

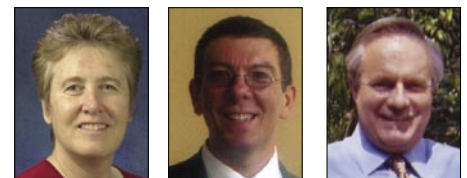
Evidence-based Dentistry: A Clinician's Perspective

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ABSTRACT

Evidence-based dentistry is a discipline that provides best, explicit-based evidence to dentists and their patients in shared decision-making. Currently, dentists are being trained and directed to adopt the role of translational researchers in developing evidence-based dental practices. Practically, evidence-based dentistry is not usable in its current mode for the provision of labor-intensive services that characterize current dental practice. The purpose of this article is to introduce a model of evidence-based dental practice. This model conceptualizes a team approach in explaining problems and solutions to change current dental practice. These changes constitute an evidence-based dental practice that involves the electronic chart, centralized database, knowledge management software, and personnel in optimizing effective oral health care to dental patients.

Beginning with medicine, and by transference affecting dentistry, is the growing perception that dentists rely too heavily on conceptual knowledge and training, local clinical expertise, and experience in communicating what is best for patient care. These perceptions are vocalized by biomedical-dental researchers, responsible for producing new knowledge, and policy-makers, advocating decision-making behavioral changes in dentists. The goal of both is improving patient care



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with new advances in knowledge and technology. Practically, the argument reduces simplistically to who is the final arbiter of best evidence: those who create new knowledge, assuring its confidence in scientifically quantifying or qualifying outcomes, or those who apply evidence in patient care settings.

An arbiter is an individual or consensus manager who decides an issue for what is best and acceptable given the current standard of that issue. In this case, the arbiter determines best evidence in formulating a clinical practice guideline. A CPG provides decision, utility, and cost data for dentist-patient negotiations in arriving at an informed consent. Informed consent is shared decision-making. Shared decision-making is the daily negotiation that a dentist does with patients in arriving at a mutual understanding regarding needed dental services. Mutual understandings are developed when dentists explain treatment options, based on their understanding of what is best for the patient using conceptual knowledge, clinical expertise, and experiences in like-patient situations and conditions, determined by local practice norms. Patients communicate what is best for themselves in terms of their past experiences with dentistry, ability to comply with maintenance requirements, and economic constraints. Both express their personal utilities in making trade-offs in deciding what can and cannot be done, or selecting a choice where the risks of one outcome is offset by the benefits of another. A trade-off is basic to the clinical decision, choosing the treatment option that is best for dentist and patient in providing and accepting dental treatments. The outcome of shared decision-making is a treatment plan upon which both dentists and their patients can agree. In this traditional approach, the dentist is the final arbiter of best evidence, utilizing intuitive knowledge, clinical expertise and experience to communicate treat-

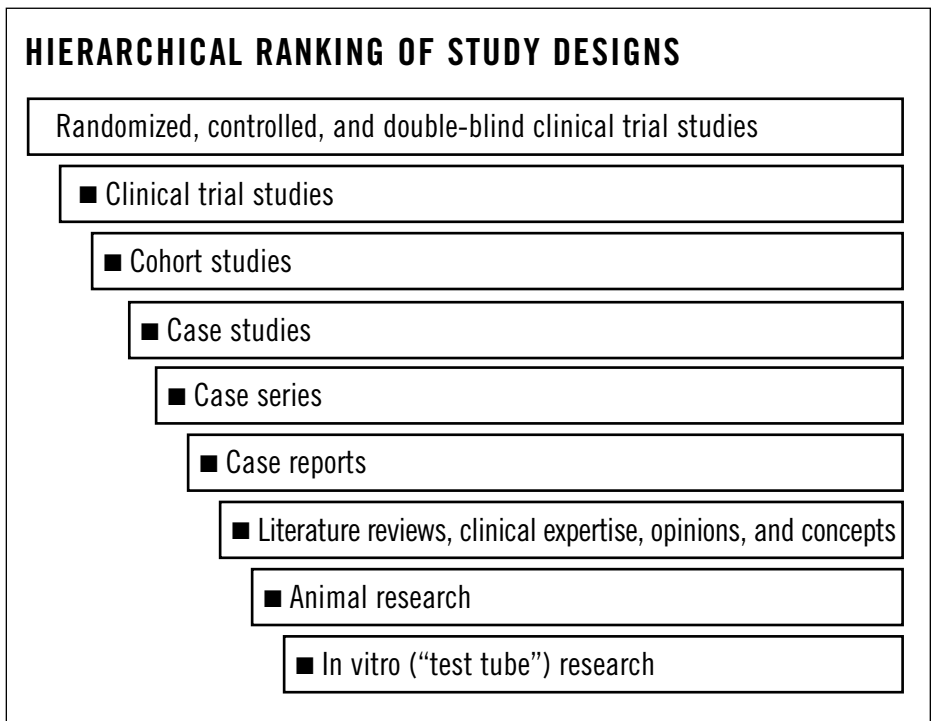


Figure 1. Hierarchical ranking of study designs: A randomized, controlled, and double-blind clinical trial study design being the highest and the standard of evidence quality.

ment options deemed appropriate to the individual patient. Conducted on a routine basis in current dental practices and in the past, this approach is termed the intuitive approach to decision-making, making practice-specific clinical decisions appropriate to individual patient care.

Intuitive Approach

In the intuitive approach, evidence is derived from applying knowledge logically based on concepts learned during training and implicitly in rendering oral health services, based on experience and patient characteristics of well-being, and the judgment of clinical experts. This knowledge, or evidence, may have been determined from a long-term monitoring of patients under conditions and patient attributes that reflect the environs of the practice. In other words, evidence has been rendered best through the long-term, multifaceted monitoring of its implementation and

compliance subject to patient (human) behaviors. In the intuitive approach to decision-making, shared decision-making communicates how this evidence will be applied to the individual patient for which a decision is needed. To this communication, the dentist and patient bring their personal utilities. The dentist may weight evidence, or render importance to the evidence, based on personal or professional experience, beliefs of its effectiveness or efficacy, and practice behavior, or practice profile. The patient may weight evidence based on risk behavior, costs, and personal or cultural preferences and values. These weightings are part of a dialogue that communicates trade-offs each party is willing to accept in reaching a mutually determined clinical decision. This dialogue is a process that occurs at the time of the dental examination of which the assessment, evaluation, and treatment planning are guided by the dentist's communication of best evidence and

filtered by the dentist's clinical knowledge, expertise, experience, and personal beliefs and values.

Analytical Approach

The analytic approach to decision-making, on the other hand, is based on a consensus of current research, filtered by the professional literature or consensus manager groups, organizations, or agencies. In the analytic approach, evidence is derived from basic researchers who explain and contribute to a body of knowledge using parametric, technological, animal, or human models. The variables studied are chosen to demonstrate rapid, dramatic effects. After the 1960s, clinical studies became pre-eminent in determining effective health care.¹ Evidence derived from clinical studies is categorized hierarchically based on the soundness of the study's methodology and findings (**Figure 1**). The highest explicit standard is the randomized, controlled, and double-blind clinical trial-study design. The clinical practice guideline is produced by the "conscientious, explicit, and judicious use" of quantitative and qualitative "clinically relevant scientific evidence" synthesized through systematic research.^{2,3} Systematic reviews are conducted much like primary investigations, except that they identify and appraise all relevant studies from all sources in response to a specific clinical question.⁴ The data from each study is synthesized according to explicit and reproducible criteria, limiting bias, and random error. In other words, best evidence developed against a scientifically determined standard is assessed, evaluated, and disseminated to the dentist who then applies this evidence to individual patients.

Thus, best evidence does not rely on local conceptual knowledge, training, clinical expertise, or experience to provide treatment options for shared decision-making. Instead, the dentist becomes the conduit for predetermined best evidence. The dentist's role is to

consider the patient's utility and costs data in the context of his or her presenting conditions and chief complaints, assisting the patient in making a clinical decision appropriate to his or her situation. The context of the situation is where dentists apply their individualized conceptual knowledge, clinical experience, and expertise. Thus, knowledge, clinical expertise and experience is useful in converting "average patient" best evidence into "individual patient" evidence, discussing individual patient limitations that determine trade-offs between treatment options in reaching the clinical decision.

Shared decision-making is focused on the CPG. The dentist uses the CPG to communicate to the patient the various treatment options and their probabilities of reaching a desired outcome based on the "average patient." The dentist, then, uses clinical expertise and experience of the patient's utilities and costs to assist that patient in analyzing, through the CPG, the option that the patient decides is best for his or her situation, individualizing "average patient" data to the patient.

Criticism of the Intuitive Approach

In the dentist-patient relationship, the dentist is the final arbiter of evidence, responsible for its collection, evaluation of effectiveness and efficacy, implementation, and monitoring of long-term outcomes. Thus, evidence reflects the context, practice behavior, and bias of the clinician in an intuitive implementation of knowledge to individual patient care. Evidence, then, is a compilation and consensus of existing evidence derived from conceptual and learned treatment modalities, clinical experience, and the judgment of clinical experts in determining what is the current state-of-the-art of knowledge, or best evidence. However, current debate is critical of the clinician's proprietary status in determining what evidence is best evidence. The criticism is the same,

the clinician's lack of using explicitly derived evidence in implementing standards of care to individual patients. An evidence shift is suggested, holding the analytical approach superior to the intuitive approach and evidence to an explicit standard of acceptance. The arbiter of this evidence is the translational researcher. Currently, the translational researcher-produced CPG is disseminated in a narrative format and appears in professional journals. The format may vary, reporting on one article or a systematic review. An article analysis and evaluation includes subjects and therapies used, the main outcome measures, results, and conclusions, followed by a commentary and analysis of a member of the editorial board.

The systematic review includes all data sources and study designs, data extraction and synthesis, results, and conclusions, followed by a commentary of a member of the editorial board.

Criticism of the Analytic Approach

The analytic approach, however, is not without controversy. In 2002, Marks was commissioned by The Health Development Agency (National Health Service, United Kingdom) to provide an analysis of the analytic approach to decision-making.⁵ According to Marks, the analytic approach is as much flawed as the intuitive approach to clinical decision-making. Similar to the intuitive approach, the analytic approach in and of itself is opinioned-based. Best evidence results from a systematic process of filters that represent successive biases toward a state of knowledge influenced by the interests of those that fund discovery. In other words, translational researchers subject their findings to conforming processes that parallel those of the clinician: evidence supported by training, routines, and habits. Thus, the systematic review is neither objective nor hierarchical in its audit of clinical knowledge. To date, there exists no best evidence to sup-

port the researcher's claim that the systematic review is more rigorous and sound than other qualitatively derived evidence. Marks argued that the systematic review actually wastes valuable information and knowledge. Yet, the evidence derived from the systematic review is based on an explicit standard of developing new knowledge, the analytic approach, and confers less random error and bias as that evidence derived over a long period of time from the intuitive approach. It is population-based evidence that can be generalized.

Purpose

Despite the criticisms of either approach, dentists are being encouraged to change how decision-making is done in private practice, the basis of an evidence-based dental practice. The purpose of this article is to describe a conceptual model for an evidence-based dental practice. In this model, decision-making for the clinical decision, and ultimately the treatment plan, is emphasized. This model uses explicitly derived evidence and intuitive approaches in a process to communicate evidence on "average patients" in shared decision-making. The outcome is a clinical decision made by an individual patient during informed consent. However, the model may be inclusive of other practice decisions including patient behaviors, dental practice administration, equipment, and restorative, rehabilitative dental services. As a model that conceptualizes a process of decision-making, it does not possess the power to predict conditions and thus, does not include etiological factors or patient risk factors.

Evidence-based Dental Practice

The foundation of an evidence-based dental practice is best evidence. The arbiter of best evidence is the researcher, specifically the translational researcher. This represents a shift in the traditional paradigm that describes current dental practices. With this shift, dentists are no

longer the arbiters of best evidence. This concept has been adopted by policy-makers in the public market of health care and third and fourth parties that operate in private markets. Evidence becomes a means of improving and monitoring health care delivery. In the public market, this is used to regulate health care inequalities, promote cost-effective treatments and practice, and provide greater accountability of public spending and resource allocation to health and health-care research. In private markets, this is used to define benefits based on cost/

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profit margins, regulate the mechanics and safety of practices, and control practice profiles. This paradigm shift is problematic for dentistry. Unlike medicine, dentistry has remained an independent profession seeking practice modes independent of third-party regulators and the public sector, influenced only when costs favor third-party benefit structures that may bear significantly on the patient's clinical decision. Fundamentally, the dentist-patient relationship is the metaphysical norm for dental practice in emphasizing personal responsibility for one's oral health. Thus, dentists are very suspicious of any attempt to undermine this tenet by government and private regulators.

Reasons for a Paradigm Shift

There are two 21st century concerns that provide an imperative for the success of dental practice and the assurance of optimal oral health care for dental patients. One concern is the demographic and service shift to older adults, the other, an explosion in new knowledge.

Older Adults

Previously, practice dynamics centered on procedure-oriented care. Fluoridation and public awareness of healthy personal lifestyles have shifted the practice away from procedure-oriented care to patient-centered care. In patient-centered care, risk assessment and management goals include promoting compliance in following healthy behaviors and oral self-care. However, older adults are at greatest risk for changes in their health and functional status that adversely affect their abilities to meet these goals. The need for interdisciplinary (primary health care teams) and intradisciplinary (dental specialty care teams) -coordinated treatment plans to effect optimal therapies and treatments will change the dynamics of dental practice. Currently, practice management services understand this and are actively marketing dental practice in the model of "A Center for Dental Medicine."⁶ In such a practice, dentists work in teams to include all needed health care and dental specialty services to meet the needs of older adults in developing treatment plans and implementing coordinated services. Thus, the arena of knowledge has increased to provide effective and efficacious dental care to older adults, including coordinated medical, dental, psychological, and social services. The dentist becomes a member of a team of health-care professionals whose knowledge must transcend the oral cavity and include evidence regarding reciprocal interactions in medicine, psychology, and social welfare in promoting oral health.

Knowledge Explosion

The second concern is the explosion of knowledge to advance dental care services and delivery. Since the 1990s, advances in computer technology, the worldwide web, and librarian resources has characterized the explosion of knowledge specifically in health care, the universal way that knowledge may be accessed, and the need for knowledge

management systems.⁷ In the future, dentists and other health-care professionals may consult interactively using the Internet to discuss and monitor shared patient cases. Fundamental to this process will be the dentist's ability to provide best evidence to support dental interventions. As such, professional dentistry has defined evidence-based dentistry to be "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, with the dentist's clinical expertise and the patient's treatment needs and preferences."⁸

Model of Evidence-based Dental Practice

A model of evidence-based dental practice addresses both concerns in facilitating the profession's definition of evidence-based dentistry. The reality of this model is the use of knowledge management strategies mediated by interactive software to achieve shared decision-making within the dental examination appointment. This model is based on a definition of evidence-based dental practice: "Evidence-based Dental Practice is patient-centered care provided by dentists in optimizing interdisciplinary resources for promoting oral health and preventing disease in individual patients. The practice of evidence-based dental care means integrating researchers, clinical experience and expertise, and patients in clinical decision-making."

The Evidence-based Dental Practice Team

In evidence-based dental practice, basic researchers perform and produce evidence on the "average patient." Translational researchers systematically evaluate evidence produced by basic researchers and others. In shared decision-making, clinicians apply the product of translational researchers, the CPG, to individual patients. To initi-

ate the CPG, translational researchers develop research questions with the assistance of the dentist.

Researchers

Basic researchers are concerned with the soundness and generalization of information; whether findings can be applied to similar patients in similar settings. Significance is statistical significance or the acceptance that some relationship exists between two variables or the acceptance of a measure of a variable. Results are rapid using large study popu-

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lations to show dramatic differences. Concerns are stated in terms of validity and reliability of study design to express confidence in providing evidence.

The translational researcher has the primary responsibility of the systematic review, and rightly so, because translational researchers are most qualified in this discipline. These responsibilities involve producing, disseminating, and measuring outcomes of best evidence.

Dentists

Dentists perform assessments, evaluate services needed, and develop plans for treatments and therapies. Dentists are concerned with clinical significance; whether differences in research findings have meaning in care delivery. Dentists make judgments that may weight best evidence differently from the researcher. Personal and professional experiences, values and preferences, and appropriate practices, as well as patient well-being and quality of life issues weigh heavily on how best evidence is used in clinical decisions.

Dentists have primary responsibility

for the completion of the treatment plan and quality assurance of every aspect of practice that involves the patient care and care delivery. Dentists may work with translational researchers to record the long-term monitoring of best evidence as applied to individual patients for subsequent outcome analysis. This long-term monitoring may come from the dentist's clinical experience and from experts in the dental field.

Patients

Lastly, patients provide individual characteristics and health circumstances, or factual data. This information is used to modify best evidence on the "average patient," individualizing it to the presenting patient. Patient compliance with treatment outcomes determines the meaning, or importance, of best evidence in practice.

The outcome of this shared decision-making team is the clinical decision. Best evidence begins with the clinical question regarding some aspect of the individual patient's care. All resources with their varying degrees of weighting best evidence achieve a consensus for an aspect of the patient's dental care. The process ends with the translational researcher analyzing the outcomes provided by the dentist in monitoring long-term outcomes of best evidence.

Central Repository of Best Evidence

The organization and infrastructure of the evidence-based dental practice requires knowledge management strategies under control of a centralized repository. This central repository is suggested as the American Dental Association. The ADA is the ethical, regulatory, and community advocate for patient oral health and personal self-care. Knowledge management starts with the patient's electronic chart being integrated with the central repository of the primary network. The primary network controls all aspects of the central repository of best evidence. Being the central processing

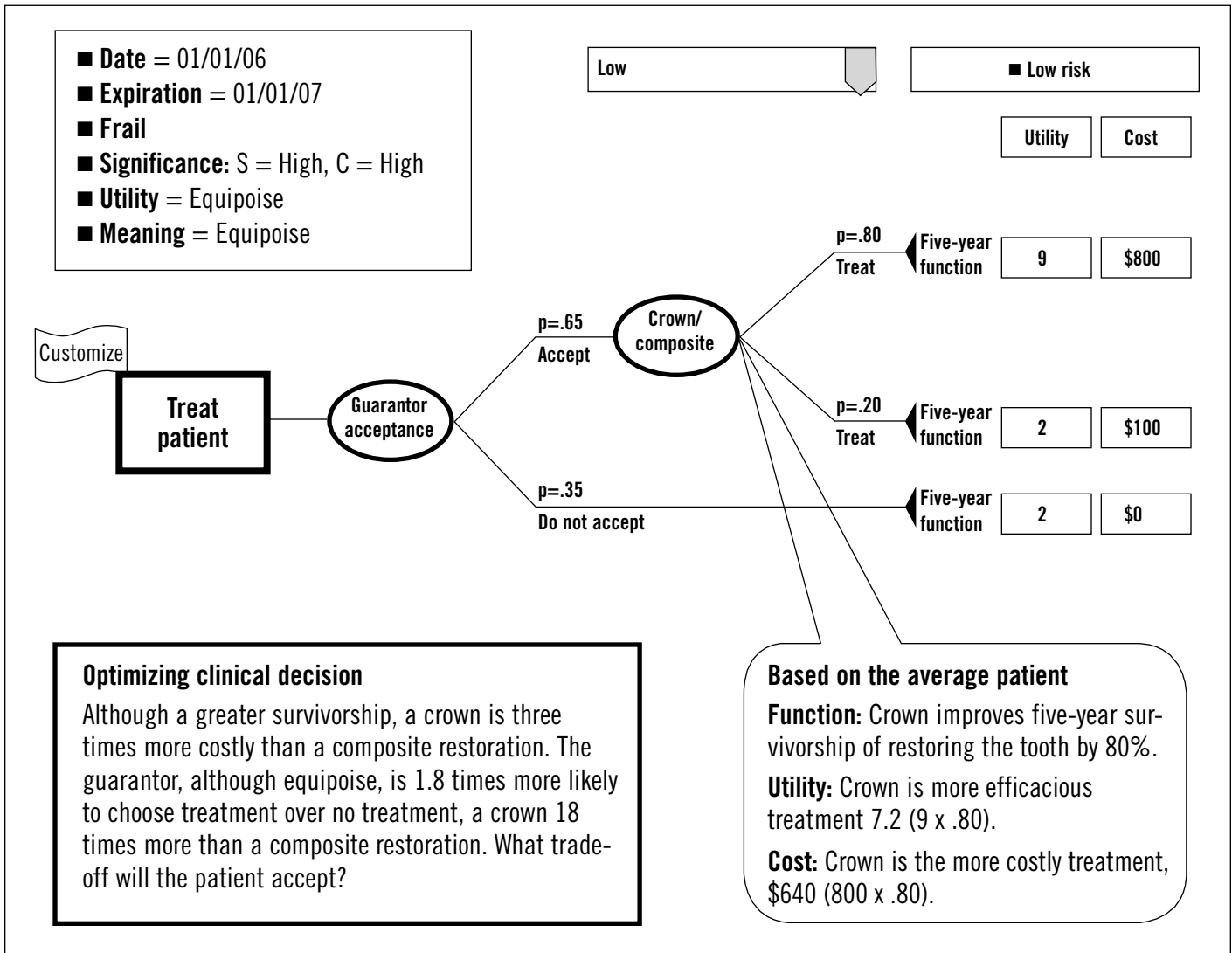


Figure 2. An example of a clinical practice guideline with treatment options, associated probabilities, utilities, and costs in determining the optimum clinical decision.

agency, the ADA is responsible for managing researchers, clinicians, and patient data in the production, storage, monitoring, and dissemination of best evidence. Evidence in this database is based on the “average patient.” The product and knowledge management format of the primary network is the CPG. Using the CPG integrated with the patient’s electronic chart provides a transfer of information from and to the central repository. This is important to understand because it is the basis by which best evidence is analyzed and updated.

Implementation of the Evidence-based Dental Practice

Through the electronic chart, the dentist accesses the knowledge management, decision-making software by clicking on its icon. The software is accessed only when there is uncertainty about a decision that has to be made. Routine decision-making does not warrant accessing evidence-based dentistry databases. For example, a tooth with caries into the dentin does not require new research to determine that it needs rehabilitation either with

an indirect or direct restorative material to restore tooth health.

Dentist Inputs

Once the icon is clicked, the dentist is presented with a form with which the clinical question is inputted. The input template structures the inputs to form a research question from which best evidence may be extracted and delivered to the dentist (Figure 2). Once the inputs are completed, the dentist clicks the “Continue” button. From this submission, a CPG is provided that is

retained within the patient's chart for subsequent retrieval. With this CPG, the dentist may discuss with the patient treatment options and the probabilities of related outcomes. These estimates are based on the "average patient." The information for the CPG resides in the database having been developed by researchers with or without the assistance of a dentist. Utility data is also provided categorized, based on three risk levels: high, moderate, and low. For example, a patient who is a high-risk taker (risk-seeker) may value a procedure that conservatively removes suspected cancerous tissue to reduce scarring and decrements in appearance; the low-risk taker (risk-adverse) values total removal of the suspected cancerous tissue with a periphery of healthy tissue regardless of postsurgical scarring. Utility data is provided as a ranking on a value scale from zero to nine. For the conservative procedure, the high-risk taker may value this procedure an eight, the low-risk taker a two. Finally, cost data is available and may be limited to practice schedules (delineated by insurance coverage benefits specific to the patient) or include national, regional, and local data, if so desired by the dentist.

Shared Decision-making

Using the CPG based on the "average patient," the dentist and presenting patient discuss options, utilities, and costs that meet the patient's expectations and goals. Patients can manipulate preferences because different scenarios are made instantaneous using the CPG and knowledge management software. This is done by the dentist who merely changes the numbers in the CPG, the software updating the values and decision analysis instantaneously.

Informed Consent

The patient becomes an informed consumer responsible for his or her decision and, ultimately, its outcome.

With the clinical decision having been made, the dentist inputs the patient's scoring and preferences. At follow-up, the dentist may input the patient's actual outcome and utility scores, submitting the results through the CPG individualized to the patient.

Reciprocation of Knowledge

Concurrently, the dentist may do the same in rating clinical significance of the evidence from a link within the CPG. Thus, the process is two-fold. One component of the process is shared decision-making. The second component is reciprocation of knowledge with the central repository. In the second component of the process, the dentist provides feedback from patients who have experienced the treatment under consideration. Translational researchers, then, may use this reciprocal evidence in evaluating the developed CPG for updating or revising best evidence.

Conclusion

Understandably, the evidence-based dental practice concept is unlike current modes of integrating research findings into patient care in which there are proprietors of independent domains of knowledge development and management, seeking credence in the uncertainty and multifaceted nature of human behaviors that is health care. In the 21st century, the mode is toward real-time, interactive, cooperation and coordination of resources over distances to best meet the needs and challenges of a differing demographic and economic world. A conceptual model of evidence-based dental practice is described that integrates best evidence from systematic reviews with shared decision-making. The basis for this model is knowledge management software that allows dentists and their patients to view and analyze clinical decisions that are made under uncertainty. This process has two

components: one that assists patients in becoming informed consumers, and the second, reciprocating knowledge between private practice and research development. Utilizing advances in computer technology and the assets of each domain in a team approach to oral health will assure our patients effective and efficacious care in meeting their needs: trust, value, and goals for optimum oral health. **CDA**

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