1 Evidence-based dentistry: what it is and how to practise it

Oral disease is widespread and most people, from children to the elderly, will seek dental care at some point, either for a check-up or for treatment following clinical symptoms. More people are living longer and more will retain most or all of their teeth. For example, in 1978, 30% of adults in the UK had lost all of their teeth compared with 13% in 1998; complete tooth loss usually occurs over the age of 45 years[1]. Furthermore, changing diets and lifestyles affect patterns of oral disease and there are constantly new advances in treatments. All of these have important implications for effective dental care management.

About 45% of the population aged 18 years and over are registered with a National Health Service (NHS) dental practitioner in England and Wales[2]. In a survey of UK general dental practitioners in 2000 an estimated 85% of all patients were seen in the NHS and 15% privately, though this varies greatly across the UK[3]. Other studies suggest that as many as 25% of patients are seen privately[3]. Dental care can be expensive. In 2001–2002, general dentistry in the UK generated an estimated income of £3.7 billion[4]. Patients spent a total of £2.5 billion of which about £1.9 billion was spent privately and £0.6 billion was spent on NHS charges[4]. Dentists therefore have an obligation to provide the most effective treatment available and use the best methods of disease prevention and diagnosis while taking financial cost and their expertise into consideration.

WHAT IS EVIDENCE-BASED DENTISTRY?

In dentistry there are well-established causes of oral disease, and diagnostic methods and treatments that work. There is also bad practice: there may be tests and treatments that are effective but not commonly used and, possibly worse, tests and treatments that despite being ineffective are used. How can we decide what is a cause of disease and what is not, and what is an effective treatment and what is ineffective?

Evidence-based dentistry is the integration and interpretation of the available current research evidence, combined with personal experience. It allows dentists, as well as academic researchers, to keep abreast of new developments and to make decisions that should improve their clinical practice. The term 'evidence-based medicine', from

which evidence-based dentistry has followed, is relatively new (it first became current in the early 1990s) but the core principles that underlie the subject have been in place for many decades in the areas of epidemiology and public health.

The American Dental Association has defined evidence-based dentistry as[5]:

an approach to oral health care that requires the judicious integration of:

- *systematic assessments of clinically relevant scientific evidence, relating to the patient's oral and medical condition and history, together with the*
- *dentist's clinical expertise and*
- *the patient's treatment needs and preferences*

WHY DO WE NEED EVIDENCE-BASED DENTISTRY?

Graduates from dental schools are up to date with the best practice in dentistry current at the time they graduate. Some of this knowledge gradually becomes out of date as new information and technology appear. It is important, especially with regards to patient safety, for dentists to be able to keep up to date with developments in diagnosis, prevention and treatment of oral disease, and newly discovered causes of disease.

There is an overwhelming amount of evidence that comes from research and policy-making organisations, but there is no one organisation that synthesises and assesses all this evidence. Advances in dentistry are usually first reported in dental journals, and in order to keep up with new research, healthcare professionals need to feel confident that they can read and evaluate dental papers. Keeping abreast of new developments through reading current literature can seem onerous and hard to combine with a heavy clinical workload. Fortunately, having an understanding of how to interpret research results, and some practice in reading the literature in a structured way, can turn the dental literature into a useful and comprehensible practice tool.

Consider the following two examples:

- Cigarette smoking is a cause of periodontitis. Why is it that not everyone who smokes develops periodontitis? Why do some non-smokers develop periodontitis? Given these two observations, how can we say that smoking is a cause of this disorder?
- Acute ulcerative gingivitis can be treated with the antibiotic metronidazole. Why is it that not every patient given metronidazole recovers from the disease? Why do some untreated patients recover? Given this, how can we say that metronidazole is an effective treatment?

Both of the above examples illustrate that people are naturally variable in their responses to exposures or treatments. Different people respond to the same exposure, or same treatment, in different ways.

When examining causes and treatments of disease we always see variation between people in whether they are affected by an exposure or treatment. We need

to be able to judge whether any differences observed are due entirely to natural variation or an effect that is above and beyond that of natural variation. For example, if 100 patients with acute ulcerative gingivitis were treated with metronidazole and 95 recovered, would this be sufficient information to say that metronidazole worked? To answer this we would also need to be able to answer the question, 'What recovery rate would we expect if they had not been treated?'. Suppose that in a similar group of untreated patients only 10 recovered. Then the effect of metronidazole above that of natural variation is associated with an *extra* 85 patients who recover. We may consider this difference to be large enough to allow us to say that metronidazole is effective. Similarly, to determine whether smoking is a cause of periodontitis or not, we could observe how many smokers develop the disease, but we also need to ask, 'How many non-smokers would develop periodontitis?'.

Clinical research allows us to make decisions about causes of and treatments for disease, while allowing for the natural differences between people. Evidence-based dentistry is founded on clinical research.

HOW TO PRACTICE EVIDENCE-BASED DENTISTRY

Evidence-based dentistry is built upon asking questions. These could arise in several ways:

- Those instigated by the management of a single patient. You may be interested in someone who has presented with clinical symptoms or wish to provide advice on some aspect of prevention (for example, you have diagnosed a patient with gingivitis, how best can this be treated?).
- A patient would like some information from you about some aspect of dentistry (for example, should they use a manual or electric toothbrush?).
- You may be interested in a particular topic which you have discussed with a colleague or you have read about in journals or other media (for example, a colleague tells you that there is a new treatment for periodontitis, and you wish to find out more about this).

The following sections describe the main steps in practising evidence-based dentistry.

(1) Define the question

Regardless of what prompted you to search for information, the next step is to define the question clearly. Is the aim sensible? Is it appropriate for the management of patients? Will it have an impact on your practice? These are all questions to consider when formulating the question because they will help you to focus not only on the literature search but also on the interpretation of the information found.

In any one day a dentist may be faced with any of the following situations:

SCENARIO 1: BEST TOOTHBRUSH

> A middle-aged woman who has arthritis in her hands attends the dental practice for a routine check-up and says she has read an article about tooth brushing. She particularly wants to know whether she should be using an electric toothbrush instead of a conventional manual one. Could you advise her?

Questions

(1) What are the options for tooth brushing?
(2) Which are more effective, electric or manual toothbrushes?
(3) If electric toothbrushes are more effective, is any one better than the others? There are different types (for example rotary or sonic) and different manufacturers.

SCENARIO 2: FLUORIDE SUPPLEMENTATION

> Jenny's mother comes to your surgery asking whether or not she should give her daughter fluoride supplements. Jenny is 3 years old and is at high risk of developing dental caries.

Questions

(1) What is the rationale for using fluoride in the prevention of dental caries?
(2) What are the options for delivering fluoride?
(3) What alternatives would be effective and appropriate for a 3-year-old child?
(4) What are the side effects of using fluoride supplements?

SCENARIO 3: BACTERIAL ENDOCARDITIS

> An adult who has a congenital cardiac lesion is at high risk of developing bacterial endocarditis. He requires dental care including root canal treatment and the extraction of several teeth. There is some doubt in your mind about whether penicillin prophylaxis is warranted for this individual.

Questions

(1) What type of congenital cardiac lesion does he have?
(2) What is the occurrence of bacterial endocarditis in the population?

(3) What is the risk of developing bacterial endocarditis as a result of invasive dental treatment?
(4) What are the guidelines for prophylaxis against bacterial endocarditis?
(5) What is the efficacy of antibiotic prophylaxis?
(6) What are the potential benefits and harms of any such prophylaxis?

The scenarios presented above illustrate some of the types of questions which can be addressed through evidence-based dentistry. The purpose of your search will fall into one or more of the following categories of research:

- Monitoring and surveillance of oral health and disease
- Identifying causes of disease or risk factors associated with disease
- Detecting and diagnosing disease
- Preventing disease
- Evaluating treatments for disease

(2) Search for the information

There are many sources of information on dental treatments and on causes of oral disease. Published articles in medical and dental journals are now easy to search online, using electronic databases such as Medline. Organisations such as the National Institute for Clinical Excellence produce summaries of the evidence on particular therapies and guidelines about their use. You may also be contacted by dental company representatives who provide literature on their products. Details of the main information sources are provided in Chapter 9.

The evidence found in the literature will come from various types of study, employing different methodologies:

- Observational studies
  - Cross-sectional survey
  - Cohort study
  - Case–control study
- Interventional studies
  - Clinical trial
- Reviews
  - Systematic reviews
  - Narrative reviews

The original research papers will be either observational or interventional studies, and, in Chapters 2–7 the methodology and interpretation of each of these types of study are discussed in relation to an example from a published paper. Chapter 8 compares and contrasts observational and interventional study designs. Reviews of the literature on a particular topic can provide an overview of the research that has been published in that area. However, it is still essential to understand the findings

from the individual studies that make up a review. Chapter 9 suggests approaches to finding and synthesising evidence, and introduces the topic of systematic reviews.

(3) Interpret the evidence

This is the most time-consuming step and is often seen as the most difficult aspect of reading research papers. However, understanding how to interpret results is central to evaluating the evidence yourself. When reading a research article, many people rely on the conclusions made by the authors without looking carefully at the results that underpin the conclusions. Occasionally there are instances where the conclusions in a paper are not well supported by the results presented, or where even though one treatment has been found more effective than another, the size of the gain is so slight that the results have little importance for patient care. Although researchers attempt to present an impartial view of their results, there can be a natural desire to emphasise positive aspects of the findings and minimise any potential negatives.

In this book we discuss many concepts that are useful in helping us form our own evaluation of the evidence presented in research papers. These range from the way the study is designed and the measures used, through to the meaning of the statistical results. Three aspects that are fundamental to interpreting research results are:

(1) The *size* of the effect of a treatment (or exposure). Is the effect large enough to be clinically important?
(2) Do the observed results represent a real effect, or are they likely to be a *chance finding*?
(3) Research results are always based on a *sample* of people (or objects), would we see similar results if we took another sample?

The definition of the outcome measure chosen to demonstrate the effect of a treatment (or exposure) is central to the consideration of these issues. All research studies involve measuring **outcome**. If our aim is to determine whether to use a new treatment or not, it is the effect of the treatment on a specified outcome measure that is examined. Similarly, to identify risk factors or causes of oral disease, it is the effect of the exposure of interest on the specified disease (the outcome measure) that is reported. In medicine, some outcome measures are easy to understand and have a clear clinical relevance, for example, whether the patient survives or dies, or whether the patient suffers a heart attack or not. Statins are drugs that reduce cholesterol levels and there is a large body of research evidence showing that people given statins are less likely to have a heart attack than those who are not. We can thus see a clear impact of statins on health by using the outcome measure 'heart attack or no heart attack'. Not all outcome measures in medicine and dentistry are as straightforward as this. We always need to consider whether the measure used in a particular study is both meaningful and appropriate for addressing the original question that prompted us to search for information.

Outcomes can be described as **true** or **surrogate** endpoints. True endpoints are those that have a clear and direct clinical relevance to patients[6,7]. In medicine, death is a true endpoint, as is suffering a stroke. In dentistry, the main true endpoints are pain, tooth loss, aesthetics and quality of life related to oral health, all of which are tangible to the patient. Caries status can be determined by counting the number of decayed, missing or filled teeth (DMFT). DMFT is therefore a true endpoint. Surrogate endpoints are measures that do not have an obvious impact that patients can identify easily. Periodontitis, for example, can be assessed in several ways, including measuring pocket depth or attachment level. Although simple to measure and objective, such surrogate outcomes are not always tangible to the patient. What really matters to a patient is whether teeth are lost or there is pain. A 2-mm loss of attachment does not necessarily mean that the tooth will be lost or that the patient will suffer pain.

A surrogate outcome is usually assumed to be a precursor to the true outcome. For example, if a 2-mm loss of attachment almost always leads to the loss of the tooth, pocket depth would be a good surrogate for tooth loss. Surrogate outcomes are generally objective measures that can be assessed in the short term. In treatment trials of periodontitis, changes in pocket depth or attachment level can be seen sooner than tooth loss, therefore decisions about whether to use a new treatment or not can be made earlier if the surrogate outcome is used. The assumption is that a change in the surrogate outcome measure now would produce a change in a more clinically important outcome, such as tooth loss, later on.

The evidence for routine scaling and polishing is an example in dentistry where a mixture of true and surrogate outcome measures have been used to determine whether this procedure is effective or not. Plaque, calculus, pocket depth, attachment change and bacteriological assessments are easily defined surrogates but are relevant only if they relate closely to outcomes that matter to the patient, such as tooth loss or bleeding. These outcomes are more clinically relevant, but the evidence on how much they are affected by routine scaling and polishing is scanty. Because most research in this area has used surrogate outcomes, no conclusions, at present, can be made about the effectiveness of scaling and polishing[8].

Surrogate outcome measures are used because they provide objective information quickly, and this is often a useful first step. But, there is sometimes a danger that the endpoint of clinical relevance to the patient is not investigated thoroughly and it can be hard to arrive at firm conclusions when the evidence is based solely on surrogate measures.

(4) Act on the evidence

The information obtained from assessing the evidence should then be considered in relation to the question that prompted you to undertake the search. Going back to the scenario of the woman with arthritis who has asked about the effectiveness of electric versus manual toothbrushes (see Scenario 1), there is much evidence comparing the two methods in healthy adults. Does evidence exist comparing the two in people who lack manual dexterity? If not, how far is the evidence on healthy adults likely to be relevant in this situation?

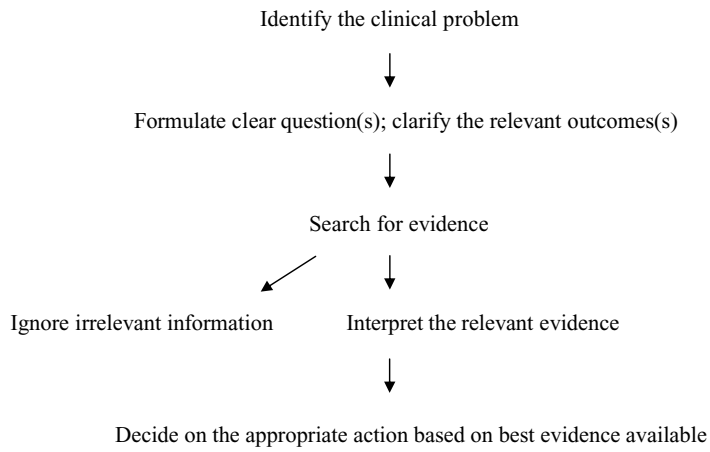

Figure 1.1 The main steps in evidence-based dentistry.

Summary

The practice of evidence-based dentistry is relatively straightforward but requires an ordered approach. The five steps are summarised in Figure 1.1.

Dentists have to elicit, sift and decide how to best use information gathered from patients, the literature, colleagues and experts in the field. Some signs and symptoms may be unexplainable, some may be difficult to treat or the patient may simply wish to discuss a treatment plan that has been recommended, but about which they are uncertain.

Therefore, it is essential to use a systematic approach when practising evidence-based dentistry. Understanding methodology makes the process easier and approaching the problem logically results in an informed decision about the best way forward. Practising evidence-based dentistry enhances patient safety and well being.

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