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REVIEW

How to apply evidence-based principles in clinical dentistry

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Abstract: The primary objective of evidence-based practice is to improve the quality of health care. It helps in making a clinical decision based on recent and advanced research and the best available evidence. Evidence-based dentistry is an integration of best available evidence with clinical expertise and patient's needs and preferences. However, there are many barriers to apply evidence-based knowledge into practice. Information overflow, inability to select appropriate evidence, and critically appraising the evidence are the main challenges a practitioner may face. The focus of this review is defining a well-structured clinical question, key principles of literature search, type of search studies, and how to appraise an evidence. Furthermore, despite the availability of good evidence, patient's needs and preferences are crucial factors in making clinical decision. Finally, the clinician's experience and lack of motivation to change practice is another big challenge to evidence-based practice. This article discusses the six structured steps to apply evidence-based practice in dentistry with examples. Finally, this article will help practitioners to integrate their experience and skill with modern research evidence as well as to educate their patients to reach a final clinical decision.

Keywords: evidence-based dentistry, decision making, PICO, systematic

Introduction

It has been found that only 10% of dental care is based on validated research.[1] It may take 17–20 years to implement the research-based knowledge to patient care.[2] There are many obstacles in applying best available evidence to practice. Lack of sufficient time, skill, confidence to search, and appraising the scientific literature are considered major barriers in making evidence-based decisions. In addition, search for high-quality evidence is considered complicated, overwhelming, and time-consuming.[3,4]

There is a growing concept of evidence-based practice that emphasizes that clinical decision should be integrated with best available evidence in the form of a well-designed research study.[5] The evidence-based approach is to improve the quality of health care and to bridge the gap between research and practice.[6] It was first introduced in medicine.[7] It was originally defined by Sackett as the "conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients".[8] According to American Dental Association (ADA),

> the evidence-based dentistry (EBD) is an approach to oral health-care-decision making that requires the judicious integration of systematic assessment of clinically relevant scientific evidence relating to the patient's oral health and medical condition and history, together with the dentist's clinical expertise and patient's needs and preferences.[9]

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EBD is meant to empower clinicians to provide the most contemporary treatment. There are many benefits of applying evidence-based approach into practice. First, it can improve the quality of patient care. With the systematic search, modern treatment modality and its rationale can be identified. Second, it can provide high standards of care.[4,9]

EBD consists of three main components:

- Best available evidence.
- Clinical experience and expertise of the clinician.
- Patient's needs and preferences (Figure 1).[10]

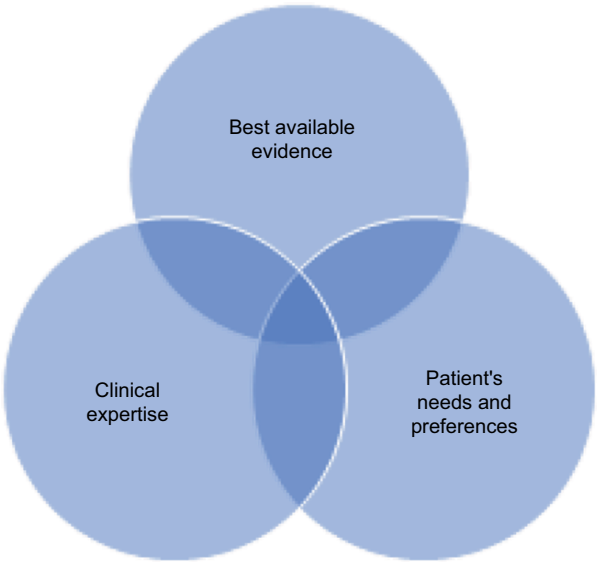

Figure 1 Components of evidence-based dentistry.
Notes: Adapted from Masic I, Miokovic M, Muhamedagic B. Evidence based medicine – new approaches and challenges. *Acta Inform Med.* 2008;16(4):219–225.10 Copyright © 2008 AVICENA. License available at: https://creativecommons.org/licenses/by-nc/3.0/legalcode.

Best research evidence means validated and clinically relevant research, which can be conventionally derived from basic sciences. Best research evidence can also be patient-centered clinical research, such as randomized controlled trial (RCTs) treatment, or interventional, diagnostic accuracy, prognosis, efficacy and safety research.[11]

Clinical expertise is the ability to use one's clinical skills, experience, and knowledge to rapidly and correctly diagnose the particular patient state of health and to assess the risk and benefits of the different interventions considering the particular clinical state and the clinical setting.[11]

Patient values are their unique preferences, concerns, and expectations that should be taken into account and must be integrated into any diagnostic or treatment plan.[11]

There is a hierarchy of evidence that is based on the degree of trustworthiness (Figure 2).[10] Systematic review and meta-analysis are considered the highest level of evidence or "gold standard". They are ranked as level 1 evidence. RCTs are also considered as level 1 evidence.

Cohort studies and case–control studies are considered as level 2 and level 3 evidence, respectively. Case reports, animal studies, and in vitro studies are considered as level 4 evidence.[12]

The process of EBD consists of the following steps:

1. Formulating well-structured searchable clinical question.
2. Determining the level of evidence that best answers the question.
3. Searching for best available evidence

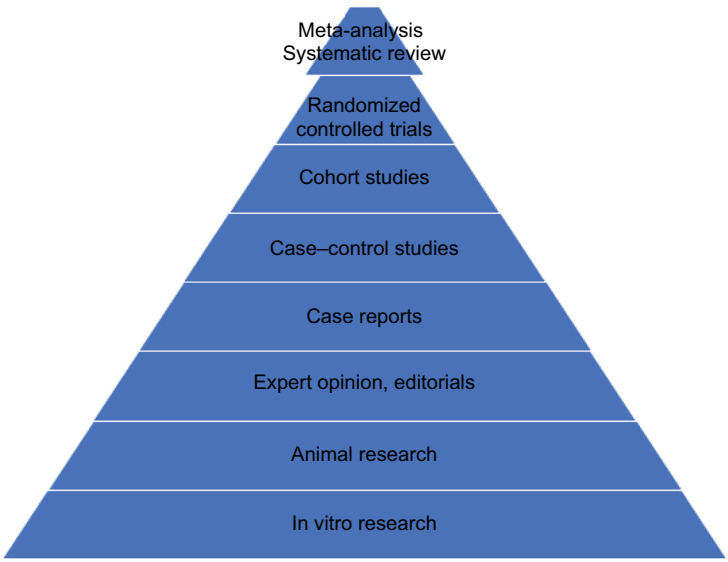

Figure 2 Hierarchy of evidence.
Notes: Adapted from Masic I, Miokovic M, Muhamedagic B. Evidence based medicine – new approaches and challenges. *Acta Inform Med.* 2008;16(4):219–225.10 Copyright © 2008 AVICENA. License available at: https://creativecommons.org/licenses/by-nc/3.0/legalcode.

4. Critically appraising the evidence for its validity and usefulness.
5. Applying information of the patient.
6. Evaluating the efficacy of EBD application on a patient.

Formulation of well-structured clinical question

First step in EBD is to develop a well-structured clinical question. Instead of reviewing the dozens of journals, EBD suggests focusing your readings specific to issues related to patients. The clinical question is structured in the form of Patient/population (P), Intervention (I), Comparison (C), Outcome (O), and Type of Studies (S) (PICOS). It may be more productive to develop a well-structured clinical question and then searching current databases to keep updated with the current literature.[12,13] A well-structured searchable question should be able to define the following characters.

- **P** stands for patients or population of interest. According to Armstrong,[14] **P** represents the patients who belong to a population with certain characteristics (age, gender, ethnic group, risk profile, and other traits, the practitioner judges to be important), which allows for comparison with the participants in research studies.
- **I** is the intervention. The "intervention" applies not only to therapy but also to prevention, diagnostic testing, and exposure/etiology. So, it is related to the clinical action that is under consideration.
- **C** is the comparison or reference standard. The comparison can be an intervention or an assessment relative to another perhaps more innovative. The comparison can be a "baseline or equivalent" or "doing nothing".[14]
- **O** is Outcome. It is a patient-centered approach. It is not always related to "best results", it may include unwanted outcomes such as the probability of side effects and cost or effort associated with achieving outcomes.[14]
- **S** stands for type of studies. We should look for the types of study design that will give best answer to the clinical question as mentioned in Table 1.

Examples of four types of PICO question are presented in Table 1.[15]

Determining the level of evidence

Different types of research studies are better suited to answer different categories of clinical questions. It is not always possible to find systematic review or meta-analysis. In such a situation, we have to work our way down the evidence pyramid to the next highest level of evidence. Best executed cohort or case-controlled designs sometimes provide better evidence than a poorly conducted RCT.

The clinical question can be divided into four types: therapy or prevention, harm or etiology, diagnosis, and prognosis. The best evidence that we should look for depending on the type of question is presented in Table 2.[16]

Searching evidence

Formulating the question is a key step in the process of searching for evidence to inform clinical decisions. Primarily there are three steps for searching evidence:

1. Identifying keyword and MeSH (Medical Subheading) terms.

Table 1 Formulating PICO question

Question: example question: What is the effect of antibiotic in preventing pain and complications after root canal therapy in patients with diabetes mellitus?	**Patient/ population**	**Intervention or exposure**	**Comparison**	**Outcome**
	Patients with diabetes mellitus	Use of antibiotics after root canal therapy	No antibiotics/ placebo after root canal therapy	Reduction in pain and complication
Harm or etiology: Does bottle feeding at night cause caries in children?	Children on bottle feeding	Bottle feeding at night	No bottle feeding at night/water consumption only	Incidence of caries
Diagnosis: Is laser fluorescent technique able to diagnose proximal caries more accurately than bitewing radiographs?	Patients with high caries rate	Laser fluorescent	Bitewing radiographs	Diagnosis of proximal caries
Prognosis: Are patients with apical periodontitis at higher risk of failure of root canal therapy than the patients without apical periodontitis?	Patient with and without apical periodontitis	Root canal therapy	NA	Success and failure of the treatment

Abbreviations: NA, not applicable; PICO, Patient/population (P), Intervention (I), Comparison (C), Outcome (O).

2. Looking for secondary sources.
3. Searching for primary sources.

Searching "search terms" and secondary sources

The search terms should be related to parts of the PICO question in Table 3. The search terms can be identified on "MeSH" (Medical Sub-Headings) on MEDLINE website via Ovid. Then the terms of similar meaning are combined with "OR" and different categories are combined by using "AND".

There are two types of research studies: first is primary research, which includes experimental and observational, clinical trials, surveys, and secondary research, which draws conclusions from primary studies.[13] Secondary research consists of systematic reviews, meta-analysis, evidence-based practice guidelines, critically appraised topics, decision analyses/decision tools, and consensus development reports.[13]

The search should be started by searching preappraised literature (secondary research) before performing database searches for primary literature.[13,17,18] These resources provide analysis and grading of the evidence, which may eliminate the need for further extensive searching. The main evidence-based resources for dentistry are:

- ADA database of Systematic Review (http://ebd.ada.org/SystematicReviews.org/About.aspx).
- Journal of Evidence-Based Practice Dentistry.
- The Cochrane Library.
- Evidence-Based Dentistry.

Table 2 Most appropriate study designs according to the type of clinical question

Type of question	Best study design
Diagnosis	Cross-sectional or prospective, blinded comparison to gold standard
Therapy	Randomized controlled trial > cohort study > case–control > case series
Prognosis	Cohort study > case–control > case series
Harm/etiology	Cohort study > case–control > case series

The secondary literature synthesizes, filters, and evaluates the primary research literature.[13] These resources provide systematic reviews and appraised summaries on different topics of dentistry. In secondary research, the risk of bias of all included studies combines the results of the primary studies to provide a pooled effect estimate. Well-designed and well-conducted systematic reviews provide the highest quality evidence relevant to a clinical question. Clinical practice guidelines represent a higher level of processing in which the evidence is processed further to inform clinical recommendations.

Depending on the nature of the question, EBD proposes a hierarchy of study designs, starting with those that minimize the risk of bias. For questions related to therapy or prevention, RCT should be preferred over observational studies. For questions of harm, etiology, and prognosis, appropriate study designs are observational studies. In diagnostic questions, most of the study designs are cross-sectional.[19]

There are various databases that index journals. More than one database should be searched to find evidence.[18] Most commonly used databases are:

- The Cochrane Database of Systematic Reviews (CDSR) and Database of Abstracts of Reviews of Effects (DARE), which are found in the Cochrane Library and can be accessed through the Cochrane Collaboration Web site (www.cochrane.org).
- PubMed, which includes MEDLINE (www.ncbi.nih.gov/pubmed).
- CINHAL (www.ebscohost.com/conhal), an acronym for Cumulative Index to Nursing and Allied Health Literature.

Appraising evidence

Studies are also subjected to biases and confounders. A good research should be designed to minimize this bias and confounding by using the control group, randomization, and blinding. Once an article is identified, it should be critically

Table 3 Search terms on the base of PICO framework

Clinical question: What is the success rate of direct pulp capping in patients with carious exposure of pulp?							
PICO framework	**Population**		**Intervention**		**Comparison**		**Outcome**
Simple search strategy	Carious pulp exposure	AND	Direct pulp capping	AND	Root canal treatment	AND	Asymptomatic AND no periapical radiolucency
Simple search strategy	Cariously exposed pulp	AND	Pulpotomy	AND	Vital pulp therapy	AND	Survival rate AND success rate
Complex search strategy	Carious pulp exposure OR cariously exposed the pulp	AND	Direct pulp capping OR pulpotomy	AND	Root canal treatment OR vital pulp therapy	AND	Asymptomatic AND no periapical radiolucency OR survival rate AND success rate

Abbreviation: PICO, Patient/population (P), Intervention (I), Comparison (C), Outcome (O).

appraised. Critical appraisal involves a structured approach to examining evidence to assess its value and clinical relevance to modern practice.[13] This allows practitioners to recognize studies that are biased or poorly designed and therefore ensure that only the most reliable information is incorporated into clinical practice.[13,20] According to the Center for Evidence-based Medicine, University of Oxford (CEBM), the search should be able to address the following four important points:

1. Does this study address a clearly focused question?
2. Did the study use valid methods to address this question? The validity of a research study is related to randomization of groups to ensure that both groups have similar baseline characteristics and the instruments used to measure outcomes should be valid and reliable.
3. Are the valid results of this study important?
4. Are these valid, important results applicable to my patients?

If the answer to the above-mentioned questions is "Yes", then we can apply the treatment to our patients.

Application of patients' information

This is the most crucial step to apply all acquired knowledge from evidence to specific circumstances to each patient. We have to look for the following questions before applying the results to our patients.[12]

1. What are the characteristics of the participants of the study? Are they similar to my patients? We have to look for the baseline characteristics of participants of the study. We should also look at the inclusion and exclusion criteria of the study.
2. Are the settings similar to our setting? Is the treatment available?
3. What alternatives are available?
4. Are the benefits outweighing the risks and harms?
5. Are the outcomes appropriate to the patient?

We need to estimate patient's risk of the outcome, which may be higher or lower than the control group. In general, the benefit of treatment will increase with the risk or severity of illness, but the harm will usually not change with the degree of risk or severity.[21] Therefore, once the patients are sufficiently at risk or their disease is sufficiently severe, treatment is worth the possible harm from treatment.[21]

Efficacy evaluation of EBD application on a patient

This is the final step to evaluate the EBD approach and its efficacy to patients. It is assessed that whether certain evidence causes changes to better and that to the extent confirmed by research. If a patient's response is different, it needs to be investigated that why some patients did not respond to the changes in an expected way and what can be done to change it.[8,12,22]

Conclusion

There is no doubt that a gap exists between clinical practice and research. Evidence-based approach improves clinical decision making and standard of care.

Finding times, lack of resources, and lack of skill are considered major barriers in applying research-based evidence in practice.

It provides a strategy to integrate new evidence into patient care. EBD requires the basic steps of formulating a clinical question in the form of PICO, systematically searching evidence, and critically analyzing the evidence. EBD helps to bridge the gap between clinical researcher and real-world practice. In addition to providing guidelines on effective care of the patients, it enables the dentists to change their practice.

If the dental practitioners want to maximize their abilities and achieve excellence in practice and provide cost-effective quality services, they must develop strategies to enable them to use findings from relevant, well-designed, practice-oriented research studies.

Disclosure

The author reports no conflicts of interest in this work.

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