Appraising the evidence and applying it to make wiser decisions

Paolo Prolo [1],
David J. Weiss [2]
Ward Edwards [3]
Francesco Chiappelli [1].

[1] *UCLA School of Dentistry Division of Oral Biology & Medicine Los Angeles, CA 90095-1668;*
[2] *California State University*
[3] *Wise Decisions, Inc., Studio City, CA.*

Received for publication: April 30, 2003
Accepted: May 21, 2003

Abstract
Over the past several decades, evidence based health care, and evidence based dentistry in particular, has come to be seen as the proper foundation for selecting a treatment program. Evidence based dentistry can be defined as the process of systematically evaluating the research evidence to determine the best treatment in everyday clinical practice. Integration of research evidence into practice relies on the ability of dentists to identify appropriately designed and conducted research, whose results have been correctly analyzed. However, questions arise as to the relevance of the published research to individual clinical needs, particularly in situations when either the published evidence is mixed or it cannot be translated into the present needs of the clinician. An algorithm is needed that is designed to aid the clinician in selectively reviewing the evidence and determining its applicability.

Key Words
algorithm, decision making, evidence, options.

Correspondence to:
Paolo Prolo, M.D.
UCLA School of Dentistry
Division of Oral Biology & Medicine
CHS 63-090
Box 951668
10833 LeConte Avenue
Los Angeles, CA 90095-1668
Phone +1-310-794-6625
Fax +1-310-794-7109
E-mail: pprolo@dent.ucla.edu

Introduction

Evidence based dentistry (EBD) can be defined as a process of systematic evaluation of the research evidence for application in clinical practice. The integration of research evidence into the practice of clinical dentistry relies on the ability of dentists to identify the relevant research, and to be able to determine whether a study has been appropriately designed and carried out.

Published evidence often appears to offer mixed conclusions, a situation that is fairly normal to researchers. Indeed, the academic process often favors publication of results that contradict established findings. However, clinicians who are unfamiliar with this situation may be tempted to eliminate confusion by rejecting an evidence-based approach.

Starting point: Systematic Review

Research in evidence-based dentistry involves the systematic review of the published literature, critically assessed from the viewpoint of research methodology, design and data analysis. The systematic review rests on: a) asking an answerable question, b) searching for the published evidence, c) appraising the evidence, d) applying the evidence to patient care, and e) evaluating the outcome. Criteria evaluate the population studied, the intervention, the comparison or prediction approach, and the outcome. Criteria also use consolidated standards for evaluating the quality of randomized trials (e.g. Jadad scale). Individual studies are evaluated by means of the systematic examination of the statistical analysis. Integrative data analyses are systematically conducted using meta-analysis[1,2,3,4].

A systematic review is generally preceded by a best-case series. The reader scans the available literature for a relatively small numbers of published reports on the given topic of the research question. These identified reports are selected based on how representative they are of the state of the literature. The papers are critically assessed. Taken together, the critiques generate a preliminary statement of the best available evidence. The information of the best-case series directs both to what the best available evidence may be, and how to refine the systematic review of the literature to insure appropriate focus on the posed research question. In brief, the best-case series establishes a) that the correct domain of the literature is being examined, b) that there is sufficient adequate literature to establish the best available evidence, c) in preliminary terms, the best available evidence.

Systematic reviews and best-case series are grounded on consensus among the readers of research, from the viewpoint of the research methodology, design and analysis, as well as from the viewpoint of the scientific relevance of the reported findings. A small group of experts is convened for each problem domain. Obtaining consensus among readers is often difficult, and may be forced (i.e., readers will discuss every report until a unifying statement of consensus is attained), or graded (i.e., following discussion, some degree of consensus will be established). Based on the consensus of the group, a statement on the quality of the evidence on each individual report is made a cogent synthesis of the best available evidence.

Once the best evidence is gathered and ranked, it must be formatted for use by the clinician and then made available to interested practitioners. These efforts have costs associated with them. Fee-for-service seems an unlikely model. We doubt that general practitioners will be willing to pay for each treatment recommendation. Are professional associations, insurance companies, states or universities prepared to subsidize such a service? The answer to the latter question might be positive, if this service is proven to provide savings in term of cost to the community (i.e. costs paid for by state or federal sponsored plans, such Medicare in the United States or similar plans in other countries; less labor days lost due to treatment; less claims to insurance companies by unhappy patients).

Working example: Tooth restoration

We will now consider a very common question, one that patients ask dentists almost everyday. " Should I keep my old amalgam fillings or should I have them replaced with the new ones?" Dental amalgam, a mixture of elemental mercury and a silver-dominated metal alloy, has been the most widely used filling material for the past century. About 1980, serious consideration was given to the possibility that mercury or other metals could escape from amalgam and affect the health of dental providers and patients. Alternative materials exist. However, they are not well suited for important applications, and are all more expensive than amalgam. Patients increasingly favor the use of alternative alloys or resin-based or resin-modified glass ionomer composites, commonly known as white fillings. This trend is not only for cosmetic reasons but also it is driven by the mounting belief of the physiological toxicity of metals contained in alloys. Mostly anecdotal reports associate the mercury content in amalgam with a wide number of diseases that range from rheumatic disorders to dementia of the Alzheimer's type. Consumer groups in the United States increasingly file suits against dental associations for their allegedly unlawful practice of deceiving patients about the presence of mercury in amalgam-based restorative materials. Insurance companies in the United States cover the cost of white fillings, but hesitate in covering full replacement of silver with white fillings. A bill has been introduced in California to ban the use of amalgam by 2007. What the general public does not know is that there may actually be more danger of exposure to mercury during the replacement with white fillings than in passive leakage from well-established silver fillings. Resin-based composite

materials (e.g. formaldehyde) are also toxic to cells and tissues, and may be slowly released into the mouth[5].

Exhaustive perusal of the pertinent research literature on silver and white fillings was conducted by means of traditional search strategies [MEDLINE, Bandolier (dental and oral health), DMJ-IADR (dental journals)]. Reports were critically evaluated based on the criteria of research methodology, design and data analysis, following the "What-Who-How" algorithm, quality of reporting of meta-analyses [QUOROM], consolidated standards for reporting of trials [CONSORT], problem/population – intervention – comparison/prediction – outcome [PIC/PO], systematic evaluation of the statistical analysis [SESTA][4,6]. The literature review to date suggests that alternative metal alloys used for tooth restoration, which contains nickel or cobalt, may not be safer than mercury-based amalgam. Nickel and cobalt can act as metal allergens and induce a moderate-to-strong hypersensitivity reaction in close to 10% of female patients, an incidence that is 6 times greater than in male patients[7]. The present evidence is not absolute in demonstrating that amalgam is a health hazard[8]. By contrast, resin-based materials release toxic components into the oral environment (e.g. methacrylate and its ethyl derivatives, adhesives, cements), which can cause adverse local and systemic effects[9]. This information provides the basis to reach a decision regarding the best treatment plan.

Ending Point: Decision Making

The process of gathering the best evidence entails decisions, but not by the practitioner or patient. Those decisions are made by the analyst, who reads and evaluates the literature. The job of the evidence searchers is to produce a set of probabilities (that will likely depend on characteristics of the patient) for the various treatments under consideration.

Once the information is made available to the practitioner, then the stakeholders in that decision can make a decision about what treatment to pursue. The decision made by the stakeholders can involve tradeoffs: a certain treatment might be "best" (highest probability of desired outcome), but costs more or calls for more post-procedure steps by the patient. We should not forget that there are also probabilities associated with no treatment, as in our working example on tooth restoration.

Decision making theory recognizes two principal domains: the descriptive question about the process by which decisions are made[10], and the normative question about the process by which decisions ought to be made[11,12]. Optimal decision making in medicine and in dentistry rests on a *normative process* of decision making, that is on the assessment of probabilities for the occurrence of given outcomes based on the best available evidence. One essential component of making a wise and good decision is to gain a sound understanding of the clinical situation (i.e., sound history and diagnosis). The process of understanding brings together the realization of its intricacies and of certain options that would aid in its resolution (evidence-based research)[4]. That is to say, without a cognitive comprehension of the matter at stake, it is ludicrous to attempt to make decisions about it[12]. Secondly, the decision-maker must have the ability and knowledge – that is, the skills and expertise - to estimate and to evaluate the relative value subjectively attributed to individual outcomes (Figure 1).

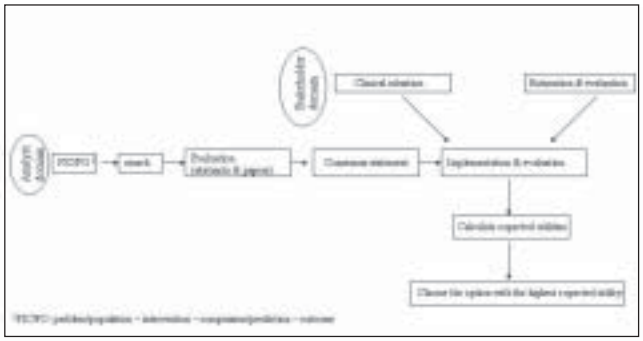

Figure 1 - The process of applying evidence

Taken together, these elements blend into an optimal format of normative decision making in dentistry: that is, the process by which the dentist can reliably assess the risk-to-benefit ratio (i.e., effectiveness of intervention), in order to maximize the expected subjective utility of the outcome of a given situation. This represents "*…by far the most common and the most useful decision rule…*"[12].

In conclusion, evidence based dentistry aims at ensuring the practice of clinical dentistry based on the best available evidence. This, in turn, rests on the critical evaluation of research findings, and on the decision making process that should determine the inclusion or exclusion of this evidence into the treatment protocol. These issues are particularly salient in the context of a domain of dental research characterized by the mixed nature of its evidence. A specific algorithm is therefore needed to aid the clinician in selectively reviewing the evidence and determining its applicability.

References

1. Needleman I, Grace M, Sloan P. QUOROM and systematic reviews. Br Dent J. 2002; 192: 605.
2. Chiappelli F, Prolo P. Evidence based dentistry for the 21st century. Gen Dent. 2002; 50: 270-3.
3. Chiappelli F, Prolo P. The meta-construct of evidence-based dentistry. Part II. J Evid Based Dent Pract. 2002; 2: 1-7.
4. Chiappelli F, Prolo P, Newman M, Cruz M, Sunga E, Concepcion E, Edgerton M. Evidence-based dentistry: Benefit or hindrance. J Dent Res. 2003; 82: 6-7.
5. Chiappelli F, Prolo P. Evidence-based dentistry and tooth restoration. ICCE/9 Proc. 9th Annual International Conference on Composite Engineering. D. Hui, ed.; 2002. pp. 117-8.

6. Wong J, Prolo P. Extending evidence-based dentistry beyond clinical trials: implications for materials research in endodontics. Braz J Oral Sci. 2003; 2(5) (in press).
7. Grimaudo NJ. Biocompatibility of nickel and cobalt. Gen Dent. 2001; 49: 498-503.
8. Eley BM. The future of dental amalgam: a review of the literature. Part 7: posible alternative materials to amalgam for the restoration of posterior teeth. Br Dent J. 1997; 183: 11-4.
9. Geurtsen W. Biocompatibility of resin-modified filling materials. Crit Rev Oral Biol Med. 2000; 11: 333-55.
10. Mellers BA, Schwartz A, Cooke ADJ. Judgment and decision-making. Ann Rev Psychol. 1998; 49: 447-77.
11. Edwards W, Barron FH. SMARTS and SMARTER: improved simple methods for multiattribute utility measurements. Organ Behav Hum Decis Process. 1994; 60: 306-25.
12. Edwards W, Fasolo B. Decision technology. Ann Rev Psychol. 2001; 52: 581-606.