A practical approach to evidence-based dentistry

How to search for evidence to inform clinical decisions

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SECOND IN A SERIES

In the first article of this series, we introduced the definition, principles and procedures of evidence-based dentistry (EBD).[1] In this second article, we will describe how to formulate clinical questions to facilitate searching for evidence, as well as where and how to search for relevant evidence. Many types of evidence-based resources are available, and they are characterized by their degrees of coverage of preappraised or summarized evidence at varying levels of processing, from primary studies to systematic reviews and clinical guidelines. The practice of EBD requires familiarity with these resources. Knowing how to search for evidence that can inform clinical decisions is a fundamental skill for the practice of EBD. In later articles, we will explain how to appraise evidence critically and use it to inform clinical decisions.

ABSTRACT

Background and Overview. Knowing how to search for evidence that can inform clinical decisions is a fundamental skill for the practice of evidence-based dentistry. There are many available types of evidence-based resources, characterized by their degrees of coverage of preappraised or summarized evidence at varying levels of processing, from primary studies to systematic reviews and clinical guidelines. The practice of evidence-based dentistry requires familiarity with these resources. In this article, the authors describe the process of searching for evidence: defining the question, identifying the question's nature and main components, and selecting the study design that best addresses the question.

Practice Implications. Dentists who wish to inform their decisions with the current best evidence can use these guidelines to define their questions of interest and search efficiently for this evidence.

Key Words. Clinical questions; population, intervention, comparison, outcomes (PICO) framework; evidence processing; evidence-based dentistry resources.
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WHY IS IT IMPORTANT TO KNOW HOW TO SEARCH FOR THE BEST CURRENT EVIDENCE?

Because of the increasing number of new treatments and studies that address their effectiveness, knowing how to search for and use the best current evidence is a fundamental skill in clinical practice.[2,3] Many oral health care professionals are familiar with PubMed (www.ncbi.nlm.nih.gov/pubmed). This high-volume database is the premier source for journal article information in the biomedical sciences. It includes abstracts for approximately 345,000 articles relevant to dentistry; 90,000 of these are studies relevant to therapy questions, and about 3,000 are systematic reviews, many of which can inform clinical practice directly. For example, when we entered "antibiotics for periodontitis" in PubMed, the total number of hits (citations that PubMed provides in response to the search) available (in October 2014) was more than 2,400—a number of studies much larger than any single practitioner could possibly review. Fortunately, there are strategies to search more efficiently for relevant articles, and furthermore there often are preferable strategies that lead to EBD resources that process and appraise the evidence, thus facilitating its use in clinical practice.

DEFINING THE QUESTION OF INTEREST

Framing the question is a key step in the process of searching for evidence to inform clinical decisions.[4] There are two main types of questions that will determine an efficient and relevant search strategy: background questions and foreground questions.[4] Background questions are aimed at eliciting descriptive information concerning clinical conditions, diagnostic tests or treatments. In other words, background questions deal with foundational knowledge such as definitions and mechanisms of action. Examples of background questions are "What is chronic periodontitis?" and "How does the laser caries detection system work?" Foreground questions are targeted questions about therapy and prevention, diagnosis, etiology and prognosis that directly inform clinical decision making. Examples of foreground questions are "Are antibiotics effective as an adjunctive therapy for treating patients with chronic periodontitis?" or "What is the diagnostic accuracy of the laser caries detection system?" This series of articles will focus—as, indeed, the process of EBD focuses—on finding evidence and using evidence that has to do with foreground questions.

The first step in formulating the question of interest is to identify the nature of the question, which is related directly to the type of evidence the search will target. The nature of clinical questions falls into four main areas[4]:

◼ therapy or prevention, with questions aimed at assessing the effect of interventions on patient-important outcomes (example: "What is the effectiveness of antibiotics in preventing complications such as postoperative infections after third-molar extractions?");

◼ harm or etiology, with questions aimed at evaluating how exposure to risk factors influences patient-important outcomes (example: "Does giving toddlers milk instead of water to drink at night cause caries?");

◼ diagnosis, with questions aimed at assessing the performance of a test in differentiating between patients with and without a condition or disease (example: "How useful is a periapical radiograph in detecting interproximal caries?");

◼ prognosis, with questions aimed at estimating a patient's future course of disease on the basis of prognostic factors (example: "Are patients with diabetes at higher risk of experiencing complications after third-molar extractions than are patients without diabetes?").

Secondly, in addition to the nature of the question, we must identify the main components of the question. All types of questions typically have four main components, which vary depending on the nature of the question. The main components of therapy or prevention questions are

◼ population (the patients relevant to the question);

◼ intervention (the treatment or prevention strategy or, possibly, the harmful exposure of interest);

◼ comparison (the management strategy used as a reference against which to compare the intervention);

◼ outcomes (the consequences of the intervention in which we are interested).

The acronym PICO arises from these four components,[4] and from this point forward we will refer to these questions as "PICO questions." In questions of harm, etiology and prognosis, the intervention is replaced by exposure (the risk factor, intervention or prognostic factor), and the comparison usually is the absence of the risk or prognostic factor; in diagnostic questions, the intervention is replaced by the diagnostic test of interest and the comparison is referred to as the "reference standard." The PICO framework helps both to clarify the question and to guide the searching process. Table 1 shows the main components of the question, variations according to the nature of the question and some relevant examples.

Finally, we must identify the best type of primary study design to answer the clinical question. Depending on the nature of the question, EBD proposes a hierarchy of study designs, starting with those that minimize the risk of bias, which we should seek first to inform our clinical practice. For questions regarding therapy or prevention, well-designed and conducted randomized controlled trials (that is, clinical studies in which the researcher randomly assigns the intervention and comparison to the patients and follows them up to assess the occurrence of the outcomes of interest) should be preferred over observational studies, which are themselves superior to unsystematic clinical observations or case reports.[5] For questions of harm, etiology and prognosis,

TABLE 1

Main components and examples of clinical questions, according to their natures.

NATURE OF THE QUESTION	EXAMPLE	POPULATION	INTERVENTION (EXPOSURE OR DIAGNOSTIC TEST)	COMPARISON (OR REFERENCE STANDARD)	OUTCOMES
Therapy or Prevention	What is the effectiveness of antibiotics in preventing complications such as postoperative infections after third-molar extractions?	Patients undergoing third-molar extractions	Antibiotic prophylaxis	No prophylaxis	Alveolar osteitis, surgical wound infection
Harm or Etiology	Does giving toddlers milk instead of water to drink at night cause caries?	Toddlers	Drinking milk at night	Drinking water at night	Caries
Diagnosis	How useful is a periapical radiograph in detecting interproximal caries?	Patients suspected of having interproximal caries	Periapical radiograph	Bitewing radiograph	Diagnostic accuracy (as assessed by means of true-positive, true-negative, false-positive and false-negative findings)
Prognosis	Are patients with diabetes at higher risk of experiencing complications after third-molar extractions than are patients without diabetes?	Patients undergoing third-molar extractions	Presence of diabetes	Absence of diabetes	Pain, swelling, trismus, postoperative infections

generally the most appropriate designs (that is, those with the lowest risk of bias) are observational studies[6] in which the researcher compares outcomes between groups exposed and unexposed to the risk or prognostic factor of interest. For questions regarding diagnostic test properties, the preferred study designs are studies in which the properties of the diagnostic test are compared against those of a reference standard; these usually are cross-sectional studies.[7] We will describe these study designs in detail, as well as how to appraise and use them to inform clinical practice, in subsequent articles.
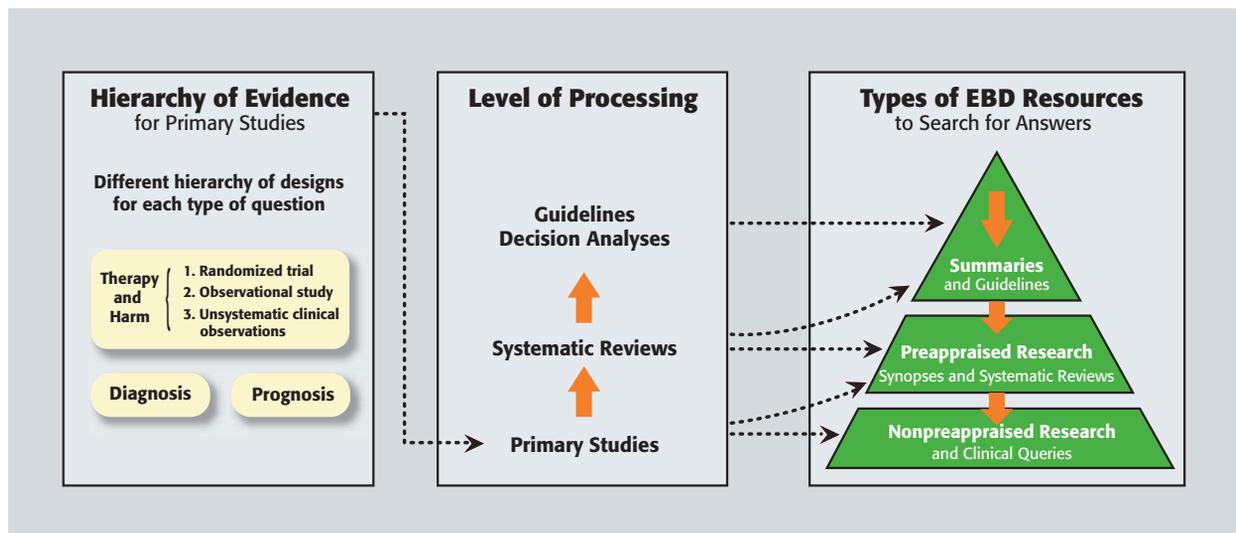

Figure. Types of evidence, according to their level of processing and resources to find them. The figure illustrates how to navigate across available types of evidence-based dentistry (EBD) resources. The left panel illustrates the hierarchy of evidence for primary studies, the middle panel helps determine the type of evidence for which to look and the right panel illustrates where to search for such evidence. Depending on the nature of the question, primary studies follow a hierarchy of study designs from lower to higher risk of bias (left panel). They can be processed further into systematic reviews, where they are comprehensively synthesized, and then clinical guidelines, which move from evidence to recommendations (middle panel). Once the desired evidence has been determined, the pyramid of types of EBD resources (right panel) helps to choose the type of resource in which to search for the evidence. Efficient searches should start from the top—for example, with online sources of summaries (such as DynaMed). These typically include more processed evidence, providing the gist and links to selected guidelines and systematic reviews. If no answer is found, sources of preappraised research (such as Evidence-Based Dentistry Journal) provide synopsis of selected and methodologically sound reviews and studies. Finally, large databases of nonpreappraised research (such as PubMed) contain all current studies, yet often are diluted by numerous citations irrelevant to the question. Reproduced with permission of the American Medical Association from Agoritsas and colleagues.[8] Copyright © 2015 American Medical Association.

EVIDENCE ACCORDING TO LEVELS OF PROCESSING

In addition to the study design corresponding to each type of question, we can find evidence at different levels of processing (Figure[8]). Studies such as randomized clinical trials and observational studies correspond to primary, or stand-alone, studies. These primary studies can be summarized in systematic reviews that address a focused clinical question in a comprehensive and reproducible manner.[9] Rigorous systematic reviews involve the use of explicit eligibility criteria to guide comprehensive searches for primary studies addressing the question of interest. Systematic reviews critically appraise the risk of bias of all included studies, the applicability or directness of the studies in answering the question and, when appropriate, combine the results of the primary studies to provide a pooled effect estimate across studies considering issues of both precision and consistency of results. Because well-designed and well-conducted systematic reviews include all the body of highest-quality evidence relevant to a clinical question, using systematic reviews (when available) to inform clinical practice is advantageous.

Clinical practice guidelines represent a higher level of processing in which the evidence is processed further to inform clinical recommendations. Clinical practice guidelines are "systematically developed statements to assist practitioner and patients decisions about appropriate health care for specific clinical circumstances."[10] In moving from evidence to recommendations, the entire body of evidence is integrated along with its level of confidence regarding important outcomes, the balance between benefits and harms, patients' values and prefer-

TABLE 2

Types of evidence-based dentistry resources: where to find evidence to inform clinical decisions.*

TYPE OF RESOURCE	RESOURCE	CONTENT	AVAILABILITY
All Levels (Comprehensive Resources)	American Dental Association (ADA) Center for Evidence-Based Dentistry	Guidelines, critical summaries, systematic reviews	Free access to ADA members
	Trip	Clinical practice guidelines, synopses, systematic reviews, primary studies and others	Free access for searching citations
	SUMSearch	Clinical practice guidelines, systematic reviews and primary studies	Free access for searching citations
	Epistemonikos	Systematic reviews, summaries, primary studies	Free access for searching citations and to abstracts
Summaries and Guidelines	UpToDate	Summaries	Subscribers only
	DynaMed	Summaries	Subscribers only
	National Guideline Clearinghouse	Clinical practice guidelines	Free access
Preappraised Resources	Evidence-Based Dentistry Journal	Synopses	Free access for searching citations and free access to abstracts
	Journal of Evidence-Based Dental Practice	Synopses	Free access for searching citations and free access to abstracts
	The Dental Elf	Synopses	Free access
	The Journal of the American Dental Association	Synopses and systematic reviews	Free access for searching citations and free access to abstracts
	Oral Health Group, Cochrane Collaboration	Systematic reviews	Free access for searching citations and free access to abstracts
Nonpreappraised Resources	PubMed	Systematic reviews and primary studies	Free access for searching citations, free access to abstracts, and free access to some articles
	Embase	Systematic reviews and primary studies	Subscribers only
	Cochrane Central Register of Controlled Trials	Primary studies	Free access for searching citations

* Most of the resources that allow free searching for citations also provide links to sources where the full text of these citations can be found, depending on personal or institutional access.

ences and considerations of use of resources.[11] We will explain this process in more detail in subsequent articles in this series.

Like clinical guidelines, decision analysis and health technology assessments also process the evidence beyond the level of systematic review. Decision analysis involves the use of mathematical models that facilitate the estimation of consequences of health care decisions by integrating evidence regarding effectiveness, costs and assumptions about health utilities.[12] Health technology assessments are defined as "a form of policy research that systematically examines the short- and long-term consequences—in terms of health and resource use—of the application of a health technology."[13]

TABLE 3

Examples of search terms and ways to combine them, based on the PICO* framework.

WHAT IS THE EFFECTIVENESS OF ANTIBIOTICS IN PREVENTING COMPLICATIONS AFTER THIRD-MOLAR EXTRACTIONS?					
PICO Framework Component	**Population**	**Intervention**	**Comparison**	**Outcomes**	**Type of study**
	Patients undergoing third-molar extractions	Antibiotic prophylaxis	No prophylaxis	Postoperative complications: pain, swelling, trismus, surgical site infection, alveolar osteitis	Systematic reviews, randomized controlled trials
	and	and	and	and	
Simple Search Strategy	Third molar	Antibiotic prophylaxis	Not applicable	Postoperative complications	Systematic reviews
Complex Search Strategy	Third molar AND adults	Amoxicillin OR (clavulanic acid) OR metronidazole	Placebo	Pain OR swelling OR trismus OR (surgical wound) infection OR dry socket	(Systematic reviews) OR (randomized controlled trials)
* PICO: Population, intervention, comparison, outcomes.					

WHICH RESOURCES SHOULD WE USE TO FIND EVIDENCE?

The types of resources vary considerably in the level or extent to which they summarize the evidence. There are three levels of resources: summaries and guidelines, pre-appraised research, and nonpreappraised research. The figure illustrates the types of evidence according to the degree of processing or summary involved and the resources that can be used to find those types of evidence. It is more efficient to start looking for answers at higher levels of processing and summary. Table 2 shows current resources for evidence to inform clinical practice.

Types of resources. *All levels (comprehensive resources).* Fortunately, some types of EBD resources provide access to evidence in all levels, whereas others specialize in one type. One example of a resource that provides access to many types of evidence is the American Dental Association's Center for Evidence-Based Dentistry (http://ebd.ada.org/en/evidence/). Another helpful site is Trip (www.tripdatabase.com), a search engine that retrieves evidence, images, videos and patient information leaflets. Trip allows the search to be refined according to the level of its processing—for example, providing filters to enable the user to access only evidence-based synopses, systematic reviews, guidelines and controlled trials. Similar resources include SUMSearch (http://sumsearch.org) and Epistemonikos (www.epistemonikos.org).

Summaries and guidelines. Resources that provide access to online summaries include UptoDate (www.uptodate.com) and DynaMed (https://dynamed.ebscohost.com). These resources provide summaries of the body of evidence regarding a topic (that is, not necessarily limited to one specific PICO question)—for example, preventive dental care and counseling for infants and young children. Although these two resources do not have sections dedicated specifically to dentistry, there are summaries of topics relevant to dental practitioners. Guidelines also provide actionable recommendations to inform clinical practice. These can be found in resources such as the National Guideline Clearinghouse (www.guideline.gov).

Preappraised resources. Preappraised research includes systematic reviews, which (as stated earlier) appraise the risk of bias of individual studies, and synopses, which are studies or systematic reviews selected for higher methodological standards and clinical relevancy. Moreover, EBD resources vary in the degree of critical appraisal of these selected studies, some adding a short commentary by an expert in the field. Resources in which synopses can be found include the journal Evidence-Based Dentistry (www.nature.com/ebd/index.html), The Journal of Evidence-Based Dental Practice (www.journals.elsevier.com/journal-of-evidence-based-dental-practice/) and The Dental Elf (www.thedentalelf.net). In addition, The Journal of the American Dental Association publishes a critical summary of systematic reviews in every issue. Many dental journals, including JADA, publish systematic reviews, but the most useful resource in finding systematic reviews relevant to the dental practitioner is the Cochrane Oral Health Group, a review group from the Cochrane Collaboration (http://ohg.cochrane.org/reviews) that constantly is publishing and updating systematic reviews focused on questions considered to be a priority for current oral health care professionals.

Nonpreappraised resources. Finally, nonpreappraised resources (that is, those that provide access to primary studies), are found in large electronic databases such as PubMed (www.ncbi.nlm.nih.gov/pubmed/), Embase (www.elsevier.com/online-tools/embase) and the Cochrane Central Register of Controlled Trials (www.cochrane.org/editorial-and-publishing-policy-resource/cochrane-central-register-controlled-trials-central). These databases also allow filtering to search for specific study designs and clinical topics.

Choosing resources. Dentists should consider two main factors when choosing which type of resource to consult to inform evidence-based practice. First, the resource should be based on the current best evidence. For example, in the case of summaries and guidelines, these resources should have an explicit and transparent assessment of the evidence used. Guidelines also should

have an explicit description of how all the important factors were integrated into the formulation of the recommendations. (In subsequent articles in this series, we will describe in more detail the factors to consider for all types of resources.) Second, the resource should be both comprehensive yet specific enough to cover the question of interest.[8] Other factors that also are relevant to consider are that the resource should be up to date (that is, clinicians should rely on the most recent evidence), and that it should be available to the practitioner who wants to use it.

A variety of resources is available for free and open to the public. However, many valuable resources (for example, the full text of the most recent journal articles or systematic reviews) are not available to nonsubscribers. Health care professionals may take advantage of subscriptions held by their institutions.

Regardless of the level of processing and summary involved, all evidence should be used with caution. The clinician should be able to differentiate evidence that inspires confidence from evidence that does not. In subsequent articles, we will provide guidance for this critical appraisal.

TRANSLATING THE QUESTION INTO SEARCH TERMS

The PICO framework not only helps in clarifying the question, but also facilitates the translation of the question into terms that are used in the search. Depending on the resource in hand, and on how broad or narrow the search, search strategies will range from simple to complex (Table 3). In large databases such as PubMed, it is possible to use filters such as Clinical Queries (www.ncbi.nlm.nih.gov/pubmed/clinical) to conduct more specific searches, and to take advantage of tools such as "Related Citations" to find additional relevant material.[14] An efficient search also will depend on the clinician's familiarity with the topic and experience in searching. Exploring these resources before using them in practice often proves useful.

CONCLUSION

Knowing how to formulate structured clinical questions and to search for the best current evidence to inform a clinical decision are vital skills for the practice of EBD. Familiarity with the many types of resources that have been developed to facilitate efficient searching is fundamental requirement for EBD practice. ∎

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