☐	☐	☐	☐	☐	☐
Premature extractions due to caries	☐	☐	☐	☐	☐	☐
Past root caries or large number of exposed roots	☐	☐	☐	☐	☐	☐
Heavily restored dentition	☐	☐	☐	☐	☐	☐
Recent and Previous Periodontal Disease Experience						
Previous history of periodontal disease	☐	☐	☐	☐	☐	☐
Evidence of gingivitis	☐	☐	☐	☐	☐	☐
Presence of periodontal pockets (BPE code 3 or 4) and/or bleeding on probing	☐	☐	☐	☐	☐	☐
Presence of furcation involvements or advanced attachment loss (BPE Code *)	☐	☐	☐	☐	☐	☐
Mucosal Lesions						
Mucosal Lesion	☐	☐	☐	☐	☐	☐
Plaque						
Poor level of oral hygiene	☐	☐	☐	☐	☐	☐
Plaque retaining factors (e.g., wearing of orthodontic appliances)	☐	☐	☐	☐	☐	☐
Saliva						
Low saliva flow rate	☐	☐	☐	☐	☐	☐
Erosion and Tooth Surface Loss						
Clinical evidence of tooth wear	☐	☐	☐	☐	☐	☐
Recommended recall interval for next oral health review:		months		months		months

Notes:

5.2.2 Explaining the Checklist

The headings in the checklist that appear in bold type and are underlined (**Medical History**, **Social History**, **Dietary Habits** *etc*) are presented in the order that the clinician would normally acquire and record information at an oral health review. In other words, the clinician would typically commence an oral health review by inquiring about the patient's *Medical History* (and any change in that medical history since the last oral health review), followed by an assessment of the *Social History*, *Dietary Habits* of the patient and their use of or *Exposure to Fluoride*. The clinician would then glean '*Clinical Evidence*' and the patient's '*Dental History*' from their clinical examination of the patient by recording the patients past disease experience, by detecting the signs and symptoms of new disease and by determining the progression or lack of progression of existing or early disease that may have been noted and preventively managed at the last visit. During the course of the clinical examination the clinician would check the patient's oral hygiene and *Plaque* levels, observe their *Saliva* flow rate, and record any evidence of *Erosion and Tooth Surface Loss*.

The various entries in the 'checklist' that appear under each of these headings pertain to factors that influence a patient's risk of or from dental disease. These factors have been selected based on the evidence reviewed for this guideline and take into account the collective expert opinion of the GDG.

5.2.2.1 Medical History

Medically compromised patients may be at increased risk of or from dental disease. We have provided guidance for clinicians by identifying conditions that may increase a patient's risk of or from dental disease and for whom more frequent recalls may be required. This is not intended to be an exhaustive exploration of all medical conditions that may have an impact on the dental management of a patient. If the dental team are concerned about aspects of a patient's medical history, they should consult with the patient's doctor/specialist when deciding on the delivery of appropriate care.

We consider it advisable for clinicians to assess a patient's medical history under the three headings identified in the 'checklist':

1) Conditions that potentially put the patient's general health at risk should they develop dental disease/infection. These conditions include, but are not limited to:

- Congenital/acquired cardiovascular disease carrying an increased risk of infective endocarditis
- Haematological conditions/bleeding disorders/anti-coagulant therapy (for example, haemophilia, Von Willebrands disease, homozygous sickle cell anaemia, thalassaemia, cyclic neturopenia)
- Immunosuppression (for example, HIV/AIDS, transplant patients)

For patients with the above conditions it is imperative that emphasis should be placed on primary prevention (the prevention of oral disease before it occurs) and secondary prevention (limiting the progression and effect of oral diseases at as early a stage as possible after onset) thus minimising the necessity for operative/surgical intervention.

1b): Conditions that increase a patient's risk of developing dental disease. These conditions include, but are not limited to:

- Diabetes: People with diabetes (both type I and type II) are at increased risk of developing destructive periodontal disease. This may be due to an altered periodontal tissue response to plaque. Therefore, individuals with diabetes may need a more frequent recall. Inadequate plaque control and the presence of other risk factors will modify the recall interval further.
- Xerostomia or 'dry mouth' can occur as a side-effect of cancer treatments such as head and neck radiotherapy. It may also be associated with specific conditions such as Sjögrens Syndrome or particular drug therapies (*for example,* anti-cholinergics, tricyclic anti-depressants, anti-psychotics, tranquillizers, hypnotics, anti-hypertensives, diuretics, anti-parkinsonian drugs, appetite suppressants, muscle relaxants, expectorants). Patients with inadequate salivary function and reduced salivary flow rate are at increased risk to dental caries due to the loss of cleansing and buffering action of saliva and may require more frequent oral health supervision.
- Conditions requiring the use of long-term medications containing glucose, sucrose or fructose. These patients are at increased risk to dental caries due to the enhanced cariogenic challenge resulting from the frequent sugar intake. Extended recall intervals are contraindicated in such patients due to the potential for rapid progression of caries.
- Epilepsy: In patients with epilepsy, gingival overgrowth may occur as a side effect of drug therapy, specifically phenytoin. The risk factor most associated with gingival overgrowth in such patients is poor oral hygiene. Such patients may benefit from more frequent recalls to deliver, monitor compliance with, and to reinforce oral hygiene instruction. However, although improved plaque control may treat the inflammatory component of gingival overgrowth, it may be of little benefit for reducing the fibrous component.
- Acid reflux into the mouth increases a patient's risk of developing tooth surface wear, and can occur as a consequence of disorders such as gastro-oesophageal reflux. It is also associated with eating disorders, especially bulimia. Such patients may benefit from more frequent recall to reinforce preventive advice designed to limit the erosive effect of acid reflux (*for example,* advising patients that they should not brush immediately following acid reflux/vomiting). Regular follow up is essential in such patients to ascertain whether the dentition is stable or deteriorating.
-

1c) Conditions that may complicate the provision of dental treatment or may compromise the patient's ability to maintain their oral health

- Special needs patients (a person who has a mental or physical impairment which has a substantial and long-term adverse effect on their ability to carry out normal day-to-day activities)
- Cleft lip/palate, severe malocclusion
- Anxious/nervous/phobic patients

For all of the above patients, emphasis should be placed on primary prevention (the prevention of oral disease before it occurs) and secondary prevention (limiting the progression and effect of oral diseases at as early a stage as possible after onset) thus minimising the necessity for operative/surgical intervention.

The provision of the latter may be extremely difficult in such patients and may, on occasions, necessitate a general anaesthetic with its attendant risks. For extremely anxious, nervous, or phobic patients, more frequent recalls may provide an opportunity for primary prevention and allow for gradual acclimatization to dental procedures via non-invasive preventive interventions.

Heading and entries in checklist	Evidence Source (Chapter in guideline where discussed)	Rationale for inclusion in checklist and explanatory notes
Social History		
4. Caries in mothers and siblings	**4** Review of caries risk assessment and prediction literature (Chapter Three Section 3.1.1)	**4** Applies to children only. The presence of caries in mothers and siblings is an indicator of increased caries risk for an individual child.
5. Tobacco use	**5** Review of risk factors for periodontal disease and oral cancer (Chapter Three Sections 3.2.3 and 3.3.3)	**5** Tobacco use is the most significant modifiable risk factor for periodontal disease. Smokers have been shown to have between a two-fold and seven-fold increase in risk for having periodontitis and/or periodontal tissue loss than non-smokers. Tobacco use (both smoking and smokeless tobacco[*i.e*. chewing tobacco, chewing tobacco with betel quid, snuff] also a risk factor for oral cancer.
6. Excessive alcohol use	**6** Review of risk factors for oral cancer (Chapter Three Section 3.3.3)	**6** Excessive alcohol consumption is a risk factor for the development of oral cancer. Current UK recommendations are that men should not drink more than 21-28 units of alcohol per week and women should not drink more than 14-21 units. Tobacco use and alcohol consumption are associated with oral cancer in a dose response fashion and have a synergistic effect when combined. Clinicians should maintain a high level of vigilance where these factors are associated with clinical evidence of potentially malignant lesions. Clinicians should also be aware that cases of oral cancer have been reported in young people who have little or no exposure to tobacco or alcohol, emphasising the importance of perpetual vigilance and of carrying out a thorough systematic examination of the oral mucosa for every patient as an integral part of their oral health review, regardless of the presence or absence of risk factors
7. Family history of chronic or aggressive (early onset/juvenile) periodontitis	**7** Review of risk factors for periodontal disease (Chapter Three Section 3.2.3) and GDG expertise.	**7** Although comparatively rare, this group of patients need regular supervision to try to control rapidly progressive disease.

Dietary Habits **8.** High sugar intake	**8** Review of caries risk assessment and prediction literature (Chapter Three, Section 3.1.1)	**8** High sugar intake increases caries risk. The frequency, amount and consistency of sugar containing foods and drinks consumed may impact on a patient's caries risk. Long-term regular low doses of medications containing glucose, fructose or sucrose may also increase caries risk (see also Medical History section above). The National Clinical Guidelines (1997) produced by the Faculty of Dental Surgery, suggest that greater than three sugary intakes daily is indicative of an increased caries risk.
Exposure to Fluoride **9.** Use of fluoride toothpaste	**9** Review of caries risk assessment and prediction literature (Chapter Three Section 3.1.1)	**9** Regular brushing with a fluoride containing toothpaste reduces caries risk.
10. Other sources of fluoride e.g. live in a fluoridated area	**10** Evidence from recent Cochrane fluoride reviews supplemented by GDG opinion	**10** The dental team should be aware of the fluoride status of local water supplies and adjust their caries risk assessments accordingly. Teams in fluoridated areas must, however, be sensitive to the risk status of individuals who have not had life long residence in fluoridated areas and also be alert for those individuals for whom the overall cariogenic challenge is abnormally high
Recent and Previous Caries Experience **11.** New lesions since last check-up **12.** Anterior caries or restorations **13.** Premature extractions due to caries **14.** Past root caries or large number of exposed roots **15.** Heavily restored dentition	**11-15** Review of caries risk assessment and prediction literature (Chapter Three, Section 3.1.1). Individual entries (new lesions *etc*.) are based on the expert opinion of GDG and 'risk assessment tables' in (Faculty of General Dental Practitioners 1998;	**11** The most consistent predictor of caries risk is past caries experience (clinical evidence of previous disease). Patients with clinical evidence of new lesions since their last check-up, anterior caries or restorations, premature extractions due to caries, past root caries or large number of exposed roots or who have a heavily restored dentition, can be considered as being at increased risk of developing future disease.

	Kidd 1998;Scottish Intercollegiate Guideline Network 2000)	

Recent and previous periodontal disease experience **16.** Previous history of periodontal disease **17.** Evidence of gingivitis **18.** Presence of periodontal pockets (BPE code 3 or 4) and/or bleeding on probing **19.** Presence of furcation involvements or advanced attachment loss (BPE Code*)	**16-19** Review of periodontal diseases literature (Chapter Three Section 3.2).	**16-19** Gingivitis has been shown to be a risk factor for periodontitis and conversely, a continuous absence of gingival bleeding is a reliable predictor of periodontal health. Periodontal disease has been shown to progress faster in untreated disease than treated periodontitis.
20. Mucosal Lesion	**20.** Review of oral cancer literature, including survival rates from oral cancer and stage at initial presentation (Chapter Three, Section 3.3.2) risk factors for oral cancer (Chapter Three, Section 3.3.3) and potentially malignant lesions and conditions (Chapter	**20.** Oral cancer often apparently arises de novo from clinically normal mucosa. However, there are a number of clinically identifiable precursor lesions and conditions, principally leukoplakia, erythroplakia, oral lichen planus and oral submucous fibrosis. Erythroplakia has a high potential for malignant transformation. The reported rates of malignant transformation of leukoplakia in the international literature range from 0.3 to 17.5%. Estimates of the percentage of leukoplakias that regress to normal vary between 4.6% per year to 28.6%. Leukoplakia lesions on the floor of the mouth, lateral tongue and lower lip are most likely to show dysplastic or malignant change. Clinicians should maintain a high index of suspicion for all intra-oral areas that appear unusual.

	Three, Section 3.3.6)	Patients whose cancer is detected at an early stage generally have improved survival times than those presenting with late stage disease and in addition will usually require less radical treatment.
21. Plaque Poor level of oral hygiene Plaque retaining factors	21. Review of caries risk assessment and prediction literature (Chapter Three, Section 3.1.1). Review of risk factors for periodontal disease (Section 3.2.3)	**21.**Dental plaque is a key aetiological factor in the development of dental caries and periodontal diseases. Plaque retaining factors include appliances (fixed orthodontic appliances, partial dentures), status of existing restorations, crowded teeth, deep fissures.
22. Saliva Low saliva flow rate	22. Review of caries risk assessment and prediction literature (Chapter Three Section 3.1.1).	22. See Sections 3.1.1 and Section on Medical History above.
23. Erosion and tooth surface loss	23 Expert opinion of GDG	See section on 'acid reflux' in Medical History above. Tooth wear is usually due to a combination of processes, abrasion, attrition and erosion. The preventive management of tooth wear in an individual depends on the aetiology and which of these processes predominates. Management may include appropriate oral hygiene instruction, provision of occlusal protection, dietary assessment and counselling, determination of any reflux activity. Adequate follow up is required to determine whether the dentition is stable or deteriorating (Shaw 2003).

5.2.3 Using the 'checklist' as part of a risk assessment for each patient

This 'checklist' forms part of a risk assessment process that can be thought of as involving three stages:

1. **Identification** (identifying the risk and protective factors present in each individual patient)
2. **Evaluation** (evaluating these factors in the context of the patient's past and current disease experience)
3. **Prediction** (using all of the above information to predict the potential future occurrence of disease in that patient and to assign an appropriate recall interval)

1) **Identification:** The first stage in the risk assessment process involves using the 'checklist' to identify in each individual patient the risk and protective factors that may negatively or positively impact on their oral health. It is important to appreciate that, because some of these factors relate to personal and behavioural habits and practices (*for example,* dietary habits, oral hygiene practices, smoking, alcohol consumption *etc*), the information provided by the patient may not be entirely accurate. There is often a marked discrepancy between 'reported' and 'actual' behaviour and some patients may also be unwilling or may exercise their right not to disclose this information. Thus, although these factors can be used to give an indication of a patient's risk status, their overall usefulness in the process of assessing a patient's risk of developing dental disease may be compromised by the validity of the data collected.

Furthermore, a number of the factors identified in the 'checklist' are *necessary* but are not *sufficient* to produce dental disease. They are *necessary* in the sense that *disease cannot occur in the absence of these factors*. However, they are not *sufficient* in the sense that *disease does not inevitably occur in the presence of these factors*. For example, dental plaque is recognised as a key aetiological factor in both periodontal disease and dental caries. However, this does not mean that all patients with poor oral hygiene and plaque control will develop periodontal disease and dental caries. In the case of periodontal disease, the attack from dental plaque, the response of the host and the modifying effect of risk factors will account for a variety of disease patterns. Dental caries is also a multifactorial disease and a number of other factors must be acting concurrently for dental caries to occur. Thus it is frequently the *combinations of factors* present in an individual patient rather than individual factors *per se* that are important in terms of their potential impact on that patient's oral health. Hence, the second stage in carrying out a risk assessment for an individual patient must involve 'weighing and evaluating' the potential impact (both past and present) of these combinations of factors.

2) **Evaluation:** Having identified what factors are present or absent in an individual patient, the clinician must relate this information to the patient's past and current disease experience. This is readily achieved by considering these factors in the context of the clinical evidence obtained from a clinical examination of the patient to detect the signs and symptoms of their past and

recent/current disease experience. The patient's past disease experience essentially represents the cumulative effect of all risk and protective factors, known and unknown, to which an individual has been exposed over their lifetime. As noted earlier (Chapter Three, Section 3.1.1), past caries experience is the most reliable predictor of future caries experience. However, exposure to risk and protective factors and hence disease activity may vary over time thus reducing the predictive power of past disease experience at the individual level (Hausen 2003). For example, even if a patient has had no caries experience in the past, if they have developed new carious lesions since their last oral health review, this is a clear indication that there has been recent exposure to risk factors sufficient to initiate and produce the disease process. In this situation, due to a change in the patient's circumstances (exposure to risk factors), the non-occurrence of disease in the past has not acted as a reliable predictor of the non-occurrence of future disease. This serves to emphasise the importance of carrying out a risk assessment every time a patient attends for an oral health review and of evaluating the patient's *present disease experience*, which is a clinical manifestation of the effects of recent and current exposure to risk and protective factors.

3) **Prediction:** By relating the 'checklist' of factors to the past and current disease experience of the patient, clinicians can then predict what the patient's future disease experience is likely to be and can decide on the frequency of recall and the type of oral health supervision that may be required by the patient in the future. The process of using all of the available information to predict the patient's future disease experience and to assign an appropriate recall interval involves the use *clinical judgment and expertise*. The value and practical utility of this clinical judgment is supported by our review of the caries prediction literature. As noted earlier (Chapter Three, Section 3.1.1), the clinical judgment of the dentist and their ability to combine risk factors, based on their knowledge of the patient and clinical and socio-demographic information obtained during a clinical examination, is as good as, or better than, any other method of predicting caries risk. Hence, dentists should choose a recall interval for each patient that, in their clinical judgment and based on their knowledge of the patient and their risk and protective factors, is appropriate for that patient in order to promote and maintain their oral health. This recall interval may need to change over time if the patient's risk and protective factors alter. Both clinician and patient should attempt to reduce the patient's risk factors and enhance their protective factors and alter the recall interval accordingly.

It is reasonable to assume that the ability of the clinician to predict the likely occurrence or non-occurrence of future disease and their ability to assign an appropriate recall interval for an individual patient will improve as the clinician builds up an accurate record of the patient's disease experience and determines the rate at which disease is or is not progressing over time. In this context, the longevity of the professional relationship between dentist and patient can be considered as having an important input into the choice of recall interval. By implication, the greatest uncertainty regarding what recall interval to assign for an individual patient will exist where the dentist is unfamiliar with the patient's disease experience *for example,* when the patient

is a new or recent patient. In such circumstances it is good practice for clinicians to manage this uncertainty by adopting a precautionary approach and assigning a conservative recall interval initially and then progressively altering this interval over time (where appropriate) on the basis of the clinical evidence obtained at each oral health review. For example, if a dentist detects a 'white spot lesion' in a new patient, the dentist will be unable to determine if this lesion has recently appeared or has been present without progressing for years. In such a situation of uncertainty it is prudent for the clinician to err on the side of caution by applying topical fluoride, delivering preventive advice and assigning a short recall interval initially to monitor the lesion. If the lesion fails to progress over time, the recall interval can be modified accordingly.

The same management principles will apply for patients with a medical history that may impact on their risk of or from dental disease. The recall interval for patients with the medical conditions outlined earlier in this Chapter will vary from patient to patient and will depend, as emphasised above, on the clinical evidence and dental history of the patient and the presence of other risk and protective factors. For new patients with these medical conditions clinicians should adopt a precautionary approach and assign a conservative recall interval initially, extending this interval over time in accordance with the clinical evidence and the data obtained at each oral health review.

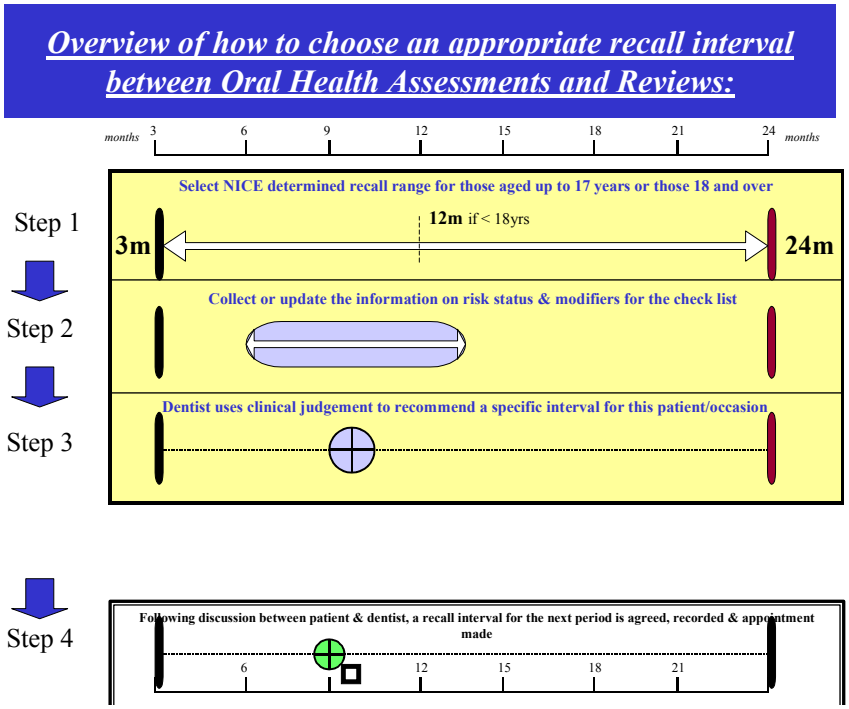
The stages in the risk assessment process outlined above represent good clinical practice. It is not desirable to be unduly prescriptive about types of patients with specific conditions or specific factors that warrant assigning a particular recall interval. The Guideline Development Group are simply advocating that clinicians should consider the factors outlined in the 'checklist' each time they examine a patient and should understand the importance of considering these factors in the context of the patient's past and current disease levels as determined by a careful clinical examination of the patient. Patients (or parent/guardian of the patient) must be informed that a single 'set' interval for all patients for the whole of their lives is no longer deemed appropriate and that for any individual this interval may vary throughout life.

It is envisaged that an experienced clinician should be able to carry out a risk assessment for each individual patient quickly, easily and intuitively as part of an oral health review. In order to illustrate how this can operate in practice we have presented in the following sections:

- a diagram that demonstrates to the dental team the stages involved in selecting an appropriate recall interval for an individual patient
- a number of ***'clinical scenarios'*** involving the assignment of recall intervals. These scenarios are not intended to be an exhaustive exploration of the myriad clinical situations that dentists may encounter on a daily basis. Rather, they merely ***serve to highlight the logic and rationale behind the key recommendation contained in this guideline, namely that "the recommended interval between oral health reviews should be determined specifically for each patient depending on disease levels and risk of or from oral disease."***

5.3 The Process of Recall Interval Selection

The following diagram has been designed and developed by the Guideline Development Group to illustrate to the dentist and dental team the sequential process used to select a recall interval appropriate to a particular patient at a particular time. This diagram may ultimately be used as a leaflet, poster, model or interactive computer graphic.



The first step is to consider the patient's age and the corresponding upper and lower limits stipulated in this guidance.

The second step involves considering the checklist of modifying factors carefully in the context of the patient's histories (medical, social and dental) and the evidence obtained during the clinical examination.

The third step is where the clinician (advised on many occasions by other members of the dental team) integrates all the diagnostic and prognostic information available at this particular time and uses their clinical judgement to recommend a specific recall interval between now and the next Oral Health Review.

Step four involves discussing the recommended interval with the patient and exploring their preferences and expectations. An agreed interval should result

and this will be recorded and a recall appointment made. If for any reason the patient is unable to accept the recommendation, this should also be recorded.

The appropriateness of the chosen interval should be considered at the next Oral Health Review in order to learn from the patient's responses to the oral care provided and the health outcomes achieved. In this way the next interval may be adjusted accordingly depending on the patient's ability to maintain oral health between Oral Health Reviews.

It may be that the interval is maintained at the same level if it is achieving its aims. Alternatively, in a patient with low disease activity it may be possible to gradually extend the interval out towards the 24-month maximum period – once the patient and the dental team are confident that this is satisfactory. However, patients whose disease activity continues unabated in spite of attempts at preventive care may need the interval to be shortened and may need to receive more intensive preventive care and closer supervision.

5.4 Recall Interval Clinical Scenarios

A number of clinical scenarios devised by the GDG are presented in the following sections. Additional scenarios are presented in Appendix E. These scenarios have been created in order to illustrate the process of assigning a recall interval for an individual patient based on an assessment of their risk of or from oral disease. The scenarios are for illustrative purposes only and are by no means intended to capture every conceivable clinical situation that a dentist may encounter. Furthermore, although a specific recall interval will be agreed at the end of an Oral Health Review, patients should be informed to seek advice from a dentist if there are any significant changes in their medical history, dietary habits, oral hygiene practices etc in the interim that may impact on their risk of or from oral disease. In this context it should be appreciated that (as is the case with the current six month recall regime) no guarantee can be given to patients that new disease will not develop between recall visits.

SCENARIO A

Age: Patient A is four years old
Attendance record: Patient A is attending your practice for the first time (for an Oral Health Assessment).
Medical history: Patient A has no medical history of note.
Social history: Patient A has two older siblings aged 7 and 10 years, who have been patients of yours for the last 2 years. Both older siblings have no decayed, missing or filled teeth and have good oral hygiene.
Dietary habits: Patient A has apparently healthy dietary habits which suggest no specific factors likely to increase risk of caries developing
Use of fluoride: Patient A brushes regularly with fluoride toothpaste twice daily
Clinical evidence/dental history: No previous history of dental caries and no other factors which may increase caries risk
Plaque: Oral hygiene is good with only minimal plaque deposits
Saliva: No specific factors which may lead to reduced salivary flow
Other:

Recall Interval recommended by clinician for next oral health review:
6 months

Rationale: The history taking and clinical examination for this patient reveal no medical or social history of note, the patient has no cavities and has good oral hygiene and dietary practices. However, although there are no obvious risk factors, as this is a 'new patient' with no established dental history, you feel it is prudent to assign a conservative recall interval of 6 months initially.

SCENARIO B

Age: Patient B is 3 years-old.
Attendance record: Patient B has attended twice before although this visit is the first time at this practice.
Medical history: Patient B has no medical history of note.
Social history: The father of Patient B is a smoker.
Dietary habits: Discussions with the mother suggests that the patients sweet consumption is relatively low, although the review of parents' consumption at their OHA found quite a high consumption with sugar being used in tea and coffee.
Use of fluoride: Parents' use a major brand of toothpaste which patient B also uses although the mother says she doesn't like the taste too much.
Clinical Evidence and dental history: All primary teeth are present and there are no signs of any clinical lesions.
Plaque: Small amounts visible on the buccal sulcus around the Ds and Es.

Saliva: Nothing abnormal detected
Other: Both parents have a DMF of above 10 although they commented that they have improved their oral hygiene habits following discussions with their previous dentist. They have not had any new fillings for the past 3 years.

Recall Interval recommended by clinician for next oral health review:
6 months

Rationale
While no clinical lesions have been detected on balance the modifying factors are slightly negative. Oral hygiene is not particularly good, and the child is probably not using too much toothpaste as 'she doesn't like the taste'. Oral hygiene instruction and dietary advice is being offered (to parent and child) as part of the treatment being proposed following the present visit. Should there be no lesions present and OHI has improved at the next visit then it may be possible to extend the recall interval.

SCENARIO C

Age: Patient C is 11.5 years old
Attendance record: Patient C is attending your practice for the first time (for an Oral Health Assessment).
Medical history: Patient C has no medical history of note.
Social history: Patient C has two older siblings aged 13 and 15 years, who have been patients of yours for the last 2 years. Both older siblings have had decay in the primary and permanent dentition. The patient's mother also has a high DMF.
Dietary habits: Patient drinks carbonated drinks at least 3 times per day
Use of fluoride: Irregular brushing and resident in an area with sub-optimal levels of fluoride in the water supply
Clinical evidence/dental history: Three restorations present in primary teeth and there is one carious lesion requiring restoration. There is gingival inflammation in all areas
Plaque: Oral hygiene is poor
Saliva: No specific factors which may lead to reduced salivary flow
Other: None

Recall Interval recommended by clinician for next oral health review:
3 months

Rationale: The presence of a large number of additional risk modifiers (including that this is the patient's first visit to the practice) indicates that a short review interval would be prudent, hence 3 months.

SUBSEQUENT HISTORY: After pro-active prevention, patient's compliance is good, drastically reducing in-between meals drinking of carbonated drinks, improving oral hygiene and using a fluoride toothpaste regularly twice daily. Over subsequent visits no new caries is seen and the recall interval is extended to 6 months.

SCENARIO D

Age: Patient D is 14 years old
Attendance record: Patient D has been attending your practice for regular reviews since 5 years of age.
Medical history: Patient D has no medical history of note.
Social history: Patient D has one younger sibling aged 11 who is caries free. The patient's mother is also caries free.
Dietary habits: Patient D has dietary habits which suggest no specific factors likely to increase risk of caries developing
Use of fluoride: Brushing with fluoride toothpaste regularly twice daily
Clinical evidence/dental history: No previous history of dental caries and no other factors which may increase caries risk. The gingivae are healthy.
Plaque: Oral hygiene is good with only minimal plaque deposits
Saliva: No specific factors which may lead to reduced salivary flow
Other:

Recall Interval recommended by clinician for next oral health review:

12 months

Rationale: Long-standing patient in permanent dentition with known past history. No past history or current evidence of dental disease and medical history clear. No additional modifiers. Hence considered to be at low risk and review interval of 12 months seems reasonable.
SUBSEQUENT HISTORY: Patient develops new caries in two premolars at 15 years of age. It becomes apparent that a habit of frequently "grazing" between meals has become established and the dentist also records that OH has deteriorated. The patients recall interval is reduced to 6 months. After intensive prevention, the lapses in dietary practices and oral hygiene are reversed and no new caries is subsequently seen.

SCENARIO E

Age: Patient E is a 35 year old female
Attendance Record: Patient has been attending your practice regularly for six years.
Medical History: Patient has no medical history of note
Social History: Patient does not smoke and drinks alcohol occasionally at the weekends
Dietary habits: Patient has a healthy diet with plenty of fresh fruit and vegetables and rarely consumes sugar containing foods and drinks
Use of Fluoride: Patient brushes twice a day with a fluoride containing toothpaste.
Clinical Evidence and dental history: Patient has no missing teeth and five occlusal amalgam fillings present, all in permanent molar teeth. These fillings were placed 15 years ago and have not needed replacement over this period. All fillings are still in excellent condition. Bitewing radiographs taken 12 months ago revealed no interproximal lesions. On examination, her periodontal health is excellent (Basic Periodontal Examination code 0 all sextants) and she has not needed oral hygiene advice for over three years.
Plaque: Patient brushes twice a day and uses dental floss once a day.
Saliva: Patient has a normal salivary flow rate.
Other: N/A

Recall Interval recommended by clinician for next oral health review:
24 months

Rationale for 24 month interval: Over a six year period at your dental practice, this patient has not required any restorative intervention. The patient has not had any new carious lesions over a 15 year period and has excellent oral hygiene and dietary habits. The patient's periodontal health is also excellent. The patient's dental status appears stable at this point in time suggesting that a recall interval of 24 months is appropriate for this patient.

SCENARIO F (*Altering the recall interval from 24 months to 6 months*)

Age: Patient F is a 20 year old male
Attendance Record: Patient has been attending your practice every 12 months for the last 5 years
Medical History: Patient has no medical history of note
Social History: Patient does not smoke and drinks alcohol occasionally at the weekends.
Dietary habits: Patient reports a low frequency of intake of sugar containing foods and drinks
Use of Fluoride: Patient brushes twice a day with a fluoride containing toothpaste.
Clinical Evidence and dental history: Patient has two occlusal amalgam fillings present, all in permanent molar teeth, that were placed 8 years ago. All fillings are still in excellent condition. Bitewing radiographs taken 12 months ago revealed no signs of interproximal lesions.
Plaque: Patient brushes twice a day and uses dental floss once a day. The patients oral hygiene is excellent and he has not needed oral hygiene instruction or any debridement for three years.
Saliva: Patient has a normal salivary flow rate.
Other: N/A

Recall Interval recommended by clinician for next oral health review:
24 months

Rationale: Over a five year period at your dental practice, this patient has not required any restorative intervention. The patient's past caries experience is minimal and he has not had any new carious lesions over an 8 year period and has good oral hygiene and dietary practices. The patient's periodontal health is also excellent. The patient's dental status is judged to be stable at this point in time suggesting that a recall interval of 24 months is appropriate for this patient. However, you inform the patient that

they should reattend before this time if there is any change in their medical history, dietary practices etc that may impact on their oral health, or if they experience any signs or symptoms of dental disease.

24 months later: Patient F returns for an oral health review. The patient has been living away from home for the last 18 months, having just started college.

Attendance Record: At the last oral health review, the patient was advised to re-attend in 24 months. Prior to this, the patient had been attending your practice every 12 months for the last 5 years.
Medical History: Patient has no medical history of note
Social History: Patient does not smoke but drinks alcohol occasionally at the weekends.
Dietary habits: Patient reports a change in dietary practices over the last 18 months. He consumes a lot of carbonated soft drinks and 'junk food.'
Use of Fluoride: Patient's normal brushing routine has not been followed over last 18 months and use of fluoride toothpaste is less frequent than previously reported.
Clinical Evidence and dental history: Patient has developed one new carious lesion (requiring restorative intervention) on the occlusal surface of one molar tooth. Bitewing radiographs reveal one interproximal lesion. Two 'white spot' lesions are present on the buccal surfaces of two molar teeth. There is evidence of gingivitis in all sextants with calculus deposits on the lingual surfaces of the lower anterior teeth (BPE codes 1-2)
Plaque: Patient's oral hygiene has deteriorated over the last 18 months and he has used floss only occasionally.
Saliva: Patient has a normal salivary flow rate.
Other: N/A

Recall Interval recommended by clinician for next oral health review:
6 months

Rationale: The patient's risk status has clearly changed since his last oral health review. The patient's altered social environment and the resultant changes in dietary and oral hygiene practices have adversely impacted on his oral health. The patient subsequently undergoes a course of treatment involving restoration of the carious lesions, oral hygiene instruction debridement of all plaque and calculus, dietary advice, and the application of topical fluoride to white spot lesions. In light of the patients recent caries experience and altered diet and oral hygiene, they are recalled for an oral health review in 6 months to reinforce preventive advice and monitor status of white spot lesions. The reason for the short recall interval is explained to the patient and they are informed that it may be possible to extend this interval in the future if dietary habits and oral hygiene improve.

SCENARIO G
Age: Patient G is a 45 year old male
Attendance Record: Patient has been attending your practice every 6 months for five years
Medical History: Patient has no medical history of note
Social History: Patient does not smoke and is a moderate drinker.
Dietary habits: Patient has a healthy, balanced diet and, following dietary advice given at previous oral health reviews, confines intake of sugar containing foods and drinks to mealtimes with no between meal snacking.
Use of Fluoride: Patient brushes twice a day with a fluoride containing toothpaste.

Clinical Evidence and dental history: Patient required considerable restorative work when he first attended three years ago and his oral hygiene at that time was poor. However, he has not experienced any new carious lesions since then, nor has any of his restorative work needed further attention. The patient's oral hygiene has improved significantly. Bitewing radiographs reveal no approximal lesions and good alveolar bone support.
'The BPE demonstrates gingival bleeding in two sextants but no pocketing or attachment loss (BPE code 1)
Plaque: Patient brushes twice a day and uses dental floss occasionally. The patients oral hygiene is satisfactory, although there are plaque deposits around the cervical margins of the upper and lower molar teeth.
Saliva: Patient has a normal salivary flow rate.
Other: N/A

Recall Interval recommended by clinician for next oral health review:
12 months

Rationale: Over a three-year period at your dental practice, this patient has not required any further restorative intervention after their initial course of treatment. The patient has shown good compliance with dietary and oral hygiene advice given, although the patient should be helped to improve their oral hygiene around the molar teeth. The patient's dental status appears stable and after further advice in oral hygiene and the debridement of plaque deposits and you recommend that the patient attends for an oral health review in 12 months. You do not think it is advisable to increase the interval beyond 12 months as you feel it may be necessary to review oral hygiene at this time.

SCENARIO H

Age: Patient M is a 55 year old male.
Attendance Record: Patient H has been attending your practice for one year.
Medical History: Patient has no medical history of note.
Social History: Patient smokes 35 cigarettes a day and has daily alcohol.
Dietary Habits: Patient has a normal diet.
Use of fluoride: Patient uses fluoride toothpaste.
Clinical Evidence / Dental History: Patient is partially dentate with an upper partial denture. The dentition is sound. There is no obvious mucosal disease.
Plaque: The patient's oral hygiene is good.
Saliva: Salivary flow is normal.
Other: He has tried to give up smoking in the past but without success.

Recall Interval recommended by clinician for next oral health review :
6 months.

Rationale: Patient has two recognised factors associated with oral cancer and would therefore benefit from regular review of the oral mucosa.

SCENARIO I

Age: Patient I is a 65 year old male.
Attendance Record: Patient has been attending your practice for five years.
Medical History: Patient is asthmatic and use a steroid inhaler.
Social History: Patient is non-smoker and has occasional alcohol.
Dietary Habits: Patient has a normal diet.
Use of fluoride: Patient uses fluoride toothpaste.
Clinical Evidence / Dental History: Patient is edentulous and has full dentures that are three years old. There is a white patch on the right lateral margin of the tongue that has been assessed by biopsy in a specialist unit some five years previously and reported as a non-dysplastic leukoplakia. The patient had been discharged back to the practice for on-going care.
Plaque: The patient maintains good denture hygiene.
Saliva: Salivary flow is normal.
Other: The patient has suffered from recurrent candidal infections associated with his inhaler therapy.

Recall Interval recommended by clinician for next oral health review:
6 months.
Rationale: The patient has a recognised pre-cancerous condition at a high risk site in the mouth. Regular review of the mucosa at six-monthly intervals would increase the likelihood of early detection of malignant change if this occurred.

SCENARIO J

Age: Patient J is a 56 year old male
Attendance Record: The patient attended your practice six months ago for the first time and has been compliant in completing a course of non-surgical periodontal therapy
Medical History: The patient is taking low dose aspirin due to family history of coronary heart disease
Social History: The patient is a non-smoker with a moderate alcohol intake of 14 units per week.
Dietary habits: Mix of rushed meals during the week and a reasonably balanced diet at weekends
Use of fluoride: The patient brushes twice a day with a fluoride containing tooth whitening toothpaste.

Clinical evidence and dental history: The teeth are heavily restored with a mix of large amalgam restorations and a few crowns. Although there used to be some moderately deep pockets (BPE code 3) in most sextants, only four 5mm pockets remain without bleeding on probing following non-surgical periodontal therapy. Gingival health is otherwise excellent.
Plaque: The patient brushes twice a day with and uses interdental brushes two to three times per week. The plaque score is reasonably low (25%) and is mainly limited to lingual or palatal molar surfaces,
Saliva: The patient has a normal salivary flow rate.
Other: N/A

Treatment plan: The patient receives advice in home care plaque control at the same visit. He also enters supportive maintenance on a three monthly recall.

Recall Interval recommended by the clinician for next oral health review:
3 months.

Rationale: The response to periodontal therapy is good, although plaque control is not adequate. Since we have no measure of periodontal stability, his periodontal status should be re-examined in three months.

Note, if gingival or periodontal disease was still present at this point, the patient should enter a further course of active treatment and would therefore not be subject to a routine recall interval.

At the three months recall examination the periodontal health appears stable. Although the supportive periodontal maintenance should continue every three months, the recall for an oral health review could be extended to an interval of between six to twelve months depending on the clinician's assessment of risk of breakdown.

6 Implementation and Audit

6.1 Background

The bulk of the Primary Dental Care Services in the NHS in England have been provided (since 1948) by independent contractors working under so-called "item of service" arrangements in the General Dental Services (GDS). A smaller salaried Community Dental Service (CDS) has provided dental primary care for children and special needs groups. Changes from the late 1990s introduced a number of locally tailored methods of delivering dental primary care under the Personal Dental Services (PDS) arrangements and, in turn, some of these have become linked to "dental access centres" in recent years.

In August 2002 the Department of Health Published a document called "*Options for Change*" (Department of Health 2002) which set out the results of an extended process of considering how NHS Dentistry could best be modernised to reflect the sentiments of the wider NHS Plan and at the same time address some of the concerns that had been raised for some years by both the profession and patient groups. This document mapped out a future shape for NHS Dental Primary Care. *Options for Change* listed eight key areas for significant change:

- Local commissioning and funding.
- Methods of remuneration for GDPs.
- Prevention and Oral Health Assessments.
- The patient experience.
- Information and communication technology.
- Practice structure.
- Development of the Dental Team.
- Clinical Pathways.

Since August 2002, new legislation has been introduced and a fundamental change in the methods of delivery and remuneration of primary care dentistry is being introduced. The Scope agreed for this Guideline specifically asked the Guideline Development Group to "take account of the current system of delivering dental care and also the policy direction in which the clinical and payment systems are being modernised" and referred to the Options document as the blueprint for this modernisation.

From April 2005 all contracts with General Dentists will be held with local primary care trusts (PCTs) and a new "Base Contract" will operate remunerating practices on the basis of a rolling average of previous earnings and expenditures. The direct link to item of service care will be broken. It is anticipated that this Base Contract will gradually evolve over coming years in a variety of ways with a focus on access and patient-centred preventive care services with an emphasis on quality rather than quantity of care.

Thus as the final form of this guidance will be published on 29th September 2004, the earliest the initial recalls according to this strategy could be planned would be at the end of 2004/early 2005. It would be expected that the majority would fall after April 1st 2005 and come under the new arrangements. It will be necessary to ensure that reasonable arrangements are put in place to make the position clear to both patients and the profession as new arrangements develop and evolve.

6.2 Implementation

This guidance contains a number of tools and suggestions to facilitate effective implementation and review. The Risk Checklist and its explanatory notes, the Recall Interval Selection diagram, and the Clinical Scenarios are all designed to help NHS dental practices and their patients get used to what will be for many a new way of planning and receiving routine NHS dental care.

NHS Clinical Care Pathways – the first Clinical Care Pathway to be developed is one that deals with the Oral Health Assessment and the Oral Health Review. This Pathway is currently under development and will be tested by NHS *Options for Change* Field Sites. The Pathway has been designed from the inception to accommodate the NICE recommendations on recall intervals and this integration should help a seamless introduction into the modernised, preventive NHS dental care.

Support for Practices, Dental Teams and for Patients – The Guideline Document, Quick Reference Guide, Leaflets and the Patient version of the guidance should all ensure that easy to access information about the recall recommendations are widely available to dental practices and clinics delivering NHS care in England and Wales.

PostGraduate and Continuing Education – It is hoped that the key messages of the guidance and the clinical, preventive philosophy behind it can be incorporated in planned educational activities over the coming year.

NeLH, the virtual Centre for Improving Oral Health and the developing National Oral Health Knowledge Service – A number of developments in supporting and coordinating Evidence Based Dentistry are currently under development. Steps will be taken to ensure that the guidance appears on the National electronic Library for Health (NeLH) and that its rationale and recommendations are promoted by the *virtual* Centre for Improving Oral Health and are linked to new dental IT developments.

6.3 Audit

Given that these recommendations will represent a significant departure from current practice for many dentists, the Guideline Development Group specifically recommends that:

- The acceptability and performance of the guidance should be assessed routinely in order to refine and improve the guidance informing the

recommended interval and the effectiveness of the Oral Health Assessment/Oral Health Review.

This means that as the new arrangements for delivering dental care come in and settle down, an impact assessment of the introduction of this guidance should be introduced. It is hoped that arrangements can be made to establish what changes in recall behaviour are brought about by the publication of this guidance, although the simultaneous introduction of a number of changes may complicate this.

- A new minimum dataset should be established, consistent with the new, more preventive, philosophy of the Options for Change style evolving arrangements for NHS Dentistry. Data should be recorded routinely in such a way to facilitate its use for service improvement at the patient, practice, primary care trusts, Shadow Health Authority and national levels.

Minimum Data requirements – it will be important for the profession, the PCTs and the Shadow Special Health Authority (Dental Practice Board) to agree a coherent and workable dataset to allow efficient collection of data and the comparison of what happens in different localities over time. Continuity of existing longitudinal data sets is necessary.

Audit at the Practice level – Recall intervals will make a ready and important audit topic at the practice level. Some coordinated production of audit tools may facilitate this process. The incorporation of the minimum data set into Dental IT software would help automate the data collection and reduce the administrative burden. It is important that any patient who may suffer from disease progression and is allocated a more extended recall should be monitored.

Audit at the local (PCT) level – this will become more important as PCTs develop the local arrangements and seek to understand the quality dimensions and patient acceptability of the new styles of dental care. The Strategic Health Authorities (SHAs) and Welsh Health Boards may also call for the (anonymised) results of such local audits.

Audit at local National level – with the radical changes in commissioning NHS dental care, there will be a need to understand how the new arrangements are working and to evaluate the overall performance to the new systems and the quality of care being delivered. Once again, this will demand more of the new IT arrangements which hold the key to ready and efficient access to understanding change and quality.

New Dental and NHS-wide IT developments should, over time, allow much of this routine information to be collected without additional administrative burdens. It is essential that these needs are reflected in the design, specification and development of new IT systems and that these requirements

are met while satisfying contemporary data protection and privacy requirements.
If not addressed early on, there is a danger that the automated collection and processing of audit data about dental recalls, which will be needed, may be compromised. This is due to the scale and pace of the remuneration changes which will be introduced in 2005. Confidentiality considerations are a further consideration as appropriate information and agreement must be obtained from the patient, where necessary, to ensure that the legitimate use of patient information for improving the quality of patient care can continue.

6.4 Research Recommendations

In our search for literature relevant to developing this guideline, we found that the research addressing many areas was either inconclusive or did not exist. The absence of reliable research was partly a consequence of a lack of funding in certain areas and poor or inappropriate study design in others. The Guideline Development Group agreed that research conducted in the following areas would dramatically enhance the updating and applicability of this guideline in the future:

- Dental attendance patterns should be examined for changes following the publication of the guideline. This requires that the future use of routine data for this purpose must be communicated appropriately to patients in order to satisfy confidentiality considerations.
- Following publication of the guideline, information will be needed on whether patients visit the dentist at the interval deemed appropriate, and the reasons why/why not.
- High quality research is needed on the long-term clinical and cost effectiveness of one-to-one oral health advice and whether this may depend upon:
- The frequency with which it is delivered
- Characteristics of the individual patient other than their physical or oral health (for example, age, sex, social class, occupation)
- The medium used to deliver the advice
- The physical/oral health of the patient
- Who is imparting/delivering the advice

- High quality research is needed to examine the effects of varying dental recall intervals on oral health. More specifically, a better understanding is required of what aspect or aspects of the oral health review impact on oral health
- High quality research is required to examine the impact of oral health (relating to gingivitis, caries, periodontal disease, and mucosal disease) on quality of life.

- High quality research is needed to examine the effects on periodontal health of a routine scale and polish treatment in different populations. Specifically, research is needed to examine the clinical effectiveness and cost-effectiveness of providing this treatment at different time intervals

Research designs will need to accommodate the mix of arrangements (NHS and a range of private and mixed configurations) under which dental primary care is provided.

References

1. Adelaide University and Colgate Oral Care Nature and aetiology & clinical aspects of caries diagnosis. http://www.adelaide.edu.au/spdent/dperu/caries/CariesInfo1.pdf [accessed 1-8-2003].

2. Adelaide University and Colgate Oral Care Last concepts of caries prevention: planning for prevention. http://www.adelaide.edu.au/spdent/dperu/caries/CariesInfo2.pdf [accessed 1-8-2003].

3. Akehurst, R. and Sanderson, D. (1993) Cost-effectiveness in dental health. a review of strategies available for preventing caries. *York Discussion Paper*. York: Centre for Health Economics.

4. Albandar JM. (2002a) Global risk factors and risk indicators for periodontal diseases. [Review] [245 refs]. *Periodontology 2000* 29: 177-206.

5. Albandar JM. (2002b) Periodontal diseases in North America. *Periodontology 2000* 29: 31-69.

6. American Academy of Periodontology (1996) Periodontal literature reviews: a summary of current knowledge. Chicago: American Academy of Periodontology.

7. Audit Commission (2002) Dentistry: primary dental care services in England and Wales. London: Audit Commission.

8. Axelsson P and Lindhe J. (1981) Effect of controlled oral hygiene procedures on caries and periodontal disease in adults. Results after 6 years. *Journal of Clinical Periodontology* 8(3): 239-48.

9. Bader JD, Shugars DA, and Bonito AJ. (2001a) A systematic review of selected caries prevention and management methods. *Community Dentistry & Oral Epidemiology* 29(6): 399-411.

10. Bader JD, Shugars DA, and Bonito AJ. (2001b) Systematic reviews of selected dental caries diagnostic and management methods. *Journal of Dental Education* 65(10): 960-8.

11. Banting DW. (2001) The diagnosis of root caries. *Journal of Dental Education* 65(10): 991-6.

12. Bearne A and Kravitz A. (2000) The 1999 BDA Heathrow Timings inquiry. *British Dental Journal* 188(4): 189-94.

13. Beck J (1990) Identification of risk factors. In Bader JD, editor. *Risk assessment in dentistry*. Chapel Hill, NC: University of Carolina, Department of Dental Ecology,

14. Bedi R and Gilthorpe MS. (1995) The prevalence of betel-quid and tobacco chewing among the Bangladeshi community resident in a United Kingdom area of multiple deprivation. *Primary Dental Care* 2(2): 39-42.

15. Berkey CS, Douglass CW, Valachovic RW et al. (1988) Longitudinal radiographic analysis of carious lesion progression. *Community Dentistry & Oral Epidemiology* 16(2): 83-90.

16. Boehmer U, Kressin NR, Spiro A, III et al. (2001) Oral health of ambulatory care patients. *Military Medicine* 166(2): 171-8.

17. Brabner D, Downer MC, Moles DR et al. (1995) Initial caries attack and average progression rates in 12-year-old Isle of Wight children. *Community Dental Health* 12(4): 190-3.

18. Bright Futures Risk assessment. Bright futures in practice: oral health. http://www.brightfutures.org/oralhealth/

19. British Dental Association. (2000) Opportunistic oral cancer screening. *British Dental Association Occasional Paper* 6.

20. Bullock C, Boath E, Lewis M et al. (2001) A case-control study of differences between regular and causal adult attenders in general dental practice. *Primary Dental Care* 8(1): 35-40.

21. Calnan M, Almond S, and Smith N. (2003) Ageing and public satisfaction with the health service: An analysis of recent trends. *Social Science & Medicine* 57(4): 757-62.

22. Calnan M, Dickinson M, and Manley G. (1999) The quality of general dental care: public and users' perceptions. *Quality in Health Care* 8(3): 149-53.

23. Calvert, N. W., Thomas, N., and Payne, J. N. (2000) Can fluoridated school milk be a cost-effective althernative to community water fluoridation? Sheffield: School of Health and Related Research, University of Sheffield.

24. Campus G, Lumbau A, Lai S et al. (2001) Socio-economic and behavioural factors related to caries in twelve-year-old Sardinian children. *Caries Research* 35(6): 427-34.

25. Carvalho JC, Van Nieuwenhuysen JP, and D'Hoore W. (2001) The decline in dental caries among Belgian children between 1983 and 1998. *Community Dentistry & Oral Epidemiology* 29(1): 55-61.

26. Casiglia J and Woo SB. (2001) A comprehensive review of oral cancer. *General Dentistry* 49(1): 72-82.

27. Chadwick, B. L, Dummer, P. M., and Dunstan, F. (2001) The Longevity of Dental Restorations: a Systematic Review. York: Centre for Reviews and Dissemination.

28. Chavers LS, Gilbert GH, and Shelton BJ. (2002) Racial and socioeconomic disparities in oral disadvantage, a measure of oral health-related quality of life: 24-month incidence. *Journal of Public Health Dentistry* 62(3): 140-7.

29. Cobb CM. (1996) Non-surgical pocket therapy: mechanical. *Annals of Periodontology* 1(1): 443-90.

30. Conway DI, Macpherson LM, Gibson J et al. (2002) Oral cancer: prevention and detection in primary dental healthcare. *Primary Dental Care* 9(4): 119-23.

31. Corbet EF, Zee KY, and Lo EC. (2002) Periodontal diseases in Asia and Oceania. *Periodontology 2000* 29: 122-52.

32. Davenport C, Elley K, Salas C et al. (2003) The clinical effectiveness and cost-effectiveness of routine dental checks: a systematic review and economic evaluation. *Health Technology Assessment* 7(7).

33. Dawson AS and Smales RJ. (1992) The influence of examination frequency and changing dentist on dental treatment provision in an Australian defence force population. *British Dental Journal* 173(7): 237-41.

34. Department of Health (2000) Modernising NHS dentistry: implementing the NHS plan. London: Department of Health.

35. Department of Health Health survey for England: the health of minority ethnic groups. http://www.doh.gov.uk/newsdesk/archive/jan2001/4-naa-24012001.html [accessed 1-8-2001].

36. Department of Health (2002) NHS dentistry: options for change. London: Depatment of Health.

37. Downer M (1997) Oral cancer. In Pine C, editor. *Community Oral Health*. Oxford: Wright,

38. Downer MC, Azli NA, Bedi R et al. (1999) How long do routine dental restorations last? A systematic review. *British Dental Journal* 187(8): 432-9.

39. Ekstrand KR, Bruun G, and Bruun M. (1998a) Plaque and gingival status as indicators for caries progression on approximal surfaces. *Caries Research* 32(1): 41-5.

40. Ekstrand KR, Kuzmina I, Bjorndal L et al. (1995) Relationship between external and histologic features of progressive stages of caries in the occlusal fossa. *Caries Research* 29(4): 243-50.

41. Ekstrand KR, Ricketts DN, and Kidd EA. (1997) Reproducibility and accuracy of three methods for assessment of demineralization depth of the occlusal surface: an in vitro examination. *Caries Research* 31(3): 224-31.

42. Ekstrand KR, Ricketts DN, Kidd EA et al. (1998b) Detection, diagnosing, monitoring and logical treatment of occlusal caries in relation to lesion activity and severity: an in vivo examination with histological validation. *Caries Research* 32(4): 247-54.

43. Epstein JB and Scully C. (1997) Assessing the patient at risk for oral squamous cell carcinoma. *Special Care in Dentistry* 17(4): 120-8.

44. Epstein JB, Zhang L, and Rosin M. (2002) Advances in the diagnosis of oral premalignant and malignant lesions. *Journal of the Canadian Dental Association* 68(10): 617-21.

45. Espelid I, Tveit AB, and Fjelltveit A. (1994) Variations among dentists in radiographic detection of occlusal caries. *Caries Research* 28(3): 169-75.

46. Faculty of General Dental Practitioners (1998) Selection criteria for dental radiography. London: Royal College of Surgeons of England.

47. Farrand P, Rowe RM, Johnston A et al. (2001) Prevalence, age of onset and demographic relationships of different areca nut habits amongst children in Tower Hamlets, London. *British Dental Journal* 190(3): 150-4.

48. Foster LV. (1998) Three year in vivo investigation to determine the progression of approximal primary carious lesions extending into dentine. *British Dental Journal* 185(7): 353-7.

49. Freire M, Hardy R, and Sheiham A. (2002) Mothers' sense of coherence and their adolescent children's oral health status and behaviours. *Community Dental Health* 19(1): 24-31.

50. Gray, M., Gold, L., Burls, A., and Elley, K. (2000) The clinical effectiveness of toludine blue dye as an adjunct to oral cancer screening in general dental practice. Birmingham: University of Birmingham, Department of Public Health and Epidemiology.

51. Greenwood M, Thomson PJ, Lowry RJ et al. (2003) Oral cancer: material deprivation, unemployment and risk factor behaviour--an initial study. *International Journal of Oral & Maxillofacial Surgery* 32(1): 74-7.

52. Haffajee AD, Socransky SS, Lindhe J et al. (1991) Clinical risk indicators for periodontal attachment loss. *Journal of Clinical Periodontology* 18(2): 117-25.

53. Hancock M, Calnan M, and Manley G. (1999) Private or NHS General Dental Service care in the United Kingdom? A study of public

perceptions and experiences. *Journal of Public Health Medicine* 21(4): 415-20.

54. Hawkins RJ, Wang EE, and Leake JL. (1999) Preventive health care, 1999 update: prevention of oral cancer mortality. The Canadian Task Force on Preventive Health Care. *Journal of the Canadian Dental Association* 65(11): 617.

55. Health Development Agency (2001) The scientific basis of dental health education - a policy document (revised fourth edition). London: Health Development Agency.

56. Hendricks SJ, Freeman R, and Sheiham A. (1990) Why inner city mothers take their children for routine medical and dental examinations. *Community Dental Health* 7(1): 33-41.

57. Hindle I, Downer MC, and Speight PM. (1996) The epidemiology of oral cancer. *Br J Oral Maxillofac Surg* 34(5): 471-6.

58. HM Treasury Green book, appraisal and evaluation in central government. http://greenbook.treasury.gov.uk/ [accessed 13-1-2004].

59. Horowitz AM, Siriphant P, Sheikh A et al. (2001) Perspectives of Maryland dentists on oral cancer. *Journal of the American Dental Association* 132(1): 65-72.

60. Hujoel PP, Loe H, Anerud A et al. (1999) The informativeness of attachment loss on tooth mortality. *Journal of Periodontology* 70(1): 44-8.

61. Jones JA, Kressin NR, Spiro A, III et al. (2001)Self-reported and clinical oral health in users of VA health care. *Journals of Gerontology Series A Biological Sciences & Medical Sciences* 56(1): M55-M62.

62. Kay ES, Brickley M, Knill-Jones R. (1995) Restoration of approximal carious lesions – application of decision analysis. *Community Dentistry and Oral Epidemiology*; 23: 271-5.

63. Kay E and Locker D. (1998) A systematic review of the effectiveness of health promotion aimed at improving oral health. *Community Dental Health* 15(3): 132-44.

64. Kidd EA. (1998) Assessment of caries risk. *Dent Update* 25(9): 385-90.

65. Kinane DF. (2001) Causation and pathogenesis of periodontal disease. [Review] [90 refs]. *Periodontology 2000* 25: 8-20.

66. Kingman A and Albandar JM. (2002) Methodological aspects of epidemiological studies of periodontal diseases. *Periodontology 2000* 29: 11-30.

67. Lancaster T and Stead LF. (2002) Individual behavioural counselling for smoking cessation. *Cochrane Database of Systematic Reviews*(3): CD001292.

68. Lang NP, Adler R, Joss A et al. (1990) Absence of bleeding on probing. An indicator of periodontal stability. *Journal of Clinical Periodontology* 17(10): 714-21.

69. Lawrence HP and Sheiham A. (1997) Caries progression in 12- to 16-year-old schoolchildren in fluoridated and fluoride-deficient areas in Brazil. *Community Dentistry & Oral Epidemiology* 25(6): 402-11.

70. Leake JL. (2001) Clinical decision-making for caries management in root surfaces. *Journal of Dental Education* 65(10): 1147-53.

71. Lester V, Ashley FP, and Gibbons DE. (1998) Reported dental attendance and perceived barriers to care in frail and functionally dependent older adults. *British Dental Journal* 184(6): 285-9.

72. Lindhe J, Okamoto H, Yoneyama T et al. (1989) Periodontal loser sites in untreated adult subjects. *Journal of Clinical Periodontology* 16(10): 671-8.

73. Lissowska J, Pilarska A, Pilarski P et al. (2003) Smoking, alcohol, diet, dentition and sexual practices in the epidemiology of oral cancer in Poland. *European Journal of Cancer Prevention* 12(1): 25-33.

74. Llewellyn CD, Johnson NW, and Warnakulasuriya KA. (2001) Risk factors for squamous cell carcinoma of the oral cavity in young people--a comprehensive literature review. *Oral Oncology* 37(5): 401-18.

75. Llewellyn CD, Linklater K, Bell J et al. (2003) Squamous cell carcinoma of the oral cavity in patients aged 45 years and under: a descriptive analysis of 116 cases diagnosed in the South East of England from 1990 to 1997. *Oral Oncology* 39(2): 106-14.

76. Locker D. (2001) Does dental care improve the oral health of older adults? *Community Dental Health* 18(1): 7-15.

77. Loe H, Thielade E, and JENSEN SB. (1965) Experimental gingivitis in man. *Journal of Periodontology* 36: 177-87.

78. Lunder N. (1994) Forlengede innkallingsintervaller. Effecktar par ressursbruk og tannhelse hos et arskull barn fra 7 til 13 ar. [Effects for extended recall intervals for children between the ages of 7 to 13.]. *Nor Tannlaegeforenings Tidende* 104: 100-2.

79. Lunder N and der Fehr FR. (1996) Approximal cavitation related to bite-wing image and caries activity in adolescents. *Caries Research* 30(2): 143-7.

80. Mejare I, Kallest l C, and Stenlund H. (1999) Incidence and progression of approximal caries from 11 to 22 years of age in Sweden: A prospective radiographic study. *Caries Research* 33(2): 93-100.

81. Mejàre IandMjör IA (2003) Prognosis for caries and restorations. In Fejerskov O and Kidd EAM, editors. *Dental caries: the disease and its clinical management*. Oxford: Blackwell, p 295-302.

82. Mejare I and Stenlund H. (2000) Caries rates for the mesial surface of the first permanent molar and the distal surface of the second primary molar from 6 to 12 years of age in Sweden. *Caries Research* 34(6): 454-61.

83. Moles DR, Downer MC, and Speight PM. (2002) Meta-analysis of measures of performance reported in oral cancer and precancer screening studies. *British Dental Journal* 192(6): 340-4.

84. Moss,S, Melia,J, Rodrigues,V et al. (1997) Review of the natural history of prostate, skin and oral cancer.

85. Murray JandPitts N (1997) Trends in oral health. In Pine C, editor. *Community Oral Health*. Oxford: Wright,

86. National Institute for Clinical Excellence (2001) Information for national collaborating centres and guideline development groups. *Guideline development process series 3*. London: National Institute for Clinical Excellence.

87. National Institutes of Health. (2001) Diagnosis and management of dental caries throughout life. *NIH Consensus Statement* 18(1): 1-23.

88. National Screening Committee (2001) Improving outcomes for oral cancer. Workshops convened under the auspices of the National Screening Committee.

89. Needleman,I, McGrath,C, Floyd,P et al. (2004) Impact of oral health on the life quality of periodontal patients. *Journal of Clinical Periodontology* .

90. Neville BW and Day TA. (2002) Oral cancer and precancerous lesions. *CA: A Cancer Journal for Clinicians* 52(4): 195-215.

91. Newsome PR and Wright GH. (1999) A review of patient satisfaction: 2. Dental patient satisfaction: an appraisal of recent literature. *British Dental Journal* 186(4 Spec No): 166-70.

92. Nunn ME. (2003) Understanding the etiology of periodontitis: an overview of periodontal risk factors. *Periodontology 2000* 32: 11-23.

93. Nyvad B and Fejerskov O. (1986) Active root surface caries converted into inactive caries as a response to oral hygiene. *Scandinavian Journal of Dental Research* 94(3): 281-4.

94. Nyvad B, ten Cate JM, and Fejerskov O. (1997) Arrest of root surface caries in situ. *J Dent Res* 76(12): 1845-53.

95. O'Hanlon S, Forster DP, and Lowry RJ. (1997) Oral cancer in the North-East of England: incidence, mortality trends and the link with material deprivation. *Community Dentistry & Oral Epidemiology* 25(5): 371-6.

96. Office of Fair Trading (2003) Survey of consumers' experience of dental services. London: Office of Fair Trading.

97. Oral Health Strategy Group (1994) An oral health strategy for England. London: Department of Health.

98. Papapanou PandLindhe J (2003) Epidemiology of periodontal diseases. In Lindhe J, Karring T, and Lang NP, editors. *Clinical Periodontology and Implant Dentistry*. Oxford: Blackwell Munksgaard, p 50-80.

99. Peek CW, Gilbert GH, and Duncan RP. (2002) Predictors of chewing difficulty onset among dentate adults: 24-month incidence. *Journal of Public Health Dentistry* 62(4): 214-21.

100. Petersen PE, Hoerup N, Poomviset N et al. (2001) Oral health status and oral health behaviour of urban and rural schoolchildren in Southern Thailand. *International Dental Journal* 51(2): 95-102.

101. Pine CM and ten Bosch JJ. (1996) Dynamics of and diagnostic methods for detecting small carious lesions. *Caries Research* 30(6): 381-8.

102. Pitts NB. (1983) Monitoring of caries progression in permanent and primary posterior approximal enamel by bitewing radiography. *Community Dentistry & Oral Epidemiology* 11(4): 228-35.

103. Pitts NB. (2001) Clinical diagnosis of dental caries: a European perspective. *Journal of Dental Education* 65(10): 972-8.

104. Pitts NB. (2003) NHS Dentistry: Options for Change in context--a personal overview of a landmark document and what it could mean for the future of dental services. *British Dental Journal* 195(11): 631-5.

105. Quinn, M., Babb, P., Brock, A., Kirby, L., and Jones, J. (2004) Cancer trends in England and Wales 1950-1999. *Studies on medical and population subjects No. 66.* London: The Stationary Office.

106. Ratledge DK, Kidd EA, and Beighton D. (2001) A clinical and microbiological study of approximal carious lesions. Part 1: the relationship

between cavitation, radiographic lesion depth, the site-specific gingival index and the level of infection of the dentine. *Caries Research* 35(1): 3-7.

107 Reich E, Lussi A, and Newbrun E. (1999) Caries-risk assessment. *International Dental Journal* 49(1): 15-26.

108. Richards W and Ameen J. (2002) The impact of attendance patterns on oral health in a general dental practice. *British Dental Journal* 193(12): 697-702.

109. Rikard-Bell G, Donnelly N, and Ward J. (2003) Preventive dentistry: what do Australian patients endorse and recall of smoking cessation advice by their dentists? *British Dental Journal* 194(3): 159-64.

110. Rodrigues VC, Moss SM, and Tuomainen H. (1998) Oral cancer in the UK: to screen or not to screen. *Oral Oncology* 34(6): 454-65.

111. Rosati C (1994) Prevention of oral cancer. In Canadian Guide to Clinical Preventive Health Care, editor. *Canadian Task Force on the Periodic Health Examination*. Ottowa: Health Canada, p 826-36.

112. Schatzle M, Loe H, Burgin W et al. (2003) Clinical course of chronic periodontitis. I. Role of gingivitis. *Journal of Clinical Periodontology* 30(10): 887-901.

113. Scottish Intercollegiate Guideline Network (2000) Preventing dental caries in children at high caries risk. Targeted prevention of dental caries in the permanent teeth of 6-16 year olds presenting for dental care. Edinburgh: Scottish Intercollegiate Guideline Network.

114. Shah JP, Johnson NW, and Batsakis JG. (2003) *Oral cancer*.London: Martin Dunitz.

115. Sheiham A, Smales FC, Cushing AM et al. (1986) Changes in periodontal health in a cohort of British workers over a 14-year period. *British Dental Journal* 160(4): 125-7.

116. Sheldon T and Treasure E. (1999) Dental restorations: what type of filling? *Effective Health Care* 5(2): 1-12.

117. Shwartz M, Grondahl HG, Pliskin JS et al. (1984) A longitudinal analysis from bite-wing radiographs of the rate of progression of approximal carious lesions through human dental enamel. *Archives of Oral Biology* 29(7): 529-36.

118. Silverman SJ. (2001) Demographics and occurrence of oral and pharyngeal cancers. The outcomes, the trends, the challenge. *Journal of the American Dental Association* 132 Suppl: 7S-11S.

119. Socransky SandHaffajee AD (2003) Microbiology of periodontal disease. In Lindhe J, Karring T, and Lang NP, editors. *Clinical periodontology and implant dentistry*. Oxford: Blackwell Munksgaard,

120 Sprod, A. J, Anderson, R., and Treasure, E. T. (1996) Effective oral health promotion: literature review. Cardiff: Health Promotion Wales.

121. Steele JG, Walls AW, Ayatollahi SM et al. (1996) Dental attitudes and behaviour among a sample of dentate older adults from three English communities. *British Dental Journal* 180(4): 131-6.

122. Taylor GW. (2001) Bidirectional interrelationships between diabetes and periodontal diseases: an epidemiologic perspective. *Annals of Periodontology* 6(1): 99-112.

123. Thielade E. (1986) The non-specific theory in microbial etiology of inflammatory periodontal diseases. *Journal of Clinical Periodontology* 13(10): 905-11.

124. Thomas S and Wilson A. (1993) A quantitative evaluation of the aetiological role of betel quid in oral carcinogenesis. *European Journal of Cancer B Oral Oncology* 29B(4): 265-71.

125. Thomson WM. (2001) Use of dental services by 26-year-old New Zealanders. *New Zealand Dental Journal* 97(428): 44-8.

126. Tinanoff N and Douglass JM. (2001) Clinical decision-making for caries management in primary teeth. *Journal of Dental Education* 65(10): 1133-42.

127. Tomar SL and Asma S. (2000) Smoking-attributable periodontitis in the United States: findings from NHANES III. National Health and Nutrition Examination Survey. *Journal of Periodontology* 71(5): 743-51.

128. Tyas MJ and Burrow MF. (2001) Clinical evaluation of a resin-modified glass ionomer adhesive system--results at three years. *Oper Dent* 26(1): 17-20.

129. Ugur ZA and Gaengler P. (2002) Utilisation of dental services among a Turkish population in Witten, Germany. *International Dental Journal* 52(3): 144-50.

130. Ullah MS, Aleksejuniene J, and Eriksen HM. (2002) Oral health of 12-year-old Bangladeshi children. *Acta Odontologica Scandinavica* 60(2): 117-22.

131. van Amerongen JP, Penning C, Kidd EA et al. (1992) An in vitro assessment of the extent of caries under small occlusal cavities. *Caries Research* 26(2): 89-93.

132. van der Waal I, Schepman KP, van der Meij EH et al. (1997) Oral leukoplakia: a clinicopathological review. *Oral Oncology* 33(5): 291-301.

133. Wang N, Marstrander P, Holst D et al. (1992) Extending recall intervals--effect on resource consumption and dental health. *Community Dentistry & Oral Epidemiology* 20(3): 122-4.

134. Wang NJ and Holst D. (1995) Individualizing recall intervals in child dental care. *Community Dentistry & Oral Epidemiology* 23(1): 1-7.

135. Warnakulasuriya KA and Johnson NW. (1999) Dentists and oral cancer prevention in the UK: opinions, attitudes and practices to screening for mucosal lesions and to counselling patients on tobacco and alcohol use: baseline data from 1991. *Oral Diseases* 5(1): 10-4.

136. Watt RG, Daly B, and Kay EJ. (2003a) Prevention. Part 1: smoking cessation advice within the general dental practice. *British Dental Journal* 194(12): 665-8.

137. Watt RG, McGlone P, and Kay EJ. (2003b) Prevention. Part 2: Dietary advice in the dental surgery. *British Dental Journal* 195(1): 27-31.

138. West R, McNeill A, and Raw M. (2000) Smoking cessation guidelines for health professionals: an update. Health Education Authority. *Thorax* 55(12): 987-99.

139. World Health Organisation Periodontal country profiles: an overview of CPITN data in the WHO Global Oral Data Bank for the age groups 15-19 years, 35-44 years and 65-74 years. http://www.dent.niigata-u.ac.jp/prevent/perio/contents.html

140. Zero D, Fontana M, and Lennon AM. (2001) Clinical applications and outcomes of using indicators of risk in caries management. *Journal of Dental Education* 65(10): 1126-32.

Beck J, Pauker S. (1983) The Markov process in medical prognosis. *Medical Decision Making* 3:419-458.

Birch S (1986) Measuring dental health: improvements on the DMF index. *Community Dent Health* 3:303-11.

Fyffe HE, Kay EJ (1992) Assessment in dental health state utilities. *Community Dent Oral Epidemiol* 20:269-73.

Kay EJ and Nuttall NM (1993) An example of the application of Markov models in dentistry – a prediction of the fate of molar teeth in 12-year old Scottish children. *Community Dent Health* 10:217-23.

Lu KH. (1970) A Markov model of diagnostic errors in assessment of caries experience. *Archs oral Biol*. 15:869-77.

Melkersson, M. and Olsson, C. (1999). Is Visiting the Dentist a Good Habit? Analyzing Count Data with Excess Zeros and Excess Ones. *Umeå Economic Studies*, 492. Umeå University.

Glossary of Terms

Note: Words that are bolded within a definition are also defined in the glossary.

Active carious lesion: Caries lesions may be classified according to their activity. The clinical distinction between active and arrested lesions is sometimes difficult to make. There will often be a continuum of transient changes from active to arrested and vice versa. A lesion considered to be progressive can be described as an active caries lesion. In contrast, a lesion that may have formed years previously and then stopped further progression can be referred to as an arrested or inactive caries lesion. Once cavitation has occurred, exposed dentine is a good indicator of activity status. Active or progressing caries in dentine is usually light brown in colour and very soft. In long standing caries, the dentine is usually much firmer to touch and dark in colour. Root caries also usually shows these characteristics (Adelaide University et al. 1998).

Caries experience: the sum of filled and unfilled cavities, together with any missing teeth resulting from decay.

Caries risk assessment: A process that attempts to identify people who are at greater risk for a high level of caries and who may need more oral health supervision and preventive intervention.

Cavitated lesions: Carious lesions where there is a visible macroscopic breakdown in the tooth surface (*that is,* a visible ‘hole’) and the area may have softened walls or floor.

Dental caries (dental decay, tooth decay or ‘cavities’): An initially subsurface, preventable disease of the mineralised tissues of the teeth with a multi-factorial aetiology related to the interactions over time between tooth substance and certain micro-organisms and dietary carbohydrates producing plaque acids.

Dentate: A term applied to a person who has one or more natural teeth present.

Edentulous/edentate: A term applied to a person who has no natural teeth remaining.

Early childhood caries: Dental decay of the primary teeth ('baby' or 'first' teeth) of infants and young children (aged 1 to 5 years) often characterised by rapid destruction of tooth tissue.

Early, initial or incipient lesion: Refer to the stage of lesion development. Used to describe the first sign of a caries lesion on enamel that can be detected with the naked eye. An initial lesion appears as a white, opaque change (a white-spot) but not all white-spot lesions are incipient.

Fissure sealants (or 'sealants'): Plastic coatings applied to the surfaces of teeth with developmental pits and grooves (primarily the chewing surfaces of teeth) to protect the tooth surfaces from collecting food debris and bacteria that promote the development of dental decay.

Fluoride: A compound of the element fluorine. Fluoride is used in a variety of ways to reduce dental decay.

Gingivitis: A reversible inflammatory condition of the gum tissue, where the gum can appear reddened and swollen and frequently bleeds easily. It is usually caused by inadequate personal oral hygiene. Gingivitis is a precursor to **periodontitis** in some people.

'Hidden' or 'occult' caries: Non-cavitated lesions in dentine that may be overlooked on a visual clinical examination but which are large and demineralised enough to be detected radiographically.

HTA Report: Refers to the report "The clinical effectiveness and cost-effectiveness of routine dental checks: a systematic review and economic evaluation" written by Davenport et al. and published by the Health Technology Assessment NHS R& D HTA Programme(Davenport et al. 2003)

Inflammation: A localised protective response elicited by injury or destruction of tissue, which serves to destroy, dilute, or wall off both the injurious agent and the injured tissue. A cellular and vascular reaction of tissues to injury (American Academy of Periodontology 1996).

International Classification of Disease (ICD): Most international databases for recording statistics on oral cancer use the International Classification of Diseases (ICD) coding system of the World Health Organisation (WHO). Most of the data currently available are expressed according to the ninth revision of this system (ICD-9).

Lesion arrest and lesion reversal: The progression of enamel lesions with macroscopically intact surfaces is often slow and such lesions do not inevitably progress to cavitation; they can stop (or be stopped via appropriate preventive intervention for example, application of topical fluoride) – lesion arrest, or even reverse (or be reversed by appropriate preventive intervention for example, application of topical fluoride) – lesion reversal/regression.

Meta-analysis: Results from a collection of independent studies (investigating the same treatment) are pooled, using statistical techniques to synthesise their findings into a single estimate of a treatment effect. Where studies are not compatible for example, because of differences in the study populations or in the outcomes measured, it may be inappropriate or even misleading to statistically pool results in this way.

Non-cavitated lesions: Lesions where there is no macroscopically visible disruption of the continuity of the enamel surface.

Non-cavitated smooth surface lesions in enamel: These lesions typically manifest on the smooth surfaces of teeth as chalky white or light brown demineralisation of the enamel where the discoloured area has no signs of cavitation after a careful visual inspection. Such lesions are usually located in areas where dental plaque may accumulate (close to the gingival margin). The surface of the area is matted (not glossy) when a tooth is dried.

Non-cavitated pit and fissure lesions in enamel: These lesions typically manifest as light or dark brown discoloration at the base of the pit or fissure with or without white demineralisation at the sides of the pit or fissure that can be detected visually after cleaning and drying the teeth.

Non-cavitated lesions in dentine: These lesions have visible signs of undermined enamel that show as opacity or discolouration beneath an apparently intact enamel surface.

Oral cancer: The term ‘oral cancer’ is used in this guideline to refer to cancer of the lip (ICD-9 code 140), tongue (code 141), gum (code 143), floor of mouth (code 144), other unspecified parts of the mouth (code 145), oropharynx (code 146), hypopharynx (code 148) and other ill-defined sites within the lip, oral cavity and pharynx (code 149). This definition excludes cancers of the salivary glands (code 142) and the nasopharynx (code 147).

Oral cavity: The mouth

Oral health: Oral health is a standard of health of the oral and related tissues which enables an individual to eat, speak, and socialise without active disease, discomfort or embarrassment and which contributes to general well-being (Oral Health Strategy Group 1994).

Oral Health Assessment: The first assessment of the oral health status of a person.

Oral Health Review: A reassessment of the oral health status of a person following a specified time interval after either i) an Oral Health Assessment if no treatment is needed, or ii) the completion of an agreed journey of care.

Oral health risk assessment: A (prognostic) tool that helps dental professionals individualise oral health supervision. It is based on the concept that the frequency and type of oral health supervision needed by a person depends on the likelihood that specific diseases or conditions may develop. Risk assessment involves examining risk factors that may negatively impact an individuals oral health, and protective factors that promote oral health. Using risk assessment, the dental professional is better positioned to make specific preventive and treatment recommendations to reduce an individual patient’s risk and improve their oral health (Bright Futures 1996).

Oral mucosa: The tissue lining the oral cavity.

Oral mucosal abnormalities: A disorder of the soft tissue that lines the mouth.

Periodontal disease: A cluster of diseases caused by microbial plaque and resulting in inflammatory responses and chronic destruction of the soft tissues and bone that support the teeth. Periodontal disease is a broad term encompassing several diseases of the gums and tissues supporting the teeth.

Periodontitis: Inflammation of the gums leading to the development of gum pockets with destruction of the soft tissue attachment of teeth and their supporting bone. Periodontitis is a major cause of tooth loss.

Pharynx: Throat

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

Preventive treatment approach: A dental care philosophy which encourages prevention and monitoring rather than early intervention (Davenport et al. 2003).

Primary caries: Caries lesions on unrestored tooth surfaces.

Primary prevention: Primary prevention protects people against disease, often by placing barriers between the aetiological agent and the host. It is aimed at keeping a population healthy to minimise the risk of disease or injury.

Probing attachment level: The distance from the cemento-enamel junction (CEJ) to the location of the tip of a periodontal probe inserted in the pocket with moderate probing force(Papapanou et al. 2003).

Probing depth: The distance from the gingival margin to the location of the tip of a periodontal probe inserted in the pocket with moderate probing force(Papapanou et al. 2003).

Rampant caries: Multiple active carious lesions occurring in the same patient. This frequently involves surfaces of teeth that do not usually experience dental caries (for example, the free smooth surfaces of anterior teeth). Patients with rampant caries can be classified according to the assumed causality for example, bottle or nursing caries, baby caries, early childhood caries, radiation caries or drug-induced caries.

Randomised controlled trial: A study to test a specific drug or other treatment in which people are randomly assigned to two (or more) groups: one (the experimental group) receiving the treatment that is being tested, and the other (the comparison or control group) receiving an alternative treatment, a placebo (dummy treatment) or no treatment. The two groups are followed up to compare differences in outcomes to see how effective the experimental treatment was. (Through randomisation, the groups should be similar in all aspects apart from the treatment they receive during the study.)

Recall interval: The time period, usually expressed in months or years, between an Oral Health Assessment and the first Oral Health Review, or between two Oral Health Reviews).

Recurrent or secondary caries: Caries lesions that develop adjacent to a filling or other dental restoration.

Restorative treatment approach: A dental care philosophy which encourages early intervention and repair of dental caries at an early stage (Davenport et al. 2003).

Risk: The probability of an event occurring in a specific time. In the context of preventive medicine and preventive dentistry risk, it is the probability of an individual developing a given disease or experiencing a particular health status over a specified period. Caries risk, for example, is the probability of an individual developing a carious lesion. By definition, risk is aimed at assessing developments in the future. However, it can only be assessed on the basis of symptoms present at, or having manifested themselves by, the time of assessment (Reich et al. 1999).

Risk factor: An exposure that is statistically related in some way to an outcome, *for example,*, smoking is a risk factor for **periodontitis**. If present, a risk factor directly increases the probability of a disease occurring and if absent or removed, reduces the probability.

Root caries: Dental decay that occurs on the root portion of a tooth. Early lesions on root surfaces are often difficult to observe visually and require tactile examination with a blunt instrument for example, periodontal probe. Use of a periodontal probe will allow detection of the leathery consistency of demineralised cementum/dentine. Colour change (darkening) is usually (but not always) present.

Secondary prevention: Secondary prevention aims to limit the progression and effect of a disease at as early a stage as possible after onset. It includes further primary prevention.

Sensitivity: In diagnostic testing, it refers to the chance of having a positive test result given that you have the disease. 100% sensitivity means that all those with the disease will test positive, but this is not the same the other way around. A patient could have a positive test result but not have the disease – this is called a ‘false positive’. The sensitivity of a test is also related to its ‘negative predictive value’ (true negatives) – a test with a sensitivity of 100% means that all those who get a negative test result do not have the disease. To fully judge the accuracy of a test, its specificity must also be considered.

Soft tissue lesion: An abnormality of the soft tissues of the oral cavity or **pharynx**.

Specificity: In diagnostic testing, it refers to the chance of having a negative test result given that you do not have the disease. 100% specificity means that all those without the disease will test negative, but this is not the same the other way around. A patient could have a negative test result yet still have the disease – this is called a ‘false negative’. The specificity of a test is also related to its ‘positive predictive value’ (true positives) – a test with a specificity of 100% means that all those who get a positive test result definitely have the disease. To fully judge the accuracy of a test, its sensitivity must also be considered.

Tertiary prevention: Tertiary prevention is concerned with limiting the extent of disability once a disease has caused some functional limitation. At this stage, the disease process will have extended to the point where the patient's health status has changed and will not return to the pre-diseased state.

White-spot lesion: Describes the first sign of a **caries lesion** on enamel that can be detected with the naked eye. However, whitespot lesions are not necessarily ‘early’ caries lesions – white-spot lesions may have been present for many years in an arrested state and it is thus misleading to describe such a lesion as ‘early.’

Xerostomia: A condition in which the mouth is dry because of a lack of saliva

APPENDIX A – Questions addressed by the guideline

Dental Caries

1) How long does it take for caries to progress from clinically detectable enamel lesion to dentine involvement?

This question to be considered in relation to:

a) Primary and permanent teeth

b) Site of caries:

- Pits and fissures
- Free smooth surfaces
- Approximal surfaces
- Secondary caries
-

2) How long does it take for caries to progress from clinically detectable enamel lesion to pulpal involvement and inflammation?

3) How long does it take for caries to progress through root surface dentine to the pulp?

4) What factors influence/modify the rate of progression of dental caries?

5) What is the accuracy* of the basic diagnostic methods (visual examination, visual examination with explorer, radiographs) used by clinicians for detecting carious lesions in primary and permanent teeth? (enamel lesions, lesions involving dentine [cavitated and non-cavitated], root caries lesions).

*measured in terms of sensitivity, specificity, positive and negative predictive values

6) At what point can lesion progression no longer be arrested or reversed?

7) What are the predictive validities of currently available caries risk assessment strategies in primary and permanent teeth?

8) What clinical and socio-demographic variables are the most accurate predictors of future caries development in children and adults?

9) What factors influence the longevity (survival rate) in primary care of dental restorations in children and adults?

Periodontal Disease

10) What is the rate of progression of treated and untreated chronic periodontitis?

11) What factors influence an individual's susceptibility for the development of severe periodontal disease?

12) What is the impact of gingivitis on:

- quality of life
- oral diseases
- restorations

Mucosal Disease

13) What is the incidence and prevalence of oral cancer and potentially malignant conditions in the UK? (leukoplakia, erythroplakia, lichen planus, oral submucous fibrosis, actinic keratosis)

14) What factors influence an individual's risk of developing oral cancer?

15) What is the rate of malignant transformation and regression of:

- Leukoplakia
- Erythroplakia
- Lichen planus
- Oral submucous fibrosis
- Actinic keratosis

16) What is the accuracy of clinical oral examinations in detecting oral cancer and precancerous lesions?

17) Does the detection of oral cancerous lesions at a stage when they are 2cm or smaller in diameter improve prognosis when compared with lesions that are detected when they are greater than 2cm in diameter?

Advice and Preventive Measures

18) How effective is 'chairside' oral health promotion and dental health education in:

- Reducing levels of dental caries
- Controlling initial carious lesions (preventive management of dental caries
- Improving periodontal health
- Promoting dietary change
- Promoting change in oral health related knowledge, attitudes and behaviours
- Promoting smoking cessation

19) Does the effectiveness of this advice vary according to differing intervals of delivery?

Patient views and expectations

20) How satisfied are patients in England and Wales with their NHS dental service?

21) What factors influence why and with what frequency patients see their dentist?

22) How frequently do patients registered with NHS dentists attend for dental check-ups?

APPENDIX B - HTA Update Literature Searches

Medline (Ovid) 2001 to July 2003

1 (dent$ adj6 (check$ or attend$ or exam$ or recall$ or visit$ or regular$ or interval$ or frequen$)).tw.

2 (recall$ adj6 interval$).tw.

3 Oral Health/

4 exp Dental Care/

5 Time factors/

6 (dental or dentistry).mp.

7 5 and 6

8 or/1-4,7

9 Preventive Dentistry/

10 exp Oral Hygiene/

11 or/9-10

12 exp Mouth Diseases/

13 exp Tooth Diseases/

14 or/12-13

15 11 and 14

16 exp Mouth Diseases/pc [Prevention & Control]

17 exp Tooth Diseases/pc [Prevention & Control]

18 or/15-17

19 (Meta-analysis/ or Meta analys$.tw. or Metaanaly$.tw. or meta-analy$.tw. or Meta analysis.pt. or (systematic adj (review$1 or overview$1)).tw. or exp Review, literature/ or (cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or cinhal or science citation index or bids or cancerlit or reference lists or bibliograph$ or hand-search$ or manual search$ or relevant journals or data extraction or selection criteria).ab. or review.pt.) not ((Animal/ not (Animal/ and Human/)) or (letter or editorial or comment).pt.)

20 randomized controlled trial.pt. or randomized controlled trials/ or random allocation/ or double blind method/ or single blind method/ or clinical trial.pt. or exp clinical trials/ or (clin$ adj25 trial$).tw. or ((single$ or doubl$ or

trebl$ or tripl$) adj25 (blind$ or mask$)).tw. or placebos/ or placebo$.tw. or random$.tw. or research design/) not (Animal/ not (Animal/ and Human/))

21 (Epidemiologic studies/ or exp case control studies/ or exp cohort studies/ or Case control.tw. or (cohort adj (study or studies)).tw. or Cohort analy$.tw. or (Follow up adj (study or studies)).tw. or (observational adj (study or studies)).tw. or Longitudinal.tw. or Retrospective.tw. or Cross sectional.tw. or Cross-sectional studies/) not (Animal/ not (Animal/ and Human/))

22 economics/ or "costs and cost analysis"/ or cost allocation/ or cost-benefit analysis/ or cost control/ or cost savings/ or cost of illness/ or cost sharing/ or "deductibles and coinsurance"/ or medical savings accounts/ or health care costs/ or direct service costs/ or drug costs/ or employer health costs/ or hospital costs/ or health expenditures/ or capital expenditures/ or value of life/ or exp economics, hospital/ or exp economics, medical/ or economics, nursing/ or economics, pharmaceutical/ or exp "fees and charges"/ or exp budgets/ or ((low or high or unit or health?care) adj cost$).mp. or (fiscal or funding or financial or finance).tw. or (cost adj (estimat$ or variableor utilit$ or containment$ or minimi$)).tw. or (economic$ or pharmacoeconomic$ or price$ or pricing).tw. or Quality-Adjusted Life Years/ or (QALY$ or life?year$ or costeffectiv$ or cost?effectiv$ or benefit-cost$ or costbenefit$ or cost?benefit$).tw. or health economi$.tw. or ec.fs. or (economic$ adj20 (evaluation$ or analys$)).tw.

23 (8 or 18) and 19

24 (8 or 18) and 20

25 (8 or 18) and 21

26 (8 or 18) and 22

Embase (Ovid) 2001 to July 2003

1 (dent$ adj6 (check$ or attend$ or exam$ or recall$ or visit$ or regular$ or interval$ or frequen$)).tw.

2 (recall$ adj6 interval$).tw.

3 Dental Health/

4 Dental Care/

5 Time/

6 dent$.mp.

7 5 and 6

8 or/1-4,7

9 Preventive Dentistry/

10 Caries Prevention/

11 Mouth Hygiene/

12 Tooth Brushing/

13 or/9-12

14 exp Mouth Disease/

15 13 and 14

16 exp Mouth Disease/pc [Prevention]

17 or/15-16

18 (exp Meta-Analysis/ or meta analy$.tw. or metaanaly$.tw. or meta-analy$.tw. or (systematic adj (review$1 or overview$1)).tw. or (cochrane or embase or psychlit or psyclit or psychinfo or psycinfo or cinahl or cinhal or science citation index or bids or cancerlit or reference lists or bibliograph$ or hand-search$ or manual search$ or relevant journals or data extraction or selection criteria).ab. or review.pt.) not ((Animal/ not (Animal/ and Human/)) or (letter or editorial).pt.)

19 (Clinical trial/ or Randomized controlled trial/ or Randomization/ or Single blind procedure/ or Double blind procedure/ or Crossover procedure/ or (Randomi?ed controlled trial$ or rct or random allocation or randomly allocated or allocated randomly or (allocated adj2 random) or single blind$ or double blind$ or ((treble or triple) adj blind$) or placebo$).tw. or Prospective study/) not (Case study/ or Case report.tw. or Abstract report/ or letter/)

20 (cohort analysis/ or longitudinal study/ or prospective study/ or follow up/ or risk/ or risk assessment/ or risk benefit analysis/ or risk factor/ or ((odds and ratio$) or (relative and risk) or (case and control$)).tw. or case control study/) not (Animal/ not (Animal/ and Human/))

21 Socioeconomics/ or Cost benefit analysis/ or Cost effectiveness analysis/ or Cost of illness/ or Cost control/ or Economic aspect/ or Financial management/ or Health care cost/ or Health care financing/ or Health economics/ or Hospital cost/ or (fiscal or financial or finance or funding).tw. or Cost minimization analysis/ or (cost adj estimate$).mp. or (cost adj variable$).mp. or (unit adj cost$).mp. or (QALY$ or life-year$ or costeffective$ or benefit-cost$ or costbenefit$).mp.

22 (8 or 17) and 18

23 (8 or 17) and 19

24 (8 or 17) and 20

25 (8 or 21) and 21

The Cochrane Library 2001 to Issue 3 2003

1 dent* near check*

2 dent* near attend*

3 dent* near exam*

4 dent* near recall*

5 dent* near visit*

6 dent* near regular*

7 dent* near interval*

8 dent near frequen*

9 recall near interval*

APPENDIX C – HTA Update Key Study Characteristics

Author & date of study (ID)	Design	Country of origin	Date of data collection	Population characteristics				Access/ Coverage	Intervention: Frequencies compared	Outcomes	Follow up
				N	Age	Dent-ition** D, M, P	Recruitment		Dental check:		
Boehmer *et al.*, 2001	Cross-sectional (CS)	United States (Boston)	April 1996 – May 1997	538	62 (mean) SD 11.9	P	Men who are participants in the Veterans Health Study – a longitudinal study of the health and functional status of male Veterans Administration ambulatory care patients.	Not stated	*(Subjective measure of dental check frequency)* **Self-reported time of last dental visit:** For analysis purposes, this was divided into 3 categories: 1) During the last year 2) Between 1 and 2 years ago 3) More than 2 years ago	Mucosa score Number of teeth Decayed coronal surfaces Root caries Periodontal treatment need	N/A
Title of Study: *Oral Health of Ambulatory Care Patients* **Aim of Study:** To assess Veterans Administration patients' clinical oral health status and its associations with sociodemographic characteristics and use of dental care.											
Bullock *et al*., 2001	Case-control study	Stoke-on-Trent, North Staffordshire. UK.	Not stated	Cases (Ca) 100 Controls (Co) 100	Ca(n) Co(n) 18-29 (28) (23) 30-44 (45) (43) 45-59 (24) (22) ≥60 (3) (12)	P	Consecutive patients (18+ yrs) attending a general dental practice were recruited into the two study groups as they presented themselves for dental examination or for treatment in response to a dental problem.	Mixed private/NHS practice	*(Objective measure of dental check frequency)* **Regular Attenders** (Controls): Adult patients, aged 18 years or over, who had attended for at least two dental examinations in the course of the past two years **Casual Attenders** (Cases): Adult patients, aged 18 years or over, who had not had a dental examination during the course of the past two years and who had attended in response to a dental problem	**Primary outcome:** Subjects with dentinal caries on bitewing radiograph. **Secondary Outcomes:** Subjects with visual caries causing cavitation. Subjects with >30% tooth-bone loss Subjects with mobile teeth.	N/A

Title of Study: *A case-control study of differences between regular and casual adult attenders in General Dental Practice.* **Aim of Study:** To assess whether adults attending a dental practice for regular dental care have better oral health than adults attending casually in response to a dental problem and to explore the barriers to asymptomatic attendance.
** D=deciduous dentition, M= Mixed dentition, P = Permanent dentition

Author & date of study (ID)	Design	Country of origin	Date of data collection	Population characteristics				Access/ Coverage	Intervention: Frequencies compared	Outcomes	Follow up
				N	Age	Denti-tion D, M, P	Recruitment		Dental check:		
Campus *et al*., 2001	CS	Sardinia, Italy	Dec.1997 to March 1998	403	12 yr olds	P	Systematic cluster sampling of 1,250 12 yr old children attending school in study area. Excluded children without consent, those with fixed appliances	Italian population has access to dental care only on a private basis.	*(Subjective measure of dental check frequency)* **Reported dental check-ups:** *Less than once a year* *Once a year* *Twice a year* *More than twice a year*	Mean DMFS Mean no. of decayed surfaces Mean no of filled surfaces CPITN: healthy, bleeding, calculus	N/A
Title of Study: *Socio-economic and behavioural factors related to caries in twelve-year-old Sardinian children.* **Aims of the study:** 1) to determine caries prevalence among 12-year-old Sardinian children and 2) to investigate the relationships between oral clinical indices and various behavioural and social-demographic factors. A questionnaire concerning oral hygiene habits, the onset of toothbrushing habits, frequency of dental check-ups, sweet food and soft drink consumption and socio-economic background was filled out by children and parents/guardians.											
Carvalho *et al.*, 2001	CS	Belgium	1983 1998	533 496	12 year olds	P	Two samples were drawn in connection with children's compulsory regular medical check-up at the University School Health Centre in Brussels, responsible for 17 secondary schools. Eight out of these	In Belgium a partial public subsidy for health care is available. Partial refunds for dental and medical expenses are available for a list of selected treatments. In 1989, 'preventive procedures' included in list of reimbursable treatments included one annual clinical examination, one annual topical fluoride application	*(Subjective measure of dental check frequency)* **Reason for making dental appointment:** 1) *Never* 2) *discomfort or pain* 3) *Control visit at least once per year*	DMFS	N/A

							17 schools were randomly selected to participate in the sample in 1983. Children from the same schools sampled in 1998.	and one sealant application on permanent teeth.	**Comparisons made (in multiple linear regression model):** Appointment on pain (no =0; yes =1) Regular appointment (no = 0; yes =1).		
Title of Study: *The decline in dental caries among Belgian children between 1983 and 1998.* **Aim of Study:** To investigate cross-sectionally a possible dental caries decline among Belgian 12-yr-old children from 1993 to 1998 and to analyse some factors that may be related to dental caries during the study period.											

Author & date of study (ID)	Design	Country of origin	Date of data collection	Population characteristics				Access/ Coverage	Intervention: Frequencies compared	Outcomes	Follow up
				N	Age	Denti-tion D, M, P	Recruitment		Dental check:		
Chavers *et al*., 2002	Longitudinal Study (LS)	United States (Florida)	Baseline (August 1993-April 1994) Telephone interview at 6,12, 18 months. Personal interview and clinical examination at 24 months (August 1995)	873 (by 24 months, 764 persons remained in study, of whom 723 participated in a clinical examination)	45 yrs or older	P	Sampling designed to ensure that a large no. of persons at hypothesized increased risk for oral health decrements would be included (namely African Americans, rural residents, persons 45 yrs or older & the poor). Random sample of dentate respondents stratified by nonmetropolitan and metropolitan counties	Not stated	*(Subjective measure of dental check frequency)* **Problem oriented attenders (POA)** Classified as POA if respondent described their approach to dental care as: "I never go to a dentist" and/or "I go to a dentist when I have a problem or when I know I need to get something fixed" **Regular attenders (RA)** Classified as RA if respondent described their approach to dental care as "I go to a dentist occasionally, whether or not I have a problem" or "I go to a dentist regularly"	Oral Disadvantage due to: 1)Disease/ Tissue damage 2) pain 3) function	Telephone interview at 6,12, 18 months. Personal interview and clinical examination at 24 months
Title of Study: *Racial and socio-economic disparities in oral disadvantage, a measure of oral health-related quality of life: 24 month incidence.* (NOTE: Oral disadvantage is one component of 'oral health-related quality of life' (OHRQOL) and connotes a psychosocial state in which persons affected by oral disease, tissue damage, or functional limitation do not perform normal social activities, such as interpersonal contacts or employment, because of their mouth). **Aim of Study:** To estimate the incidence of oral disadvantage based on the subject's approach to dental care, sex, race, and financial status; to identify demographic and socio-economic characteristics associated with oral disadvantage; and to determine if these characteristics are differentially associated with the three domains of oral disadvantage.											
Freire *et al*., 2002	Cross-sectional (CS)	Brazil	Not Stated	664	15 yr olds & their moth-ers	P	Randomly selected from public and private schools in a fluoridated area of Brazil	Not stated	*(Subjective measure of dental check frequency)* **Pattern of dental attendance:** Check-ups mainly In trouble mainly No dental visit Do not know	Caries severity	Not applicable

Title of Study: *Mothers' sense of coherence and their adolescent children's oral health status and behaviours*
Aim of study: To investigate the relationship between mothers' sense of coherence (SOC) and their adolescent children's oral health.

Author & date of study (ID)	Design	Country of origin	Date of data collection	Population characteristics				Access/ Coverage	Intervention: Frequencies compared	Outcomes	Follow up
				N	Age	Denti-tion D, M, P	Recruitment		Dental check:		
Lissowska *et al*., 2003	Case-control study	Poland	March 1997-June 2000	Cases 122 (78 males, 44 females) Controls 124 (72 males, 52 females)	23-80 years	P	Men and women, aged 23 –80 yrs, diagnosed with histologically confirmed incident cancer of the oral cavity and pharynx in one of the biggest maxillofacial surgery clinics in the province of Warsaw. Controls were patients admitted for acute illnesses to major hospitals serving the same areas where the cases lived.	Not stated	*(Subjective measure of dental check frequency)* Every year Every 2-5 years <once every 5 years Never	Oral cavity and pharynx cancer	NA
.**Title of Study:** *Smoking, alcohol, diet, dentition and sexual practices in the epidemiology of oral cancer in Poland* **Aim of Study:** The study was conducted within the framework of an international multicentre case-control study, coordinated by the International Agency for Research on Cancer, to assess risk factors for oral cancer, including the potential impact of HPV infection on oral cancer. The aim of the study was to assess a variety of lifestyle risk factors in Poland.											

Author & date of study (ID)	Design	Country of origin	Date of data collection	Population characteristics				Access/ Coverage	Intervention: Frequencies compared	Outcomes	Follow up
				N	Age	Denti-tion D, M, P	Recruitment		Dental check:		
Locker 2001	Longitudinal study	Ontario, Canada	Data collection at baseline (1989) and after 3 years	907 (baseline) 611 (follow-up)	Mean age at baseline 63 yrs	P	Randomly selected sample of adults aged 50 years and over living independently in four Ontario communities.	Not Stated	(Objective measure of dental check frequency) Number of dental visits in the previous three years: 0 1-5 6-11 12-33	Reported oral health: Worse Same Better	3 years after baseline
Title of Study: Does dental care improve the oral health of older adults? Objective of the study: To assess the relationship between self-perceived change in oral health status and the provision of dental treatment in an older adult population.											
Petersen et al., 2001	Cross sectional	Southern Thailand	Survey completed by 1997	1156 Grade I children 1116 Grade VI children	6yrs 12 yrs	D P	Two stage random sampling of primary schools (urban and rural).	Not stated	(Subjective measure of dental check frequency) Annual Dental Visit: Yes No	DMFT (12 yr olds only)	N/A
Title of Study: Oral health status and oral health behaviour of urban and rural school children in Southern Thailand Aim of Study: To describe the level of oral disease in urban and rural school-children in Southern Thailand; to analyse self-care practices and dental visiting habits of 12-year-olds, and to assess the effect of socio-behavioural factors on dental caries experience											

Author & date of study (ID)	Design	Country of origin	Date of data collection	Population characteristics				Access/ Coverage	Intervention: Frequencies compared	Outcomes	Follow up
				N	Age	Denti-tion D, M, P	Recruitment		Dental check:		
Richards and Ameen 2002	Case control	Swansea, South Wales	December 1998 – June 1999	643	18 years or older (Average age 41.3 years with standard deviation of 13.82.)	P	Opportunistic recruitment of consecutive patients (aged 18+ years) attending a general dental practice in an urban area of Swansea	Not stated	*(Objective measure of dental check frequency)* ***Regular attenders*** Last attendance ≤ 24 months ***Irregular attenders*** Last attendance >24 months	SOHSI variables; Overall description of oral health; Toothloss; mean number of teeth; (SOHSI = Subjective Oral Health Status Indicators – an oral health quality of life measure).	NA
. **Title of Study:** The impact of attendance patterns on oral health in a general dental practice. **Aim of the study:** To examine the impact of attendance patterns on oral health in the context of government policy on dental care and registration in the UK.											
Thomson 2001	Longitudinal study	New Zealand	Not stated	1037 in original cohort Dental exam data at age 26 available for 930. 748 of these living in NZ. Analyses based on sample of 748.	26 year olds	P	Longitudinal study of a cohort of children born at a hospital in Dunedin, New Zealand between 1st April 1972 and 31st March 1973. Periodic collections of health and developmental data, including dental examinations, undertaken since then. Data presented in this paper uses data collected at ages 5, 15,18 and 26.	School Dental Service up until age of 12-13 (free access). Transfer to General Dental Benefit (GDB) Scheme at age 12 or 13 – no out of pocket charge to the user of GDB care (nevertheless, transfer to GDB scheme associated with drop in utilisation from over 95 percent to less than 75 percent). Role of State in provision of dental care generally ceases at age 18.	*(Subjective measure of dental check frequency)* **Dental visit pattern:** Regular GDB user at age 15 Yes No (Regular GDB user identified as those who reported being on the Dental Benefit Scheme, had visited the dentist within the previous 18 months and reported that their most recent visit was for a check-up). **Usual reason for dental visit at age 26:** Check-up Problem	Oral health at age 26 rated 'among the worst/below average Number with 1+ teeth lost due to caries by age 26 Number with 1+ third molars removed by age 26 Mean DMFS at age 26 Mean DFS increment between aged 18 and 26 Mean plaque score at age 26	

Title of Study: *Use of dental services by 26-year-old New Zealanders*
Aim of study: To describe the current characteristics of use of dental services and their oral health associations at age 26 among New Zealand-domiciled participants in a long-standing cohort study.

Author & date of study (ID)	Design	Country of origin	Date of data collection	Population characteristics				Access/ Coverage**	Intervention: Frequencies compared	Outcomes	Follow up
				N	Age	Denti-tion D, M, P	Recruitment		Dental check:		
Ugur *et al*.,2002	Cross Sectional	Witten, Germany (Study of Turkish population)	1997	532	Older than 12 years of age (age groups studied: 13-14 15-24 25-34 35-44 45-54 55+)	P	Not random sample. Three stage sampling process. 1) sampling of Turkish clubs in city 2) schools with Turkish students 3)Residential area with large number of Turkish residents	Not stated	*(Subjective measure of dental check frequency)* **Use of dental services:** **Regular:** People who made regular visits every year to have their teeth examined **Irregular:** People going to the dentist only if there was a 'tooth problem'	DT MT FT PT (periodontally involved teeth)	N/A
Title of Study: *Utilisation of dental services among a Turkish population in Witten, Germany* **Aim of Study:** To describe the oral health status and the dental service use pattern of a Turkish population in Witten, Germany, and to assess the factors affecting this use pattern.											
Ullah *et al*.,2002	Cross sectional	Bangladesh	2000	631	12 yr olds	P	Stratified random sample on basis of urban, semi-urban and rural residence. 14 schools selected to obtain a representative national sample.	Not stated	*(Subjective measure of dental check frequency)* **Dental visit pattern:** Regular (> once a year) Irregular (< once a year) Do not remember Never	DT, DMFT OHI-S scores	N/A
Title of Study: *Oral health of 12 year old Bangladeshi children.* **Aim of study:** To describe the experience of dental caries among 12-year-olds in Bangladesh 2) to assess their oral hygiene and periodontal conditions 3) to collect representative data on oral health habits and 4) to relate dental caries data, oral hygiene, and periodontal conditions to sex, residence (urban, semi-urban and rural), tooth cleaning habits and social factors.											

Author & Date of Study (ID)	**Study design**	**N**	**Age**	**Intervention freq (/12).**	**SUbjects**	**% Mucosa scores**			**% Edent-ulous**	**% any Denture**	**Number of teeth**	**Decayed coronal surfaces**	**root caries**		**PERIO TX NEED**
Boehmer *et al*., 2001	C/S	538	62 (mean) SD 11.9	**Self- reported time of last dental visit**	**n**	**0 or 1**	**2**	**3**					*untreated*	*untreated plus filled*	
				During Last 1 year	268	19.4	12.3	15.6*	10.1*	36.2*	Mean 20.25_a (n=241)	Mean 0.94_a (n=241)	Mean 0.09_a (n=229)	Mean 0.15 (n=181)	Mean 1.84_a
				Between 1 and 2 years ago	65	69.8	76.9	64.3	24.6	52.3	18.02_b (n=49)	1.73_a (n=49)	0.14_{ab} (n=44)	0.19 (n=38)	2.19_b
				2 years or more	199	10.8	10.8	20.1	49.8	63.3	16.22_b (n=100)	3.14_b (n=100)	0.18_b (n=91)	0.21 (n=72)	2.42_b
					*p <0.05 (Chi^2 test)						n =number of subjects. Different subscript letters indicate significant differences between groups at p<0.05 (Duncan tests)				

Author & Date of Study (ID)	Study design	N	Age	Intervention freq (/12).	NUMBER OF TEETH			SUBJECTS WITH DENTINAL CARIES ON BW RADIOGRAPH	Subjects with visual caries causing cavitation	subjects with >30% tooth bone loss	subjects with mobile teeth
		200		Dental visit pattern	Median	IQR	Range				
Bullock et al., 2001	Case Control	100 cases 100 controls	18-29 30-44 45-59 ≥ 60	**Regular Attenders (Controls)** At least two dental examinations in the course of the past two years **Casual Attenders (Cases):** No dental examination in the past two years and who had attended in response to a problem.	27 27	25-28 24-29	7-32 14-32	n (%) Absent: 78 82 Present: 17 18 N=95 (bw not taken for 5 subjects with no posterior teeth) Absent: 40 43 Present: 54 57 N=94 (bw not taken for 6 subjects with no posterior teeth)	n (%) Absent: 81 81 Present: 19 19 N=100 Absent: 21 21 Present:79 79 N=100	n (%) Absent: 80 84 Present: 15 16 N=95 Absent: 67 71 Present: 27 29 N=94	n (%) Absent: 92 92 Present: 8 8 N=100 Absent:76 76 Present:24 24 N=100
					p-value 0.154 (adjusted for age, gender and social class) p-value 0.409 (adjusted for age, gender, social class and smoking status)			p <0.001 (adjusted for age, gender and social class) p <0.001 (adjusted for age, gender, social class and smoking status)		p = 0.013 (adjusted for age, gender and social class) p = 0.046 (adjusted for age, gender, social class and smoking status)	p < 0.001 (adjusted for age, gender and social class) p 0.001 adjusted for age, gender, social class and smoking status).

Author & Date of Study (ID)	Study design	N	Age	Interven-tion freq (/12).	Subjects	Decay experience (DMFT / DFT/DMFS)	decayed surfaces (DS)	Filled teeth (FT) Filled surfaces (FS)	CPItn		
				Dental check	n	Mean DMFS	Mean number of decayed surfaces	Mean number of filled sufaces	healthy	bleeding	calculus
Campus 2001	C.S.	Total 403	12 year olds	Less than once a year	98	3.3 ± 4.2	2.0 ± 2.8	1.3 ±2.9	34.7%	36.7%	28.6%
				Once a year	112	3.2 ±4.2	2.6 ± 4.0	0.6± 1.2	34.8%	34.8%	30.4%
				Twice a year	62	4.3 ±5.9	3.1 ±5.2	1.2 ± 2.9	17.8%	53.2%	29.0%
				More than twice a year	87	3.7 ±4.8	2.5 ± 4.3	1.2 ±2.3	34.5%	33.3%	32.2%
						p for ANOVA 0.4	p for ANOVA 1.0 (Note this value (1.0) is incorrect)	p for ANOVA 0.3	p for χ^2_6 0.1		
Carvalho 2001	C.S.	Total 533 (1983) 496 (1998)	12 year olds	Appointment on pain (no = 0; yes =1)	App. on pain 218 (1983) 99(1998)	**Appointment on pain (no = 0 yes = 1)** Comparing '0' to '1' '1'> mean DMFS 3.40 SE 0.80 (p-value 0.0001)					
				Regular appointment (no =0; yes =1)	Regular app. 272 (1983) 372(1998)	Comparing '0' to '1' '1'>mean DMFS 1.50 SE 0.77 (p-value 0.053).					

Author & Date of Study (ID)	Study design	N	Age	Intervention freq (/12).	Subjects	oral disadvantage due to……..		
				Dental Check		DISEASE/TISSUE DAMAGE	PAIN	FUNCTION
Chavers et al., 2002	Longitudinal	Total Baseline 873 Final 723	45 yrs or older	Approach to dental Care: Problem oriented attenders (POA)	1,598 (weighted person intervals)	Adjusted OR (95% CI): 2.0 (1.3, 3.1) [p <0.05]	Adjusted OR (95%CI): 1.3 (0.8, 2.1) N.S	Adjusted OR (95% CI): 1.5 (1.1,2.1) [p<0.05]
						(Adjusted for age, sex, race, area of residence and socio-economic variables)	(Adjusted for age, sex, race, area of residence and socio-economic variables)	(Adjusted for age, sex, race, area of residence and socio-economic variables)
				Regular attenders (RA)	1,894 (weighted person intervals) Person intervals used as unit of analysis, not the individual.	1.0	1.0	1.0

Author & Date of Study (ID)	Study design	N	Age	Interven-tion freq (/12).	SUbjects	Decay experience (DMFT / DFT/DMFS)	Adjusted odds ratios
				Pattern of dental attendance	n (%)	Caries severity	
Freire 2002	C.S.	Total 664	15 yr olds	Check-ups mainly	41 (35) 123(53.7) 131(55.3) 59(72.8)	Zone 3 Zone2 Zone1 Zone0	Check-ups Mainly: 1
				In trouble mainly	71(60.7) 99(43.2) 91(38.4) 12(14.8)	Zone 3 Zone2 Zone1 Zone0	In trouble mainly 1.93 (1.42, 2.62))
				No dental visit	1 (0.9) 0 (0.0) 2(0.8) 5(6.2)	Zone 3 Zone2 Zone1 Zone0	No dental visit 0.09 (0.02, 0.42)
				Do not know	4(3.4) 7(3.1) 13(5.5) 5(6.2)	Zone 3 Zone2 Zone1 Zone0 Zones 3 to 0 indicate decreasing severity: Zone 3= approximal and labial anterior; Zone 2 = approximal posterior; Zone 1 = Pit and fissure posterior; Zone 0 = caries free.	Do not know 0.63 (0.31, 1.30)

Author & Date of Study (ID)	Study design	N	Age	Interven-tion freq (/12).				
				Dental Check	No. of cases	No. of Controls	Odds Ratio	95% CI
Lissowska et al., 2003	Case-Control Study	Cases 122 (78 males, 44 females) Controls 124 (72 males, 52 females)	23-80 years	Every year	28	8	1 (reference category)	
				Every 2-5 years	55	36	1.94	(0.70-5.34)
				< once every 5 years	29	40	4.67	(1.56-14.01)
				Never	11 .	33	11.89	(3.33-42.51)
					P for trend <0.01			

Author & Date of Study (ID)	Study design	N	Age	Interven-tion freq (/12).	SUbjects	reported CHANge in oral health status (oral health self rating)
				Number of visits over three yr period	n n = 518	Change in Oral health status over three years
Locker 2001	Longitudinal	Baseline 907 Follow-up 611	Mean age at baseline 63 years	0 1-5 6-11 12-33	15.9% 80.4% 3.7% 23.6 65.5 7.9 15.5 74.1 10.4 23.3 52.1 24.7	Worse Same Better Worse Same Better Worse Same Better Worse Same Better
				P<0.0001; Chi2 test		

Author & Date of Study (ID)	Study design	N	Age	Interven-tion freq (/12).	Decay experience (DMFT)	
				Pattern of dental attendance	12 year olds only	
Petersen et al 2001	C.S.	1156 1116	6 yr olds 12 yr olds	Annual Dental Visit: YES NO	DMFT Regression Co-efficient 0.53 P< 0.01 -	OR Odds Ratio 1.35 P<0.05 -

author Study design	N	Age	Interventio n freq (/12).	Overall description of health					toothloss characteristics			mean no of teeth	sohsi variables					
															ABILITY TO SOCIALISE			
Richards and Ameen Cross Sectional	643	18 years +		Ex n (%)	V.good n(%)	Good n (%)	Fair n (%)	Poor n (%)	Edent n (%)	1-21 teeth n (%)	>21 teeth n (%)		AE n (%)	AS n (%)	D n (%)	W n (%)	S n (%)	
			Regular attenders Last attendance ≤ 24 months	33 (89.2)	128 (88.3)	187 (77.9)	80 (52.6)	15 (28.3)	2 (100)	62 (84.4)	321 (75.3)	25.3 (SD 5.45) CI 24.8,25.9	333 (74)	399 (72)	211 (60.5)	446 (70.2)	327 (82.5)	
			Irregular attenders Last attendance >24 months	2 (5.4)	5 (3.45)	11 (4.6)	14 (9.2)	13 (24.5)	0 (0)	0 (0)	23 (5.4)	27.69 (SD2.65) CI 26.5,28.8	30 (6.67)	35 (6.32)	33 (9.46)	45 (7.09)	14 (3.54)	
													AE=ability to eat; AS=ability to speak; D=discontent; W=worried; S=Satisfied					

SOSHI variables dependence on attendance mode				DISEASE ACTIVITY n (%)					SEVERITY OF PAIN EXPERIENCE n (%)				SEVERITY OF OTHER SYMPTOMS EXPERIENCE		
	*	**		D	OS	GWB	HOC	AD	No	Mild	Mod	Severe	Lot n (%)	Little n (%)	None n (%)
AE	0.006	52.19	Regular attenders	169 (57)	273 (64.4)	387 (74.7)	218 (90)	161	219 (82)	109 (66)	43 (51.8)	16 (33.3)	30 (49.18)	146 (65.18)	159 (81.54)
AS	0.041	62.54													
D	0.000	37.3													
W	(0.53)	64.73													
S	0.000	51.25													
D	0.000	43.8	Irregular attenders	34 (11.5)	37 (8.7)	31 (6)	7 (2.89)	16 (6.2)	6 (2.25)	15(9.09)	11(13.2)	8(16.6)	8 (13.11)	24 (10.71)	6 (3.08)
OS	0.000	27.43													
GWB	0.000	60.5													
DS	0.000	43.69													
SP	0.000	38.9	D=discomfort;OS=other symptoms; GWB=general well being; HOC=healthy overall code; AD=active disease 2 and 3 overall code.												
SOS	0.000	11.25													
ODH	0.000	68.38													

*significance of dependence on patterns of attendance **regular patients with satisfactory symptom (%overall) SP=Severity of pain SOS=Severity of other symptoms ODH=Overall description of health	
Authors' Conclusions: The results of this case study show that there is a significant difference in oral health between regular and irregular attenders. Regular attendance is associated with better oral health.	

Author & Date of Study (ID)	Study design	N	Age	Interven-tion freq (/12).					
Thomson 2001	Longitudinal	748	26 yr olds	Use of dental services	Oral health at age 26 rated 'Among the worst/below average' n (%)	No. with 1+ missing teeth lost due to caries by age 26 n (%)	Mean DMFS at age 26 (sd)	Mean DFS increment between ages 18 and 26 (sd)	Mean plaque score (sd) at age 26
				Regular GDB user at age 15?					
				YES (n=423)	170(40.2)	41 (9.7)	12.3 (11.04)	4.95 (5.80)	0.84 (0.53)
				NO (n=325)	145 (44.6)	32 (9.8)	13.55 (11.91)	4.35 (5.49)	0.90 (0.57)
				Usual Reason for dental visit at age 26?					
				Check-up (n=341)	78 (22.9)	12(3.5)	11.18 (10.14)	4.22 (5.51)	0.78 (0.50)
				Problem (n-=407)	237(58.2) *	61 (15.0)*	14.23 (12.26) ¥	5.08 (5.77) ¥	0.94 (0.58)*
					* P<0.05	* P <0.05	¥ P<0.05. Mann-Whitney test	¥ P<0.05. Mann-Whitney test	* P<0.05

Author & Date of Study (ID)	Study design	N	Age	Interven-tion freq (/12).	Decayed teeth			missing teeth			filled teeth			Periodontally involved teeth		
Ugur 2002	CS	532	13- 55+ yr olds	Use of dental services	Beta	Odds ratio (OR)	95% CI for OR	Beta	Odds ratio (OR)	95% CI for OR	Beta	Odds ratio (OR)	95% CI for OR	Beta	Odds ratio (OR)	95% CI for OR
				Regular	-0.26	**0.78** P<0.01	0.69, 0.87	-0.10	**0.90** P<0.05	0.83, 0.99	0.78	**1.11** P<0.05	1.00, 1.16	-0.06	**0.94** P<0.01	0.92, 0.98
				Irregular	-	-	-	-	-	-	-	-	-	-	-	-

Author & Date of Study (ID)	Study design	N	Age	Interven-tion freq (/12).	SUbjects	DT. mean +/- sD	dmft mean +/- sD	ohi-s scores, mean +/- sD
					n	Dental caries prevalence related bivariately to independent variables		
Ullah 2002	CS	631	12 year olds	Dental visit pattern:		*	**	NS
				Regular (>1 a year)	51	1.08 (1.51)	1.20(1.52)	1.37 (0.26)
				Irregular (< 1 a year)	83	1.08 (1.18)	1.27(1.27)	1.32 (0.33)
				Do not remember	50	1.28 (1.44)	1.50(1.57)	1.25 (0.30)
				Never	447	0.79 (1.36)	0.83(1.39)	1.33 (0.30)
						*0.01<P< 0.05	** 0.001<p<0.01	NS: Not Significant
				Reasons for dental visit				
				Emergency		**	***	
				Check-up	166	1.19 (1.40)	1.34 (1.45)	
				No visit	14	0.71 (0.91)	1.21 (1.48)	
					451	0.79 (1.35)	0.82 (1.38)	
						** 0.001<p<0.01	*** p < 0.001	

APPENDIX D: Economic Modelling

A Markov model was constructed to evaluate the health and resource consequences of different recall intervals. A Markov model is a special type of decision tree that is used where events can occur or reoccur at any point over a long period of time (Beck and Pauker, 1983). When an event can occur at many different points in time, a probability tree would become complex, with many pathways and it would require the collection of a very large number of probabilities. A Markov model overcomes this problem by simply assuming that the event (or state) in each time period is determined probabilistically on the basis of the state in the previous period but is independent of the path taken in periods prior to that. Hence a Markov model is represented by a diagram that shows the transmission between health states from one period to another, as in Figure 1, rather than the whole pathway. Markov models have been used in dental caries research for some years (Lu, 1970).

Our model differed from the HTA Report model in the following respects:

- For each strategy there was a Markov chain of 272 *three-month* cycles.[2]
- The model distinguishes between teeth that are DMF and those that are DMF-free, as did the HTA report model. However within DMF it distinguishes between those that have dentine caries, those that are are missing and those that are filled. More importantly, within DMF-free it distinguishes between teeth that are caries-free and those that have enamel caries. [See Figure 1]
- It was assumed that if enamel caries were detected during an OHR then the dentist could arrest or reverse the caries by the next cycle, effectively changing the tooth's status back to caries-free.
- The number of teeth that are reversed depends on
    - the efficacy of the dentist (assumed to be 100% in the base case model);
    - the accuracy (sensitivity and specificity) of the dentist in diagnosing enamel caries; and
    - the frequency of the OHR, because more carious teeth will be detected (and reversed) at the enamel caries stage.
- The measure of oral health is DMFT-years rather than the number of teeth that are DMF-free at age 80. In addition to DMFT-years, we calculated quality-adjusted tooth-years (QATYs) (Birch 1986). Unlike DMFT, QATYs weight different tooth states according to the preferences of patients, this means, for example, that filled teeth are given a greater value than missing or decayed teeth but less value than a sound tooth.

[2] In the HTA Report model, the length of a cycle varied according to the recall interval being assessed. This difference is minor and does not affect the results of the analyses.

- Given that the current level of NHS fees are under review and are unlikely to reflect the real cost of an oral health review, the costs of OHRs and treatment were incorporated in terms of the amount of dentists time (measured in minutes rather than pounds sterling). Cost-effectiveness is therefore measured in terms of the minutes of dentists' time per DMFT-year saved.

All of the model's base case parameters and their sources are given in Table 1.

The estimate of the duration of an OHR was taken from a recent NHS time and motion study. The upper confidence limit (15.8 minutes) rather than the mean (11.3 minutes) was chosen because, under the new arrangements, the proposed OHR will be more comprehensive and will take longer than the current dental examination. The estimate of the duration of a caries treatment session was taken from the same study.

The data on restoration survival and diagnostic accuracy were extracted from systematic reviews. It is possible that these estimates are optimistic, as a number of the contributing studies were carried out under optimal research conditions rather than in routine practice.

Dentists' time and tooth years were both discounted at the discount rates required by the Treasury for UK government evaluations.(HM Treasury 2003)

The quality-adjustments (or utilities) for different tooth states were taken from Fyffe and Nuttall (1992) and were the mean values elicited from 110 members of the Scottish general public using the standard gamble technique.

Estimating both the caries incidence and progression rates was problematic. For the progression rate we found a dated but comprehensive review (Pitts 1983). Given the lack of evidence, for our base case analysis we took an estimate that was the mid-point between the review and a recent Finnish study (Mejare et al. 1999; Pitts 1983). The rationale for this decision is that the two studies were conducted at different times corresponding to different 'eras' in the rate of progression of caries. The 1983 paper is a review of the literature on caries progression from many countries at a time when disease progression was more rapid and hence is probably an over-estimate. The Finnish study, by contrast, was conducted (1999) when the rate of progression of dental caries had slowed, in a country known to have a lower incidence of caries than England and Wales, and is more likely to give an under-estimate. We took the same approach with estimating the enamel caries incidence, a less commonly reported statistic. As the only relevant British study was in children and exhibited much higher rates than could be sustained in adults, again the mid-point between this and the Finnish study was used (Brabner et al. 1995). Tooth loss rates were derived from a study of molars in Scottish teenagers and had been used in a previous Markov analysis (Kay and Nuttall, 1993).

Results

For the base case assumptions, Table 2 shows the health outcomes, resource use and cost for each recall interval under consideration. As recall intervals are reduced step by step from 36 months to 3 months, there is a gradual improvement in health outcome, a decrease in the number of fillings but a net increase in the amount of dentists' time.

Table 3 shows how the incremental cost-effectiveness ratio increases as recall intervals get shorter and shorter. This means that as we continue to reduce the recall intervals from 36 months, dental health does continue to improve but this is at a greater and greater relative opportunity cost in terms of dentists' time. Hence for average patients, only if we are prepared to spend a lot of dentists' time per tooth-year saved would shorter recall intervals be justified.

Table 4 shows how the optimal strategy for patients would be different for patients in different risk subgroups. For this analysis we a) vary the threshold of minutes per DMFT-year saved (the maximum amount of time society is prepared to invest to save one DMFT-year), as this is not known; and b) represent subgroups indirectly as indicated by the relative risk for caries incidence and progression compared with the overall population. The top panel of this table (along with Table 2 and Table 3) is contingent on the clinical reversal rate being 100%. If we were to assume a clinical reversal rate of only 50%, there is a marked lengthening of the optimal recall intervals for each risk group (bottom panel of Table 4).

The other sensitivity analyses are presented in Table 5 for two recall interval comparisons. The results were not very sensitive to the following model parameters:

- The duration of a treatment session
- Enamel caries incidence
- Sensitivity of dentists in detecting carious lesions
- Restoration survival
- Discount rate.

However the results are relatively sensitive to:

- The duration of an OHR
- Progression rate (from enamel to dentine)
- Specificity of dentists in detecting dentine lesions
- Clinical efficacy

Limitations of the model

An overall optimal recall interval could not be estimated with any precision because:

- The cost-effectiveness threshold (the maximum amount of time society is prepared to invest to save one DMFT-year or one QATY) for England and Wales has not been defined.
- The level of clinical efficacy (in reversing enamel caries) is not known.
- The estimates of the other model parameters were imprecise and often measured for specific populations. This lack of precision is particularly important where the model's results were found to be sensitive to changes in a specific model parameter (like, for example, the duration of an oral health review).

For the base case we assumed that all enamel caries observed during an OHR would be reversed. Clearly this is optimistic because such efficacy depends on other factors such as the co-operation of the patient in taking on health promotion advice and also because some of the carious lesions would be reversed even in the absence of the OHR. However, it does not necessarily mean that clinical effectiveness has been over-estimated because the OHR could have contributed to a decrease in the caries incidence rate in addition to arresting lesions already present in the enamel.

The overall progression of caries appears to be substantially quicker in this model than in the HTA report model. For example with 36 monthly recall intervals the number of teeth that are DMF-free at age 80 are 4 and 12 respectively. One explanation might be the general imprecision or lack of generalisability in the baseline parameter estimates of both models. Another possible explanation is the omission of a spontaneous reversal / arrest rate for dentine caries within our model. This was omitted due to lack of empirical estimates. Interestingly, although the absolute numbers of DMFT differ between the models the incremental numbers between recall intervals are quite similar.

The prevention of dental caries was the only aspect of oral health captured by the model. Furthermore, the main health outcome measures (DMFT-years, and QATYs) may not fully capture health gain even within caries. More sophisticated outcomes have been developed but the transmission probabilities between states are even harder to ascertain.

Although, the impact of a patient's relative risk (for caries incidence and progression) on cost-effectiveness was assessed, it was not possible to explicitly compare the cost-effectiveness of each recall interval for different patient subgroups because of the lack of precision in the model parameters.

Implications of the model

Contingent on the assumptions and data used, the model implies the following:

In general as dental recall intervals become shorter, the cost savings in terms of reduced time spent in treating caries will only partially offset the extra time

associated with the oral health reviews. This is consistent with the published evidence on recall intervals [See 2.4]. However, if OHRs were to reduce the incidence of caries as well as reverse existing enamel caries then overall cost savings could be possible. A Swedish study (Melkersson and Olsson 1999) using Poisson regression analysis on longitudinal data has suggested that for children with poor oral health, frequent visits to the dentist lead to fewer visits as an adult (and presumably better oral health). Therefore for this group narrower recall intervals could be cost saving.

As dental recall intervals become shorter, oral health (DMFT-years avoided) improves. (This is of course contingent on the assumption about a high clinical reversal rate – if clinical efficacy is in reality much lower or if dentists are much less specific in detecting dentine caries then shorter recall intervals will be harmful because healthy teeth will be filled unnecessarily).

The model shows it to be both more effective and more cost-effective to have shorter recall intervals in patient subgroups with high caries risk and longer recall intervals in patient subgroups with low caries risk. This assumes dentists ability to reverse or arrest enamel caries is similar for high- and low-risk groups.

Comparisons with other studies

To decide which recall intervals represent good value for money, it would be useful to compare the cost-effectiveness figures in Table 4.4 with those for other oral health interventions. No other study has estimated cost-effectiveness in terms of the dentists time per DMFT-year saved, however two studies have measured the cost per DMFT-year saved.

One study predicted the benefits and costs of water fluoridation for hypothetical populations, which were differentiated by the proportion of high-risk children (Akehurst et al. 1993). They used a ‘value’ of £10 per dmft/DMFT averted in their calculations; however, it was not clear how this was derived. They concluded that water fluoridation was the most cost-effective strategy in caries prevention; however, it seems unclear whether this was really evidence-driven.

Another study estimated the cost-effectiveness of administering school milk and water fluoridation for the prevention of dental caries in the UK (Calvert et al. 2000). With fluoridated milk provided over 10 years, high caries risk children would benefit by 5.47 dmft/DMFT years saved and low caries risk children would benefit by 1.49 years. The model estimated 60% and 54% reductions in dmft/DMFT at 8 and 14 years of age with water fluoridation for high caries area and 40% and 34% reductions in dmft/DMFT for low caries area. The cost-effectiveness ratio for milk fluoridation was estimated to be between £57.91 and £69.50 per dmft/DMFT year saved for low caries areas

and between £15.84 and £19.00 for high caries areas. The estimates for water fluoridation varied from £2 to £38 per dmft/DMFT year saved.

Our base case estimates seem comparable to these figures, however, given the uncertainty around the model parameters and especially clinical efficacy, conclusions about the relative cost-effectiveness cannot be drawn.

Table 1: Model parameters

Model parameter		Base case estimate	Source
Dentist time (minutes)			
OHR		15.8	(Bearne et al. 2000)
Filling		25.5	(Bearne et al. 2000)
Incidence rates (3 months)			
Incidence of enamel caries	P1	2.1%	(Brabner et al. 1995; Mejare et al. 1999)
Progression rate (enamel to dentine)	P2	3.1%	(Mejare et al. 1999; Pitts 1983)
Progression rate (dentine to missing)	P7	2.0%	Kay and Nuttall (1993)
Progression rate (filled to missing)	P8	0.5%	Kay and Nuttall (1993)
Accuracy			
Sensitivity (enamel caries)	P3	66%	(Bader et al. 2001a)
Sensitivity (dentine caries)	P4	63%	(Bader et al. 2001a)
Specificity (dentine caries)	P5	89%	(Bader et al. 2001a)
Clinical efficacy			
Reversal rate	P6	100%	Assumed (subject to sensitivity analysis)
Restoration survival (years)			
Median survival		12	(Chadwick et al. 2001) [as used in HTA report]
Discount rates			
0-30 years		3.5%	(HM Treasury 2003)
Beyond 30 years		3.0%	(HM Treasury 2003)
Tooth quality weightings			
No caries or enamel caries		1	Assumed
Missing		0	Assumed
Dentine caries		0.49	Fyffe and Kay (1992)
Filled		0.70	Fyffe and Kay (1992)

Table 2 : Model outcomes for base case

	Dental recall interval					
	3 months	**6 months**	**12 months**	**18 months**	**24 months**	**36 months**
Undiscounted results						
Health outcome (at age 80)						
Teeth at age 80	19.2	18.4	17.2	16.2	15.3	13.8
DMFT-free teeth at age 80	10.8	9.7	7.9	6.6	5.7	4.3
Quality-adjusted teeth at age 80	16.7	15.8	14.4	13.3	12.3	10.9
Health outcome (overall)						
Tooth years	1672	1649	1607	1569	1535	1476
DMFT-free tooth years	1238	1184	1096	1028	973	892
Quality-adjusted tooth-years (QATYs)	1542	1509	1452	1404	1362	1292
Resource use						
Number of OHRs	272	136	68	46	34	23
Number of fillings	48	51	56	60	61	65
Time cost						
Hours - OHRs	72	36	18	12	9	6
Hours - fillings	20	22	24	26	26	28
Total hours	*92*	*58*	*42*	*38*	*35*	*34*
Results discounted at 3.5% (3% after 30 years)						
Health outcome						
DMFT-free tooth years	**571**	**555**	**530**	**510**	**494**	**469**
Quality-adjusted tooth years (QATYs)	**663**	**654**	**639**	**626**	**614**	**594**
Time cost						
Total hours	**35**	**22**	**16**	**14**	**13**	**12**

Table 3: Incremental cost-effectiveness (as recall intervals are shortened from 36 months to 3 months) – base case analysis

	Incremental time (minutes) per DMFT-year saved (discounted)	Incremental time (minutes) per QATY gained (discounted)
From 36 months to 24 months	2	4
From 24 months to 18 months	3	7
From 18 months to 12 months	5	11
From 12 months to 6 months	15	29
From 6 months to 3 months	52	105

Table 4: Optimal recall interval (months), by cost-effectiveness threshold and caries relative risk

Caries Relative risk	Cost-effectiveness threshold: Minutes per DMFT-year saved						
	1	**2**	**4**	**8**	**16**	**32**	**64**
Assuming 100% clinical reversal rate							
0.25	36	36	36	36	36	24	18
0.50	36	36	36	24	18	12	6
0.75	36	36	24	12	12	6	6
1.00	**36**	**24**	**18**	**12**	**6**	**6**	**3**
1.25	36	24	18	12	6	6	3
1.50	36	24	12	12	6	3	3
1.75	36	36	12	6	6	3	3
2.00	36	36	12	6	6	3	3
Assuming 50% clinical reversal rate							
0.25	36	36	36	36	36	36	24
0.50	36	36	36	36	18	12	6
0.75	36	36	36	24	12	6	6
1.00	**36**	**36**	**36**	**18**	**12**	**6**	**3**
1.25	36	36	36	18	12	6	3
1.50	36	36	36	18	6	6	3
1.75	36	36	36	24	6	6	3
2.00	24	24	24	24	6	6	3

Table 5: Sensitivity analysis - Incremental time (minutes) per DMFT-year saved

Duration of OHR

	5	10	16	20	25	30
From 12 months to 6 months	3	9	**15**	19	24	30
From 18 months to 12 months	1	3	**5**	7	9	12

Duration of caries treatment episode

	10	20	26	40	50	60
From 12 months to 6 months	16	15	**15**	14	13	12
From 18 months to 12 months	6	6	**5**	4	4	3

3-month attack rate

	0.1%	1.5%	2.1%	2.5%	3.0%	3.5%
From 12 months to 6 months	22	17	**15**	14	14	14
From 18 months to 12 months	8	6	**5**	5	5	5

3-month progression rate

	1.1%	2.1%	3.1%	4.1%	5.1%
From 12 months to 6 months	66	24	**15**	11	9
From 18 months to 12 months	24	9.	**5**	4	3

Sensitivity (enamel)

	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%
From 12 months to 6 months	15	15	**15**	15	15	15
From 18 months to 12 months	6	9	**6**	5	5	5

Sensitivity (dentine)

	50.0%	55.0%	60.0%	65.0%	70.0%	75.0%
From 12 months to 6 months	15	15	**15**	15	15	15
From 18 months to 12 months	5	5	**5**	5	5	5

Specificity (dentine)

	75.0%	80.0%	85.0%	89.0%	95.0%	100.0%
From 12 months to 6 months	50	31	21	**15**	9	5
From 18 months to 12 months	19	12	8	**5**	3	1

Clinical reversal rate

	25.0%	50.0%	75.0%	100.0%
From 12 months to 6 months	62	20	15	**15**
From 18 months to 12 months	35	9	6	**5**

Median restoration survival

	4	8	12	16	20
From 12 months to 6 months	14	14	**15**	15	15
From 18 months to 12 months	5	5	**5**	5	6

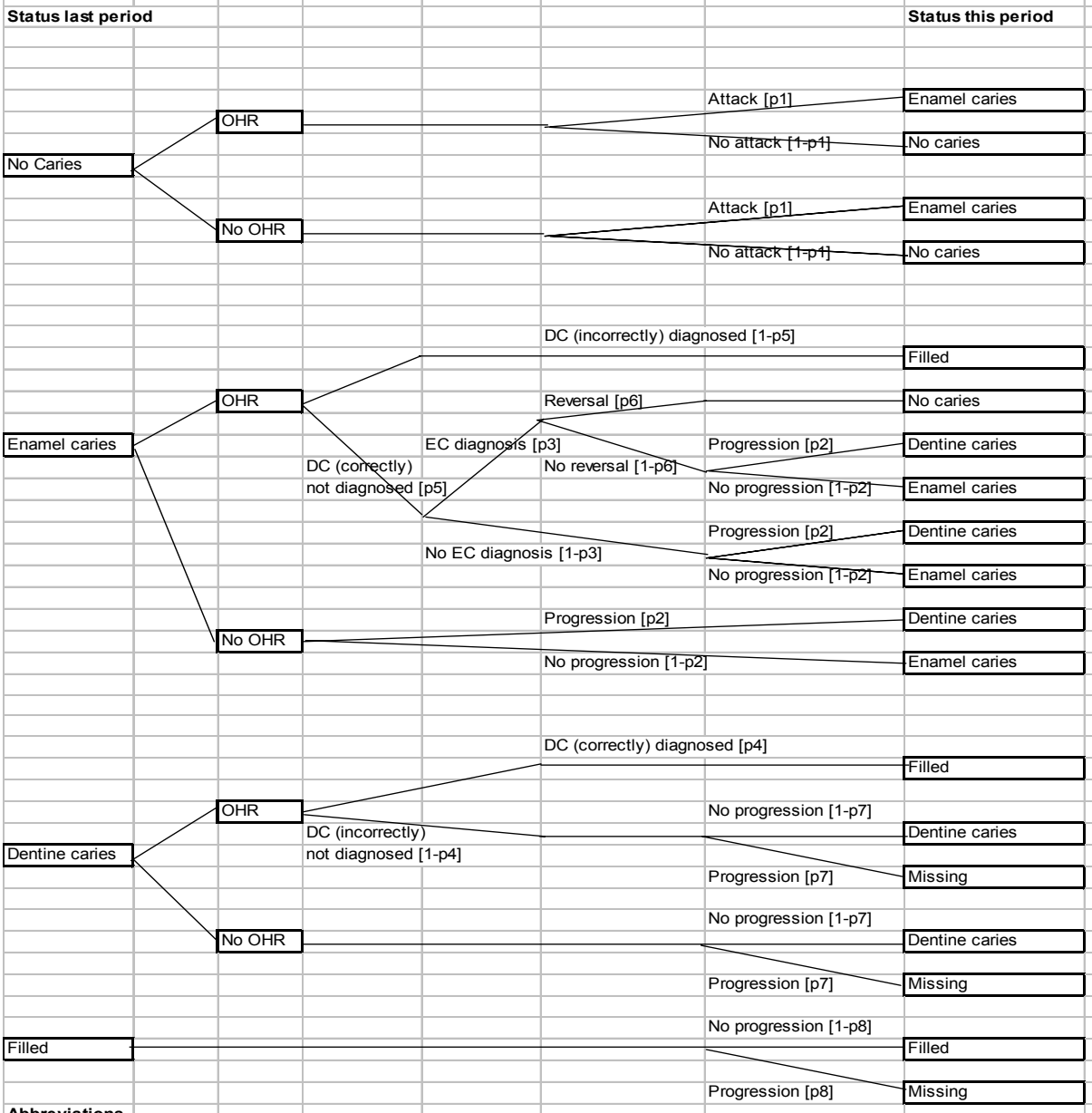
Discount rate (first 30 years)

	0.5%	2.0%	3.5%	5.0%	6.5%
From 12 months to 6 months	12	13	**15**	16	19
From 18 months to 12 months	4	5	**5**	6	7

Figure 1

Markov model for dental recall intervals

This diagram shows how the status of a tooth during any (3-month) period is dependent probabilistically on:
a) the staus in the previous period; and
b) whether there was an oral health review in the last period



Abbreviations

OHR=oral health review
DC=dentine caries
EC=enamel caries

Probabilities

p1	Incidence of enamel caries (attack rate)	p5	Specificity (dentine caries)
p2	Progression rate (enamel to dentine)	p6	Reversion rate
p3	Sensitivity (enamel caries)	p7	Progression rate (dentine to missing)
p4	Sensitivity (dentine caries)	p8	Progression rate (filling to missing)

Notes

NB1 - All teeth are in the 'No caries' in the first period of the model
NB2 - False enamel caries diagnoses are not represented because it is assumed that they won't affect tooth staus.
NB3 - Status refers to the 'true' underlying status of the tooth rather than the clinical diagnosis

APPENDIX E – Restorations, Diagnostic Accuracy and Caries Epidemiology

1 What Factors influence the Longevity in Primary Care of Dental Restorations in Children and Adults?

Over 60% of all restorative dentistry is for the replacement of restorations. The longevity of permanent dental restorations has generally increased since the 1970's although is still heavily dependant on a number of factors (see Figure 1). Studies that assess the survival rates of restorations tend to be carried out under optimal clinical conditions, suffer from poor study design and reporting. The longevity reported from these studies therefore, is unlikely to be achieved in routine dental practice (Sheldon et al. 1999). This section will firstly discuss amalgam restorations before moving on to direct methods and finally indirect methods.

Figure 1: Factors Affecting the Longevity of Dental Restorations (taken from 'Caries: The Disease and its Clinical Management')

- Caries risk status
- Type and size of restoration
- Restorative material
- Oral hygiene
- Fluoride availability
- Age of restoration

1.1 Amalgam Restorations:

1.1.1 Introduction:

Dental amalgam is an alloy of mercury, powered silver and a tin alloy, although there may be additions of copper, zinc, palladium, indium and selenium. The choice of alloy will influence the clinical handling of the material and may influence long term performance (Sheldon et al. 1999).

1.1.2 Results:

Two systematic reviews which considered the literature on the relative longevity of routine intra-coronal dental restorations note that such studies tended to have a high degree of variability which impacted on the conclusions they came to (Downer et al. 1999; Sheldon et al. 1999). Studies measuring survival rates tend to select patients with intact dentition, good oral hygiene and absence of active periodontal disease, therefore the results reported will be biased towards the most favourable. Inter-clinician variability: the skill of the operator in addition to the level of agreement between whether to replace a restoration also varied both within and between studies (Downer et al. 1999; Sheldon et al. 1999).

Amalgams demonstrated good rates of survival compared with most other materials. The Effective Health Care Bulletin reports that at 3 years no study

showed failure and at 10 years less than 10% of restorations had been replaced (although there was no data on 52% of the restorations placed) (Sheldon et al. 1999). Downer et al (Downer et al. 1999) in addition, report a lower figure of 72% of amalgams survived at 10 years. One review also noted that there were no differences in survival between larger amalgams vs. smaller ones or polished and unpolished amalgams over the 36 months of follow-ups and that the evidence that 2 surface restorations survive longer than 3 surface restorations is inconclusive (Sheldon et al. 1999). On the other hand, Downer et al concluded that occlusal amalgams lasted significantly longer than multi-surface amalgams (Downer et al. 1999) and there is some evidence to suggest that dispersed phase, high copper alloy amalgams were associated with greater survival than other types (Sheldon et al. 1999).

1.2 Composite Resins

1.2.1 Introduction:

Composite restorations are a tooth coloured mixture of filler particles of translucent glass in a resin matrix. The loading of the matrix with filler particles in addition to the size of the particles may have an influence on the long term performance of this restoration (Sheldon et al. 1999). Generally the median survival of composite restoration was 17 years (at 10 years 56% of composites still survived) and that single surface composites last significantly longer than multi-surface composites (Downer et al. 1999).

This section will be split into studies that looked at composite resins with dentine bonding and those that looked at composites without.

1.3 Composites without dentine bonding

The Effective Health Care bulletin reported the results of 48 studies which looked at composite restorations without dentine bonding. Many of these studies failed to adequately report the number of subjects, teeth/tooth types, material and type of cavity in addition to survival data. This systematic review showed good short term survival (2/ 3 years) although poor results were attributed to poor techniques/ unconventional cavity design (Sheldon et al. 1999). Studies with at least 5 years follow-up showed signs of failure especially in multi- centre studies. In addition, material type influenced survival of composite. Light, cured, microfilled and densified filled materials being more successful between 6.5 and 8.5 years. Older auto polymerising microfilled composites were more successful up to 6.5 years. Studies did not present data needed to analyse impact of operator factors and other effect modifiers.

1.4 Composite Resins with Dentine Bonding

25 studies looked at restorations with dentine bonding systems. In the majority of cases, cervical cavities had retention of restorations which relied exclusively on bonding mechanism to resist loss. These studies rarely reported the site of the filling and therefore it was impossible to asses whether survival is different for composites placed in front or back teeth. Dentine

bonding materials have often been tested in cervical cavities and in this situation the failure of these materials is rapid, beginning within 1 year (this figure is based on a combination of included studies of cervical restorations by the type of dentine binding system used).

Many of the studies incorporated into this review were poorly designed and it must be taken into account that occlusal factors may have an influence on retention. The lack of detail in the paper (especially relating to losses to recall and technique used should also be noted when interpreting this data.

Groups that used an acid primer demonstrated good survival against those which didn't and there was little difference between phosperic acid and other acids although the former studies tended to have a shorter follow-up (Downer et al. 1999; Sheldon et al. 1999).

Results of these studies suggest that enamel etching is clinically effective for long-term retention and that mechanical retention is also effective for retention of restoration. The use of all dentine bonding systems reduced patient pain after placement.

1.5 Amalgam vs. Composites

The comparison of amalgam vs. composite falls into 2 sections; those studies which made this comparison in unpaired teeth (i.e. teeth from different patients) and those which made this comparison in paired teeth.

In those studies which looked at unpaired teeth, amalgam was superior and always had a better survival. In studies using paired teeth the difference was still in favour of amalgams but the difference between the two restorations was smaller but still significant (Sheldon et al. 1999).

1.6 Other Materials

The Effective Health Care Bulletin review included 44 studies comparing a number of other materials. These studies tended to be small and occur over a short duration.

Glass Ionomer Cements (GIC) are tooth coloured restorations consisting of filler particles imbedded in a matrix. There is insufficient evidence to conclude the restoration rate although those inserted using which removes caries using hand instruments (ART) may lead to 'reasonable retention rates'(Sheldon et al. 1999). 2 studies also concluded that the conditioning of dentine does not seem to affect longevity (Sheldon et al. 1999). Downer and co-workers also report that glass ionomers have a shorter durability than composite resin and should not be considered for posterior occlusal or approximal restorations (Downer et al. 1999). When used in the composite/ GIC sandwich technique, these restorations were reported to having low survival rates although improvement it's the physical property of the material may lead to increased survival rates.

Stainless steel crowns are a traditional but resource intensive way of restoring primary molars the use of which is supported by some clinical evidence. There is, however, a current and ongoing controversy surrounding the optimal methods for restoring (or not restoring) primary teeth and a dearth of high quality evidence to reconcile the divergent views on the appropriateness and long term outcomes of the different care philosophies.

1.7 Indirect methods:

The Effective Healthcare Bulletin retrieved 27 studies that looked at ceramics, gold and composites. These studies involved had small numbers of patients and many were based on a weak design, which made no comparison to their intervention. The results of this review showed that there was no difference between porcelain and composite inlays and that in those studies (1 of which compared both materials) found that some types of porcelain inlays had significantly longer survival than composite inlays (Sheldon et al. 1999). In addition, there is limited evidence to support the use of a resin vs. GIC as luting cements. There is some evidence to support the use of heat cure and light cure in composite inlays.

There are some reports of post-op pain with inlays which needs further investigation and that 1 study found that porcelain inlays vs., amalgam inlays had an identical survival at 2 years but there was no long term data to support this (Sheldon et al. 1999).

1.8 Summary and implications of longevity of dental restorations

The material reviewed here provides estimates of the relative success of methods of restoring carious teeth. Caution is needed in interpreting the results as there are concerns that the studies rigorous enough to be included in the Effectiveness Health care Bulletin Systematic Review may not be generalisable to routine dental primary care. The pace of development of new dental materials, which are introduced before long term results of their predecessors are available, is another difficulty in this area

What is evident from the literature is that, even under optimal conditions, restorations alone are an imperfect treatment for dental caries and unlikely to be permanent. Primary prevention and preventive disease management should aim to prevent the need for restorations in the first place and to extend their longevity once they have been placed. Recall intervals should take thee factors into account.

2 What is the accuracy of the basic diagnostic methods used by clinicians for detecting carious lesions in primary and permanent teeth?

As the understanding of dental caries has advanced, several methods of diagnosing this chronic infectious disease have developed. The spectrum of disease experienced from patient to patient can fluctuate and therefore, establishing the most effective method to diagnose caries on all surfaces of both primary and permanent teeth is an important aspect of everyday clinical practice.

A systematic review presented at the last NIH Conference (Bader et al. 2001b) covered the performance of all currently available diagnostic methods for carious lesions for primary and permanent teeth, occlusal, smooth, coronal and root surfaces. There are few assessments of any diagnostic methods for primary or anterior teeth and no assessments of performances on root surfaces. In addition, the current available evidence on such diagnostic modalities suffers from weak design and variability of examination calibration (National Institutes of Health 2001).

2.1 Results

The NIH review covered visual, visual tactile, radiographic, electrical conductance, FOTI, Laser Fluorescence and combination visual / radiographic methods and the evidence did not support the superiority of either visual or visual tactile methods. While for all but electrical conductance, the specificity of the diagnostic tools was greater than sensitivity, the number of available assessments was small and there was substantial variation among reports for each of the methods. Electrical conductance may offer heightened sensitivity on occlusal surfaces but, for fixed frequency technologies, at the expense of specificity.

While the evidence is not conclusive, some digital radiographic methods may offer small gains in sensitivity against conventional film radiography on both proximal and occlusal tooth surfaces. While existing diagnostic modalities appear to have satisfactory sensitivity and specificity in diagnosing substantial, cavitated dentinal caries, specifically radiographic methods are essential in diagnosing approximal carious lesions. These modalities however, do not appear to have sufficient diagnostic ability to accurately diagnose non-cavitated caries, root surface caries or secondary caries.

The National Institute of Health Consensus Development conference statement on the diagnosis and management of caries (2001) also stated that the use of sharp explorers adds little to diagnostic information and actually may be detrimental to the patient. Studies employing receiver operating characteristics (ROC) analyses have shown radiology to have acceptable diagnostic efficacy in detecting larger cavitated lesions in vitro and in vivo studies.

2.2 Summary and implications of accuracy of the basic diagnostic methods

The evidence shows that a meticulous examination of dental caries is important and that although basic diagnostic methods can detect significant dentinal lesions, their performance is inadequate for non-cavitated caries, root surface caries or secondary caries. Radiography is still indicated for the detection of approximal lesions and the use of sharp probes should be reduced as it adds no diagnostic benefit but may cause harm by increasing the risk of subsequent caries progression. Dentists and their patients should be aware of the imperfection of caries diagnosis and the requirement to balance the risks of false positive (a sound tooth classified as decayed) and false negative (a decayed tooth classified as sound) results.

Dental Caries Experience of 5-Year Olds

The term caries experience refers to a measurement of a combination of caries, restorations (fillings) and teeth missing owing to decay. The British Association for the Study of Community Dentistry (BASCD), in combination with the NHS has carried out a series of surveys which describe the dental experience of populations of 5 yr olds and 12 yr olds, applying their criteria which recognise only established lesions clinically penetrating into the dentine. The criteria use a diagnostic threshold used excludes all enamel and precavitation lesions and diagnostic aids. Such surveys will therefore always produce lower estimates of caries experience than are found when clinically detectable enamel lesions are scored and when diagnostic aids are used, as in a dental practice setting. Within each area of England and Wales a designated NHS epidemiology co-ordinator was responsible for the local delivery of the programme assisted by a regional trainer. Representative samples were drawn from participating health authorities and boards according to the agreed BASCD guidelines.

Figure 1 illustrates the geographical variation of caries experience in children. The lower levels of mean caries prevalence ($d_3$mft I this is decayed into dentine, missing, filled teeth) of <1.5 were found towards the south and west of England, although parts of London join the north and west, Wales and the Isle of Man with mean values of greater than 1.5.

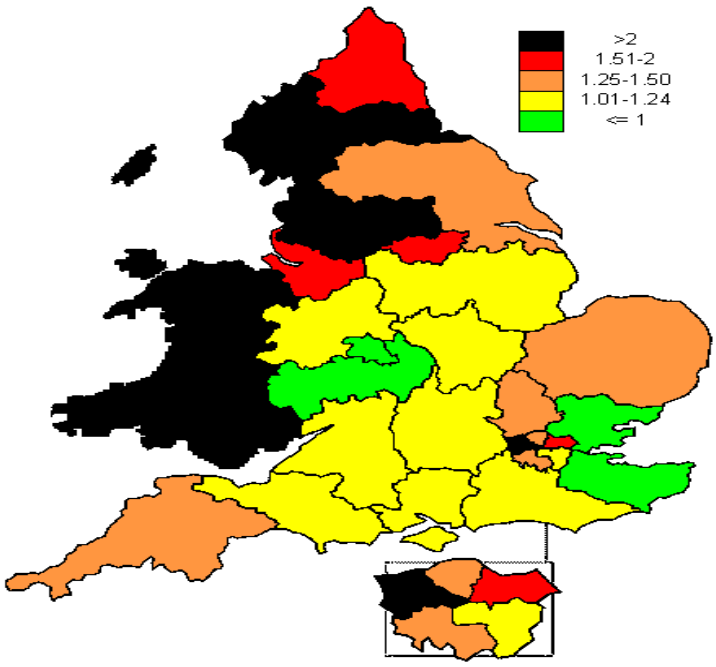


Figure 1: The Geographical Variation of Caries Experience

Figure 2 presents the mean $d_3$mft information for 5 year olds as a bar chart, ranking regions including 95% CI. This bar chart reveals that southern areas currently experience the lowest rates of caries within this population through to the fluoridated Midlands, the north and finally Wales has the highest rates.

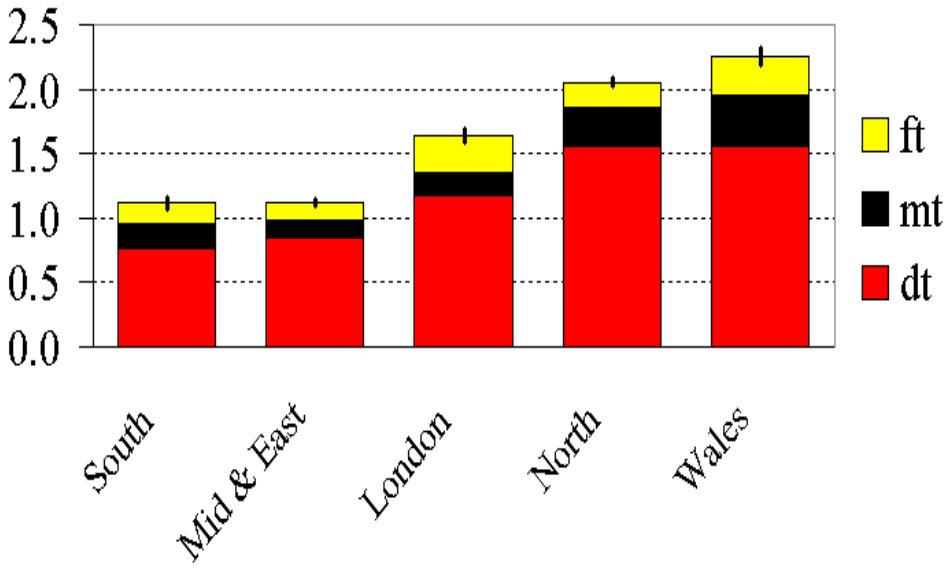


Figure 2: Dental Caries Experience (d3mft and 95% confidence intervals) of 5 year old children in the current English regions and Wales

Figure 3 shows a comparison between the mean d3mft results from 2000/1 with the results of the previous survey in 1999/2000. The rank ordering of areas has not changed in the two year period but while London and the north has increased slightly, the results for the south, Midlands and Eastern areas were virtually unchanged.

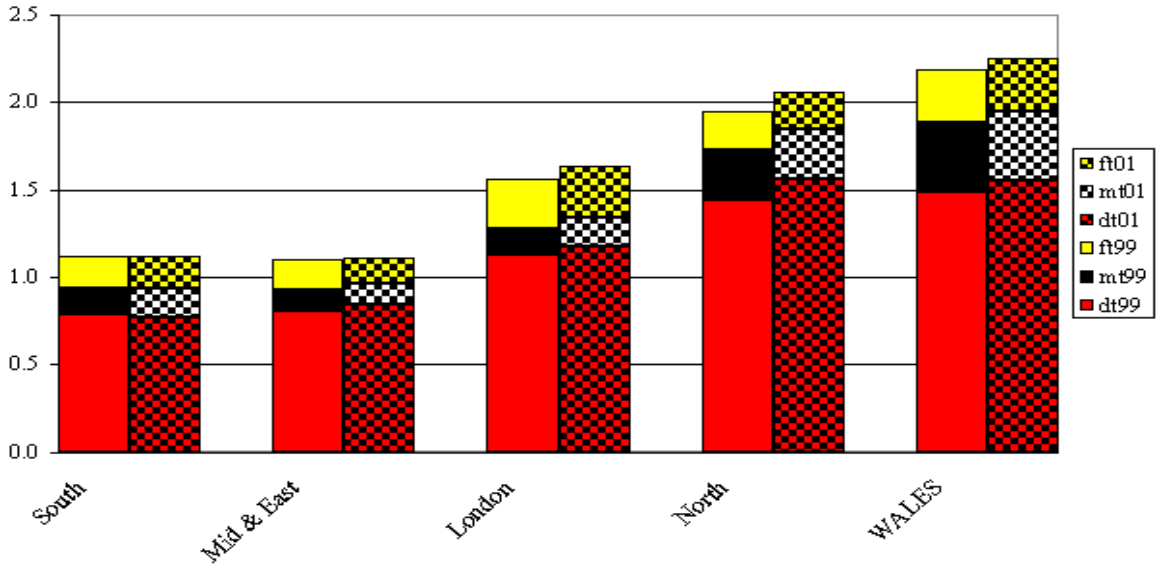


Figure 3: Comparison of dental caries experience ($d_3$mft and components) of 5 year old children in the English regions and Wales in 1999/ 2000 and 2001/ 2002.

Results

A total of 171,791 five year old children from England, Wales, Isle of Man and Jersey were examined – this was 11% less than in the 1999/ 2000 survey. This represents approximately 29% of the total population of this age group.

The results demonstrated a wide variation in prevalence across England and Wales. Mean values for $d_3$mft for regions and counties ranged from 0.75 in Jersey and 0.84 in Kent and Medway to 2.73 Gwent and 2.47 in Greater Manchester. The mean number of decayed missing filled teeth in England and Wales is 1.52.

3 Dental Caries Experience of 12-Year Olds

Again, BASCD criteria were applied and the dental caries was detected using clinical visual diagnostic criteria at D_3 threshold. Figure 4 illustrates the geographical variation of caries experience for this age group. The lower levels of mean caries prevalence were mainly in the south, the west and the

midlands while the rest of England, Wales and the isle of man had mean D_3MFT values between 1.01 and 1.50.

Figure 5 presents the mean D_3MFT information as a bar chart ranking overall the regions including 95% CI. The 6 southern areas have a mean D_3MFT values less than 1.0, while Wales and 2 more northerly English areas plus the Isle of Man have a mean D_3MFT between 1.0 and 1.5.

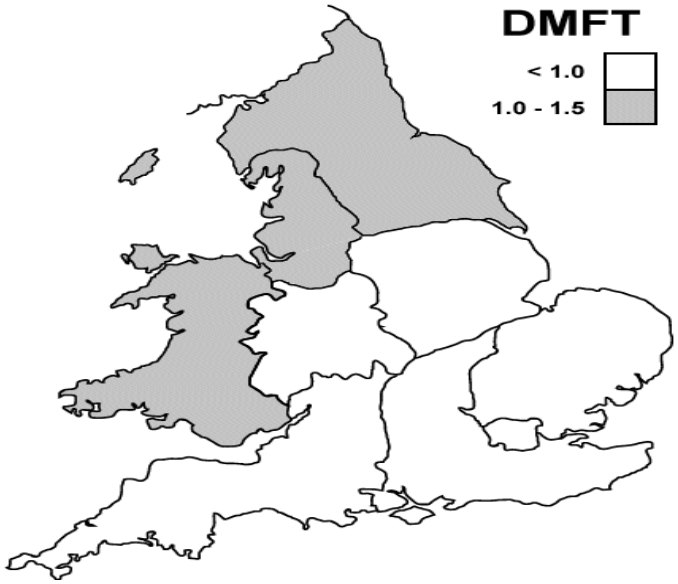


Figure 4: Dental Caries experience (D_3MFT) of 12 year old children in England and Wales

Figure 6 illustrates the comparison of the mean D_3MFT results from 2000/2001 with those from the 1996/7 survey which suggest that caries experience is improving overall.

Figure 5: Dental Caries Experience (D_3MFT and 95% confidence intervals) of 12 year old children in the current English Regions, Wales, the Isle of Man and Jersey.

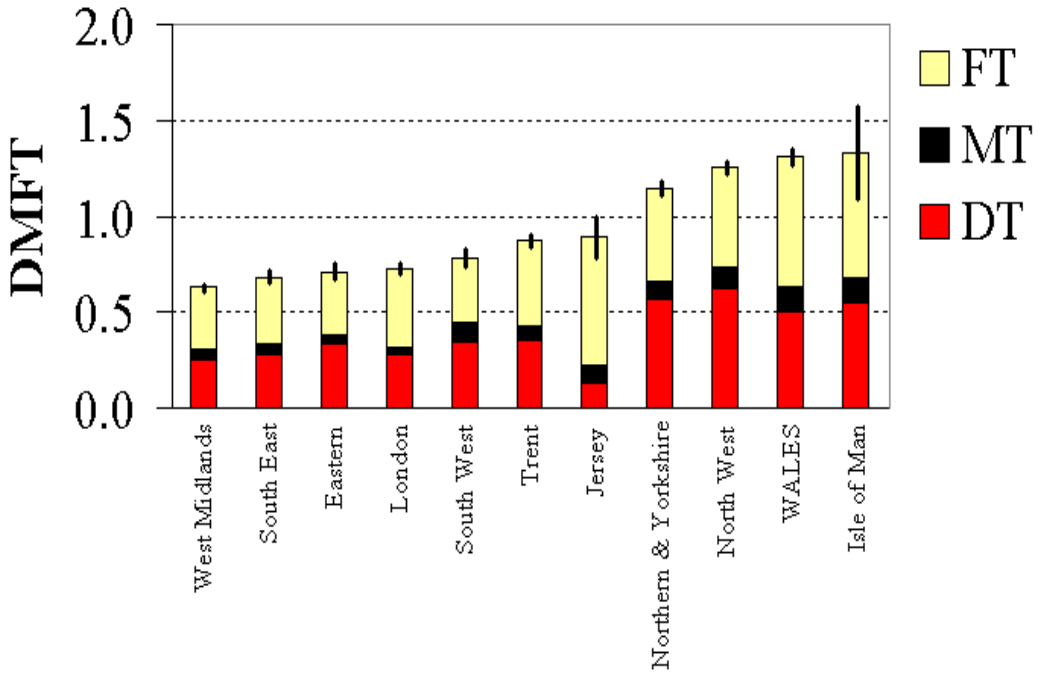
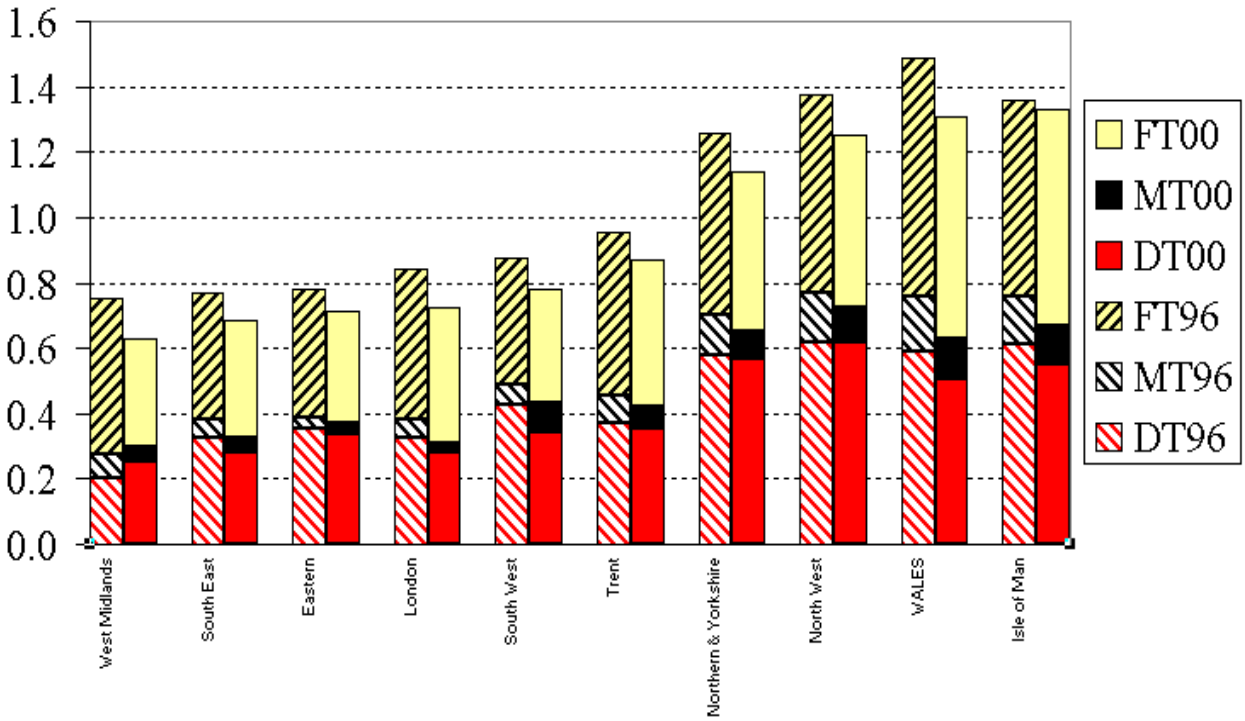


Figure 6: Comparison of Dental Experience (D_3MFT) and previous English regions, Wales and Isle of Man on 200/2001 and 1996/1997



Summary and implications of caries epidemiology in children:

A total of 105, 979 12-year olds from England, Wales, Isle of Man and Jersey were examined. This was 7% less than in the 1999/ 2000 survey. This roughly represents 17% of the total population of this age group. The results demonstrated a wide variation in caries prevalence across England and Wales. Mean values for D_3MFT for regions and counties ranged from 0.63 in West Midlands to 1.31 in Wales. The mean number of decayed missing filled teeth in England and Wales is 0.86. The overall mean number of filled teeth was low at 0.43.

These surveys quantify the current level of decay in children in England and Wales and demonstrate that, despite improvements in recent years, dental caries still presents a problem for children in the 21st Century. They also shoe that the scale of the problem differs in different parts of the country. Within this population perspective, dentists in practices and clinics will encounter a range of decay experience in children presenting for dental care. An increasing proportion have low disease levels and a relatively low level of risk to new dental decay, an unfortunate minority have active decay and are at high risk of developing new carious lesions and having existing lesions progress. The recall intervals required for the individuals in different areas and with different levels of disease experience will in turn be different.

APPENDIX F – Additional Clinical Scenarios

SCENARIO K

Age: Patient K is a 43 year old female
Attendance Record: Patient has been attending your practice for nine years and you have reviewed her oral health every six months for the first six years and on an annual basis for the last three years.
Medical History: Patient has no medical history of note
Social History: Patient does not smoke and drinks alcohol occasionally.
Dietary habits: Patient has a healthy diet with plenty of fresh fruit and vegetables and rarely consumes sugar containing foods and drinks
Use of Fluoride: Patient brushes three times a day with a fluoride containing toothpaste.
Clinical Evidence and dental history: Patient has a few small restorations, but has needed no restorative treatment in the last seven years. Bitewing radiographs reveal no approximal lesions and good alveolar bone support. The patients periodontal health is excellent and there is no evidence of gingivitis (Basic Periodontal Examination code 0 all sextants).
Plaque: Patient brushes three times a day and uses dental floss once a day. On examination, there are no plaque deposits.
Saliva: Patient has a normal salivary flow rate.

Other: N/A

Recall Interval recommended by clinician for next oral health review:
24 months

Rationale for 24 month interval: The patient has been attending your practice regularly for nine years. The patient has not required any restorative treatment for seven years. You have progressively increased the recall interval from an original interval of 6 months to 12months. The patient has been on the latter recall interval for three years and you feel confident that the patient's oral health is sufficiently stable to justify a 24 month interval before their next oral health review.

SCENARIO L

Age: Patient L is a 23 year old female
Attendance Record: Patient has been attending your practice regularly since she was a child
Medical History: Patient has no medical history of note.
Social History: Patient does not smoke and is a moderate drinker.
Dietary habits: Patient has a healthy diet and rarely consumes confectionary.
Use of Fluoride: Patient brushes three times a day with a fluoride containing toothpaste.
Clinical Evidence and dental history: Patient has never required restorative intervention and her periodontal health is excellent (Basic Periodontal Examination code 0 allsextants).
Plaque: The patient's oral hygiene is excellent and she brushes three times a day and uses dental floss once a day.
Saliva: Patient has a normal salivary flow rate.
Other: N/A

Recall Interval recommended by the clinician for next oral health review:
18 months.

Rationale: Given the patient's long established dental history of no restorations and excellent oral hygiene, a recall interval of 24 months might be appropriate. However, recognising that at the patients age, lifestyles can change suddenly and dramatically, you decide to be cautious and recall her in 18 months.

ADULTS: SCENARIO M

Age: Patient M is a 21 year old female
Attendance Record: Patient has been attending your practice regularly for six years
Medical History: Patient has no medical history of note and, apart from the contraceptive pill, is taking no medication.

Social History: Patient does not smoke and is a moderate drinker.
Dietary habits: Patient has one can of carbonated soft drink a day and says that she consumes one bar of chocolate a day.
Use of Fluoride: Patient brushes twice a day with a fluoride containing toothpaste.
Clinical Evidence and dental history: Patient has no decayed, missing or filled teeth and bitewing radiographs reveal no approximal lesions and good alveolar bone support. The BPE demonstrates gingival bleeding, but no pocketing (BPE code 1) in five sextants with calculus present around the lower anterior teeth (BPE code 2)
Plaque: Patient brushes twice a day but does not use dental floss. The patient's oral hygiene is unsatisfactory.
Saliva: Patient has a normal salivary flow rate.
Other: N/A
Treatment plan: The patient requires oral hygiene advice and professional debridement of plaque and calculus
Recall Interval recommended by the clinician for next oral health review: 12 months. Clinician recommends review of oral hygiene with debridement if needed in 6 months.
Rationale: In view of the patient's oral hygiene and periodontal status you recommend a review of oral hygiene with debridement if needed in six months. Although the patient has a number of risk factors for dental caries, she has not required restorative intervention and you consider a recall interval of 12 months to be appropriate for the next Oral Health Review.

ADULTS: SCENARIO N

Age: Patient N is a sixty-seven year old female.
Attendance Record: Patient had full upper and lower dentures fitted by you two years ago. She subsequently attended on two occasions for easing of the lower denture.
Medical History: Patient has no medical history of note and is taking no medication.
Social History: Patient does not smoke and does not drink.
Dietary habits: Patient has a healthy diet (lots of fresh fruit and vegetables).
Use of Fluoride: -N/A
Clinical Evidence and dental history: Patient has a healthy oral mucosa with no evidence of any mucosal lesions. Both upper and lower dentures fit and function well.
Plaque: Patients dentures are free of plaque deposits. Patient rinses her dentures immediately after meals and soaks them in a cleansing solution overnight.
Saliva: Patient has a normal salivary flow rate.
Other: N/A

Recall Interval recommended by clinician for next oral health review:
24 months.

Rationale: This edentulous patient has been fitted with satisfactory dentures and subsequent follow up has been uneventful. The patients healthy oral mucosa and the patient's established regime for cleansing her dentures influence your decision to recall the patient in 24 months. The patient is advised to reattend if she has any problems with her dentures of if she notices any change in the oral mucosa.

SCENARIO O

Age: Patient O is a sixty-nine year old male.
Attendance Record: Patient is partially dentate and has been a regular attender at your practice for the last five years.
Medical History: Patient is taking a diuretic and a beta-blocker for blood pressure.
Social History: Patient is a heavy smoker and you suspect he may be a heavy drinker.
Dietary habits:
Use of Fluoride: Patient brushes twice a day with a fluoride toothpaste.
Clinical Evidence and dental history: Patient has white patches in his mouth which have been biopsied by a specialist and found to be non-malignant keratotic lesions associated with his tobacco habit. He has had no new carious lesions in the last five years. The patient has a number of areas with moderate pockets of 4-6mm (BPE code 3) and/or some sextants with furcation involvements or attachment loss of 7mm or more (BPE code *)
Plaque: Patients oral hygiene is poor and he does not use interproximal aids such as interdental brushes or floss.
Saliva: Patient has a normal salivary flow rate.
Other: N/A

Recall Interval recommended by clinician for next oral health review:
6 months. Arrangements are made for the patient to have periodontal care with the hygienist.

Rationale: The patient has risk factors for oral cancer (mucosal lesions, heavy tobacco use and alcohol consumption). The 'white patches' have been biopsied and found to be non-malignant and the patient has been referred back to you for continuing care and review. However, it is the patient's periodontal status, rather than his risk factors for oral cancer, that is the main determinant of your choice of recall interval. The patient's oral mucosa will be checked as part of the next oral health review in six months.

SCENARIO P

Age: Patient P is a 48 year old female
Attendance Record: The patient has been attending your practice regularly for regular periodontal care for seven years
Medical History: The patient is taking HRT but otherwise the medical history is clear.
Social History: The patient quit smoking nine years ago and takes on average seven units of alcohol per week
Dietary habits: Good balanced diet
Use of Fluoride: The patient brushes twice a day with a fluoride containing toothpaste.
Clinical evidence and dental history: The teeth are moderately heavily restored but restoration margins are accessible and intact. Although there used to be moderately deep pockets on most teeth (BPE code 3), only three 5mm pockets remained following non-surgical periodontal therapy, which was completed five years ago. These have remained unchanged since. Gingival health is otherwise excellent.
Plaque: The patient brushes twice a day with a fluoride toothpaste and uses interdental brushes every day. There are minimal plaque deposits
Saliva: The patient has a normal salivary flow rate.
Other: N/A

Treatment plan: The patient should continue on three monthly supportive periodontal maintenance visits.

Recall Interval recommended by the clinician for next oral health review:
12 months.

Rationale: The previous history of periodontitis highlights the need for continuing supportive therapy every three months. In view of the stability of the disease at present, the next oral health review should be in 12 months time.

SCENARIO Q

Age: Patient Q is a 62 year old female
Attendance Record: This patient has visited your practice for the last ten years. Attendance is reasonably good although intervals between examinations have occasionally been prolonged. She is on a supportive periodontal maintenance programme of visits every three months.
Medical History: The patient is taking antidepressants
Social History: The patient is a heavy smoker (self-reported 20-25 cigarettes per day) with an alcohol intake from 2-10 units per week.
Dietary habits: Reasonably balanced diet.
Use of fluoride: The patient brushes twice a day with a fluoride containing toothpaste for sensitive teeth.
Clinical evidence and dental history: Initially, deep pockets were present in all sextants (BPE 4 or 4*), although not all teeth were affected. Home-care plaque control advice and non-surgical therapy produced substantial improvements. Residual deep pockets remained despite further non-surgical attempts to reduce them. The patient declined referral and preferred extraction when teeth/pockets became problematic. Some teeth have been replaced with an upper removable partial denture.

Plaque: The patient brushes twice a day and uses wood sticks daily and a single-tufted brush. The plaque score is not consistent but varies from a low level (12%) to levels associated with inflammation (40%). Today it is 30%.
Saliva: The salivary flow rate is reduced due to the medication.
Other: N/A

Treatment plan: The patient receives advice in home care plaque control at today's supportive periodontal maintenance visit (following the oral health review). She continues with her three monthly periodontal maintenance visits and is recalled for her oral health review in 6 months.

Recall Interval recommended by the clinician for next oral health review:
6 months.

Rationale: The response to periodontal therapy is good in the less severely affected areas. Plaque control is variable and in conjunction with the risk factors of heavy cigarette smoking and reduced salivary flow rate, the risk of disease is high. The removable partial denture might also act to favour plaque accumulation.

SCENARIO R

Age: Patient is an 18 year old male.
Attendance Record: This patient has been visiting your practice for the last six months only.
Medical History: There is no medical history of note.
Social History: The patient is a non-smoker with a moderate alcohol intake of 12 units per week.
Dietary habits: Irregular meals with periods of an unbalanced diet.
Use of fluoride: The patient now brushes twice a day with a fluoride containing toothpaste.
Clinical evidence and dental history: Initially, localised moderately deep pockets were limited to some first molars and incisors. This led to a diagnosis of localised aggressive periodontitis. Home-care plaque control advice and non-surgical therapy produced substantial improvements with pockets of 3-4mm present (maximum BPE 3)
Plaque: The patient brushes twice a day with and uses floss daily. After a hesitant start, the plaque score has now reduced to 17%.
Saliva: The salivary flow rate is normal.
Other: N/A

Treatment plan: The patient receives advice in home care plaque control at today's supportive periodontal maintenance visit (following the oral health review). He continues with three monthly periodontal maintenance visits and is recalled for an oral health review in 3 months.

Recall Interval recommended by the clinician for next oral health review:
3 months.

Rationale: The response to periodontal therapy is good but the potential for rapid progression of aggressive periodontitis must be considered. Once the stability of the periodontal status is known, the clinician could consider reducing the frequency of oral health reviews if this is appropriate (based on clinical status and risk factors). The frequency of supportive maintenance visits should remain at three months.

SCENARIO S

Age: Patient S is a 35 year old female
Attendance Record: Patient S has been attending your practice regularly for six years.
Medical History: Patient has no medical history of note.
Social History: Patient does not smoke and drinks alcohol occasionally at the weekends
Family History: Patient has no family history of periodontal disease nor of early tooth loss
Clinical Evidence and dental history: Patient has no missing teeth. Her gingival health looks excellent and she reports no bleeding on brushing, no mobility or drifting of her teeth. Periodontal screening reveals a BPE code of 0 with no pockets deeper than 3.5mm and no bleeding on probing. Bitewing radiographs taken 12 months ago revealed no interproximal bone loss on posterior teeth. Similarly, her restorations are not plaque retentive
Plaque: Patient brushes twice a day and uses dental floss once a day. She has not needed a scale and polish for over three years.
Saliva: Patient has a normal salivary flow rate.
Other: N/A

Recall Interval recommended by clinician for oral health review:
24 months

Rationale for 24 month interval: Over a six year period at your dental practice, this patient has required only scaling and polishing to remove stain and calculus. The patient has not developed any periodontal pockets over a 15 year period and has good oral hygiene and dietary habits. There is no discomfort arising from her periodontal tissues and the she is very happy with this situation. The patient's dental status appears stable at this point in time suggesting that a recall interval of 24 months is appropriate for this patient.

Age: Patient T is an 18 year old male
Attendance Record: Patient is attending your practice for the first time and has attended another practice irregularly over the last 10 years.
Medical History: Patient has Down Syndrome. There is no other medical history of note.
Social History: The patient lives at home with his parents.

Clinical Evidence and dental history: The patient has microdontia with short, small clinical crowns and roots. The patient has amalgam restorations in six permanent molar teeth, some of which are in contact with the gingival margins and are plaque retentive. There are no other restorations or caries lesions present. Patient has already lost 2 first molar teeth. His gingival health is poor with inflammation present at a number of interproximal sites but there is no significant mobility or drifting of any teeth. Periodontal screening reveals a BPE code of 4 with a number of pockets deeper than 3.5mm and several around his remaining first molar teeth deeper than 5.5mm. There is widespread bleeding on probing.

Plaque: Patient brushes twice a day but does not use any interproximal cleaning aids.
Saliva: Patient has a normal salivary flow rate.
Other: N/A

Treatment plan: The patient receives advice in home care plaque control (this advice is also given to the patients parents who are asked to supervise the patients oral hygiene) and a course of non-surgical periodontal therapy. He is placed on three-monthly supportive periodontal maintenance visits.

Recall Interval recommended by clinician for next oral health review:
3 months

Rationale for 3 month interval: Patient has multiple risk factors for the development of periodontal disease. The patient's dental status appears unstable at this point in time suggesting that a recall interval of 3 months is appropriate for this patient to monitor compliance with oral hygiene advice and the overall response to treatment.