Evidence-based Dentistry: Fundamentals for the Dentist

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ABSTRACT

This article explains the fundamentals of evidence-based dentistry for the dentist. Evidence-based dentistry is a discipline whose primary participant is the translational researcher. Recent developments have emphasized the importance of this discipline (clinical and translational research) for improving health care. The process of evidence-based dentistry is the reciprocation of new and existing evidence between dentists and quantitative and qualitative researchers, facilitated by the translational researcher. The product of this reciprocation is the clinical practice guideline, or best evidence, that provides the patient options in choosing treatments or services. These options are quantified and qualified by decision, utility, and cost data. Using shared decision-making, the dentist and patient arrive at a mutual understanding of which option best meets an acceptable and preferred treatment course that is cost effective. This option becomes the clinical decision.

Evidence-based dentistry is a discipline, training researchers to critically analyze new and existing evidence. The analysis follows those principles and rules that determine any systematic inquiry: the collection, classification, and utilization of numerical facts or data in making inferences about a subject. In evidence-based dentistry, evidence is derived from clinical trials, case and cohort studies, as well as case series and reports, literature reviews, clinical expertise, opinions, and concepts. Evidence may also



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include animal and *in vitro* research when human data is unavailable. The methodologies of evidence-based dentistry include basic and clinical research, the systematic review, meta-analysis, and the systematic evaluation of the statistical analysis of an original systematic review. These methodologies and the evidence subsequently derived, are developed and disseminated by translational researchers to dentists. This article presents and describes the fundamentals of evidence-based dentistry.

Evidence-based Dentistry

In November 2005, the National Institutes of Health codified the discipline of Clinical and Translational Science, calling for the development of such programs in academia.[1] Clinical and translational science is committed to discovering new knowledge and implementing biomedical and behavioral clinical advances rapidly into patient care. Along with conducting research, faculty of this discipline are involved in the training of graduate and postgraduate translational scientists, as well as integrating education and research across multiple disciplines and fields of study. For evidence-based dentistry, translational scientists work with all participants from discovery to implementation of scientific inquiry and technologies into patient care. For the dentist, this means that the translational researcher is the individual who provides best evidence, in a form conducive to the private practice routine, for shared decision-making. Within the dentist-patient relationship, shared decision-making is integral to informed consent. To accomplish this purpose, translational researchers work with other researchers, dentists, and current and potential dental patients in creating evidence usable for decision-making.

Quantitative Researcher

For the translational researcher, the quantitative researcher produces decision data that must meet an explicit standard of acceptance. Decision data is knowledge or evidence in its basic form that explains "why" structures, processes, and systems behave as they do. These are scholarly pursuits that explain and contribute to new knowledge using parametric, technological, animal, or human models. Evidence, from clinical studies on humans, contributes to explaining the "what" in improving or rehabilitating health — what is effective. The highest explicit standard for clinical studies is the randomized, controlled, and double-blinded clinical trial.

Qualitative Researcher

The qualitative researcher produces utility data that too must meet an explicit standard of acceptance. These are scholarly pursuits that also explain and contribute to new knowledge by investigating the attitudes, beliefs, and preferences of both dentists and dental and potential dental patients alike. Understanding behaviors brings an efficacy of care component to decision data. In other words, dentists and patients may perceive differently the effectiveness of care depending on their life processes. This understanding may be complicated because it changes over time and may be subject to prevailing social norms and mores.

Dentists

For the translational researcher, dentists may develop knowledge implicitly from clinical practice. Evidence is developed from applying knowledge logically based on concepts learned during training and implicitly in rendering health services based on experience and patient characteristics of well-being. In providing dental care services, the dentists may contribute to the understanding of the "when, where, and how" of knowledge — when, where, and how it is effective.

Patients

Patients are typically categorized as the consumers of products and services and not the developers or guarantors of knowledge. However, patients may be advocates or adversaries of evidence. They may exert influence on the development and application of knowledge that does not necessarily meet acceptance criteria of researchers and dentists, but serves a personal need. They may also exert pressure to deny the development and application of knowledge that is contrary to their philosophical beliefs. Even in the profession's best efforts of informing patients with best evidence and using clinician expertise to communicate individualized, effective treatments, patients ultimately decide if treatment regimens are adhered to or rejected outright.

Translational Evidence-based Dentistry Researcher

The ultimate goal of translational evidence-based dentistry researchers is a process to discover and disseminate advances in health care that produce behavioral change in making clinical decisions for both the dentist and patient. This is a dynamic process in which best evidence quantifies risks and benefits.[2] This process considers decision data on the "average patient," or quantitative research and clinical expertise and experience, in applying evidence to local factors. It also considers the integration of utility data, or qualitative evidence on the "average patient," in applying contextual ways to best communicate information and determine compliance in people's lives. The result of this process is the clinical decision, effective and efficacious health care for the individual patient.

For the research side of the process, the translational evidence-based dentistry researcher is 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, the acceptance of a measure of a variable. The variables are chosen to demonstrate rapid, dramatic effects.

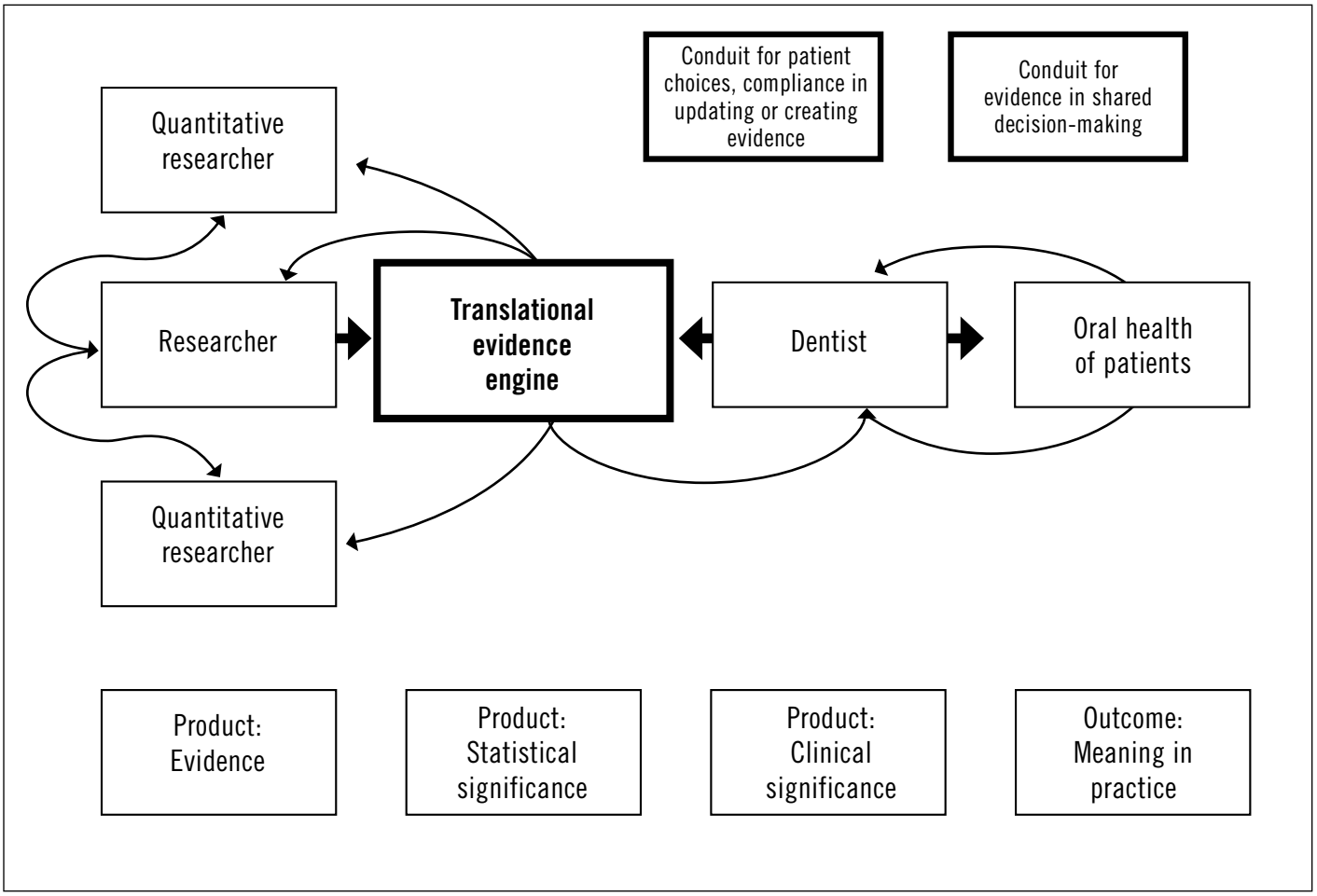

Figure 1. This illustration details a process of translating scientific evidence into better health care. The central component of this process is the translational researcher who organizes, administers, and implements the translational evidence engine.

Concerns are stated in terms of validity and reliability of study design to express confidence in providing best evidence.

For the clinical side of the process, the translational researcher is concerned with clinical significance; whether research findings can make a difference in patient care delivery. Clinical significance addresses the importance of the evidence that takes into consideration the long-term multifaceted monitoring of evidence in the context of human behavior. However, clinical significance may vary between dentists and between patients. This difference results because dentists, as well as patients, make judgments that weigh differently personal and professional experiences, values and preferences, and appropriate practices.[3] In other words, judgments of risk and benefits vary because of differences in weights given to values and preferences that also include costs.[4,5] All is important for patients in accepting best evidence in their acquiring the highest level of cost effective services, either through fee-for-service or as a defined benefit of their dental insurance plan.

Translation Evidence-based Dentistry Process

Figure 1 details a process of translating scientific evidence into better health care. The central component of this process is the translational researcher who organizes, administers, and implements the translational evidence engine. As a researcher, the translational researcher engages in identifying, designing, and coordinating with quantitative and qualitative researchers to produce decision data. In addition, the translational researchers perform systematic reviews, meta-analysis, and systematic evaluation of the statistical analysis on published data. A systematic review is collection, classification, and utilization of numerical facts or data from each level of evidence available to the translational researcher. Each in their own

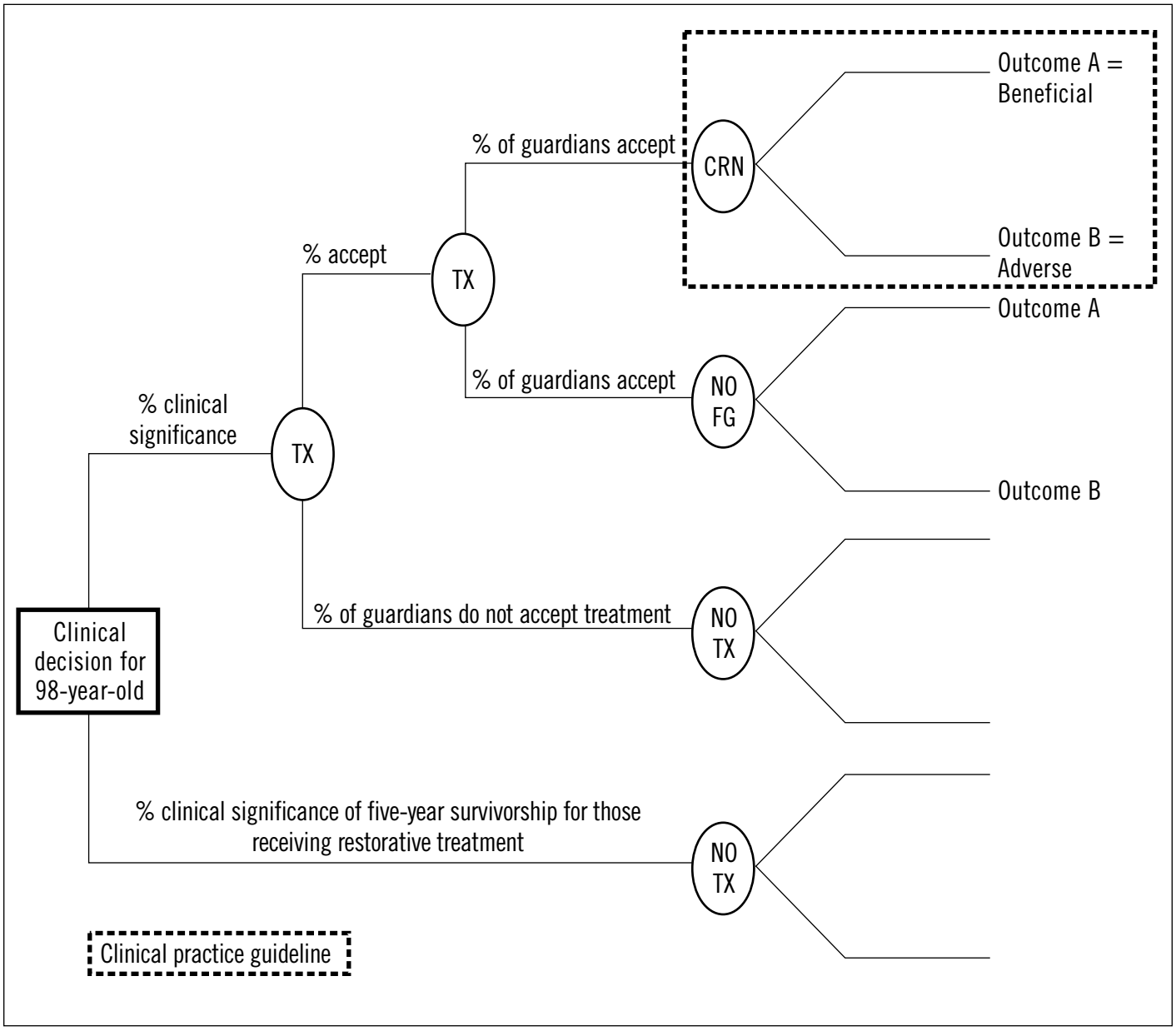

Figure 2. A clinical practice guideline is the ending branch of one particular pathway in a decision process. This diagram represents the consequence of several courses of action, read from left to right.

study or descriptive designs is analyzed to identify those resources that provide the best evidence in their respective domains. From the design domains, a consensus is arrived at to determine best evidence to provide decision or utility data for a specific research question. A meta-analysis, on the other hand, compiles individual research studies into one all-encompassing, albeit, simulated clinical trail. The data is analyzed to provide population-based decision or utility data. The product of the analysis is best evidence that conforms to statistical significance and the rigors of scientific study on humans. The outcome of this product is providing decision and utility data for use in dental practice.

Clinical significance of decision data is coordinated with dentists in developing nationally, regionally, or locally relevant best evidence. The dentist is provided decision data in the form of

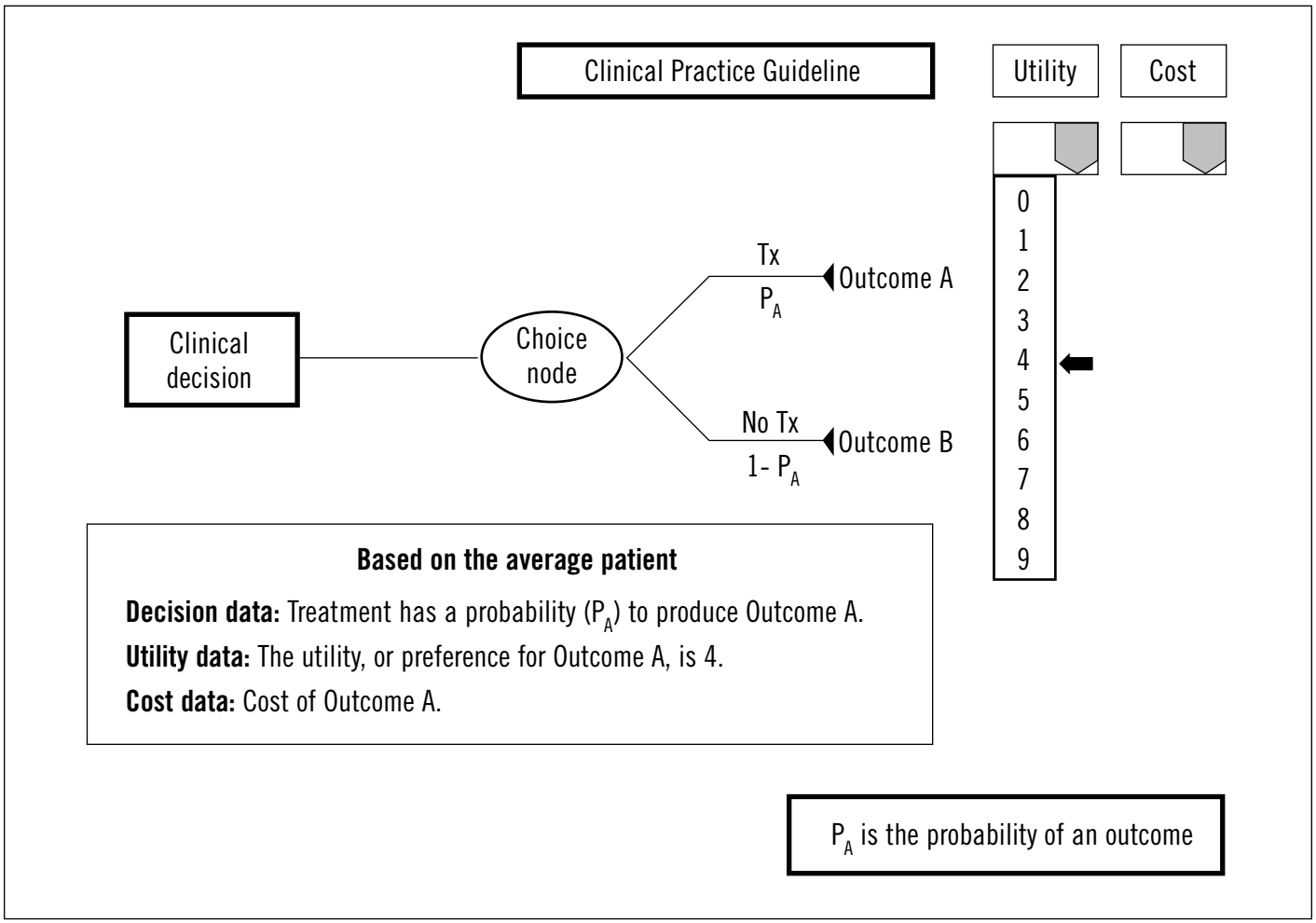

Figure 3. This is an example of a clinical practice guideline. A clinical practice guideline has a minimum of one choice or option, with two outcomes. In making a clinical decision, the clinical practice guideline is analyzed from right to left.

a clinical practice guideline, which is explained later. The dentist provides an assessment of the clinical significance of the decision data based on practice and local factors. This assessment is used by the translational researcher to reject or modify the clinical practice guideline or to re-identify and conduct investigations that produce other clinically relevant decision data.

Implementation

The translational evidence-based dentistry process starts with a clinical question. The clinical question is the purview of the dentist, having the expertise and experience to ask oral health questions or practice needs based on real conditions and situations. For patient care, the formulation of oral health questions is derived from shared decision-making. Shared decision-making involves the patient in determining needs and preferences for dental treatments, therapies, or services relevant to the patient's presenting conditions. This clinical question is turned into a research question by the translational researcher using the PIC/PO format. Through a central database, the translational researcher then provides a clinical practice guideline that the dentist then uses to reach with the patient a mutual understanding of what is acceptable and desirable dental care, or the clinical decision. Thus, the dentist acts as a conduit for the patient who is responsible for making best clinical decisions for their particular condition and situation.

Follow-up

Follow-up is the assessment of the clinical practice guideline based on the patient's clinical decision. This assessment determines the meaning of the clinical practice guideline in practice, and is patient dependent.

This follow-up is made at the time of the clinical decision and at subsequent periodic dental examinations or visits. For follow-up, the patient provides their preferences and values of dental services (choices) for updating utility data associated with the clinical practice guideline. Updating decision data is provided through patient compliance and outcomes dependent on patient healthy lifestyles and dental behaviors. With input from the dentist, the translational researcher uses these periodic assessments to update the clinical practice guideline, identifying new areas of research or improving its usefulness in private practice. Thus, the dentist acts as a conduit for the researcher in providing local data regarding patient choices, compliance, and treatment outcomes in updating or creating new evidence. Having an efficient evidence-based dentistry process has an additional benefit of involving private practice as a unit of clinical research without disrupting normal patient flow or care.

Clinical Practice Guideline

A clinical practice guideline is the ending branch of one particular pathway in a decision process (**Figure 2**); it represents the consequence of several courses of action, read from left to right. The decision process is called an algorithm.[6] An algorithm is a visual representation of a decision process, containing numerous pathways (branching) that are involved in decision-making. It does not include predisposing factors or other factors that determine risks; it only shows a decision process. A predictor model, not an algorithm, considers factors that may alter predictions of an individual's risk to a treatment or condition (risk factors) that is being studied. Algorithms do not produce predictions; instead, they provide a consensus driven model of a decision-making process.

Clinical Practice Guideline

Figure 3 is an example of a clinical practice guideline. A clinical practice guideline has a minimum of one choice or option, with two outcomes. In making a clinical decision, the clinical practice guideline is analyzed from right to left. Decision data is the probability of the outcome and provides evidence of which outcome is better. Baseline probability of an outcome represents that of the "average patient." Utility data is a measure of preferences or values, given in a scale with a number between zero and nine. Utility data provide patients with trade-offs from which the patient can select which outcome maximizes or optimizes their preference or value for a particular service. Baseline utility data is based on the preferences and values of the "average patient." Economic, or cost, data provides patients with the cost of outcomes. These costs may reflect the practice fee-for-service schedule or one that reflects dental insurance coverage. The patient can then make their choice of a particular service based on financial concerns.

Decision Analysis

The objective of the decision analysis is to optimize a clinical decision. Analysis of the data is done by multiplying decision and utility data in offering the patient a quantified and qualified choice of which treatment they would prefer based on a given probability of a desirable outcome. By multiplying decision and cost data, the patient may determine the economic choice difference between outcomes. The result of the analysis of each type of data is to determine the expected utility between options and their expected costs. By comparing the two results, the patient can determine the best option.

Sensitivity Analysis

A sensitivity analysis determines which components have the greatest impact on the clinical decision, for example, utility or cost. The analysis may be done to determine the effects of changes in one of the components or two or more of the components.

Summary

Providing best evidence for shared decision-making in the patient-dentist relationship is the responsibility of the translational researcher. The translational researcher organizes, administers, and implements a process (termed here the translational evidence-based dentistry engine) that turns best evidence into a clinical practice guideline for use in dental practice. The process provides decision, utility, and cost data in offering treatment or service options that the dentist and patient may mutually come to an agreement on in maximizing, or optimizing, a clinical decision. An additional benefit may incorporate private practice as a community research unit in advancing oral health care research. CDA

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