

Incorporating Principles and Methods of Evidence-Based Practice into Statistical Teaching

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Abstract

The principles and methods of evidence-based clinical practice assist physicians, dentists, and other health professionals in interpreting the scientific literature, and ultimately in applying relevant research findings to patient care. We illustrate the integration of evidence-based approaches into a year-long sequence in statistical methods and research design targeting dental residents, emphasizing critical appraisal of the literature. Components of this approach include instruction in meta-analysis, and use of a series of templates providing a framework for evaluation of research studies. The latter are used by students in assessing self-selected papers in areas such as therapy, diagnosis, etiology and prognosis. Similar approaches are used to construct guided evaluations of papers representing applications of modeling techniques such as logistic regression, multiple regression and survival analysis. Finally, review articles from journals of evidence-based practice are chosen to focus on specific statistical issues, such as multicollinearity. Examples of self-study materials and instructions developed for guided critique of the literature will be given.

Key Words: Evidence-based practice, statistical education, design, literature review, dentistry, health sciences

1. Introduction

Health professionals must continually strive to keep current with advances in their respective fields, and to maintain state-of-the art clinical skills and knowledge. The achievement of these important goals is complicated by the information explosion, and, some feel, by the changing nature of the relationship between patient and clinician, particularly as influenced by the consumer movement. The ability to evaluate information about new procedures, tests, materials and products is key to this endeavor and central to evidence-based practice.

Evidence-based practice (EBP) has been defined as “the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients” (Sacket et al, 1996). It is typically characterized as resting upon three domains: the best available scientific evidence, clinical skill and judgment, and the needs and preferences of the individual patient. Further, it has been suggested that one of its most valuable applications is to encourage the clinical practitioner to seek out evidence, to interpret it, and to evaluate it so that such evidence may be applied to everyday practice

(Richards and Lawrence, 1995). But to do this successfully, clinicians need appropriate skills. In the area of dental practice, Sutherland (2001a) noted that there are multiple barriers to implementing EBP methods, among them skill deficits in areas such as executing efficient electronic searches for information, formulating clear questions and evaluating the literature. The latter two, at least, represent skill sets often addressed in biostatistics courses in the health sciences.

Typically, one of the key goals in teaching biostatistics to health sciences professionals is to assist them in becoming discriminating readers of the scientific literature. It is our contention – and experience – that application of EBP principles can serve as a persuasive means of sparking motivation in health sciences students.

2. Approach: Biostatistical Education and Evidence-Based Practice as Part of Dental Professional Training

2.1 Curricular Strategies for Graduate Students and Residents

The focus in this discussion is a sequence of two formal courses addressing biostatistical analysis and research design. The first is an introductory biostatistics course, typically taken by residents (dental specialty students) and graduate students in oral sciences in their first semester of the graduate program. The second, which follows in the spring semester, focuses on research design and emphasizes study planning, grantsmanship, and review of the literature. Each program also integrates principles of evidence-based dentistry into their specific didactic courses, literature reviews, and seminars.

2.1.1 The Introductory Course in Biostatistics

Although this course does not specifically showcase the principles and methods of EBP, it does lay an important foundation for later consideration. The course syllabus is typical of many such introductory courses, addressing basic methods through one-way ANOVA and simple linear regression, but also includes introductions to more advanced techniques, emphasizing concept rather than implementation in considerations of survival analysis and multivariable modeling. Central to laying the proper foundation is the inculcation of sound principles of design, and an emphasis on the importance of integration of design and statistical analysis at the planning phase. Other topics particularly relevant to EBP are those related to power and sample size, and considerations such as the appropriate choice of controls. Articles from the *Journal of Evidence-Based Dental Practice*, which include a summary of a scientific publication and accompanying critique, are used in conjunction with the original articles to both illustrate specific statistical topics and to introduce EBP principles.

2.1.2 Integration of Statistical Methods and EBP into a Research Design Course

The research design course has been structured not only to address design issues, but to pair them with exposition of more advanced statistical techniques, including modeling techniques. This course, also taught in the context of oral health research, begins with a formal didactic unit on evidence-based dentistry which exposes the students to the principles of EBP. This segment relies heavily on a six-part series of articles on evidence based dentistry by Sutherland (2001b-2001g), which describes evidence-based practice in dentistry, and outlines the process of constructing a clinical question, and procedures for finding, evaluating and applying evidence. As part of the exposition of concepts and tools for clinical appraisal, specific templates for evaluation of articles are provided. The

course makes use of these in literature-review activities, using articles selected by the students. The Sutherland templates provide a framework for evaluation of research studies, and guide the students through assessment of their self-selected papers in areas such as therapy, diagnosis, etiology and prognosis. Small groups of students, usually corresponding to specialty program, then present and discuss their articles and critiques to the class as a whole. To illustrate: if the articles under assessment are related to therapy, the corresponding Sutherland (2001f) article discusses the status of randomized controlled trials as providing a high level of evidence, and instructs the student to assess such elements as random allocation, handling of loss to follow-up in presentation and analysis, and adequacy of blinding/masking of treatment, as well as clinical relevance. We have found it helpful to require approval of these selections by the instructors to avoid confusion in clinician-students who are relatively new to research.

Another formal component is used with assigned articles for review that are selected by the instructor. Using analogous templates developed by the instructor (DVD), the students are guided through their assessments of papers representing applications of modeling techniques such as multiple regression, logistic regression, and survival analysis. Questions for student consideration are designed to assess with evaluation of the conduct of the research, the data analysis and interpretation, and the quality of the evidence. For example, the report of Fisher and colleagues (2006) is used as a vehicle for considering the comparison of crude and adjusted odds ratios, as well as their interpretation, the validity of interpreting the odds ratio as a relative risk in this context, and exploration of approaches to modeling risk factors such as tobacco use and their implications. Other discussion points address the appropriateness of the number of predictors entertained and the generalizability of results.

In other instances, original articles paired with their corresponding review articles from the *Journal of Evidence-Based Dental Practice* are chosen to focus on specific statistical issues, such as multicollinearity (Binkley et al, 2009; Dawson, 2010). A unit on meta-analysis is also an important EBP-centered component of the research design course.

2.1.2 Resources

As previously outlined, review articles from journals of evidence-based practice can be used as a source of illustration of both EBP concepts and statistical issues. Another useful resource may be found in the considerable body of systematic reviews and meta-analyses found in the scientific literature. Systematic reviews are often considered a preferred method for assembling the best available scientific evidence. With or without a meta-analytic component, they represent a common focus of seminars, journal clubs, and review courses. In dentistry, practitioners, faculty and students may utilize a database of systematic reviews, critical summaries of systematic reviews, and clinical recommendations and guidelines developed or endorsed by the Council on Scientific Affairs of the American Dental Association (ADA) and the ADA Center for Evidence-Based Dentistry. These can be accessed via the ADA website: <http://ebd.ada.org/about.aspx>. Other materials relevant to evidence-based dentistry, including glossaries and tutorials, are also available through this site. For those interested in meta-analysis, the Cochrane Collaboration has provided a vast resource, including open learning materials. The first version (Version 1.1), edited by Alderson and Green (2002), and found at <http://www.cochrane-net.org/openlearning/>, is particularly useful to those new to the topic. more recent and greatly expanded version of the Cochrane Handbook for Systematic Reviews of Interventions (Higgins and Green, Version 5.1.0, updated March 2011) may be accessed online at <http://www.cochrane-handbook.org/>;

additional links to other resources, including Spanish language versions, a handbook for systematic reviews of diagnostic test accuracy, summaries, glossaries, and various updates are found at: <http://www.cochrane.org/training/cochrane-handbook>.

1. Discussion

It is worth noting that these approaches have been carried out in an environment that is particularly supportive and enthusiastic with respect to evidence based dentistry, support of research at the student level, and inclusion of biostatistics as part of the graduate professional curriculum. At the predoctoral level (students pursuing the DDS degree), there is an emphasis on problem-based learning and development of critical thinking skills in the curriculum. All residency and graduate programs based in the dental science building include the introductory biostatistics course as part of their curricular requirements, and many also mandate the course in research design. Master's programs, including those associated with clinical specialty training, require research-based theses, and most specialty programs require a research component, typically a more modest research project. In addition, many of the faculty have considerable interest in evidence-based methods, and programs aimed at faculty development have included discussion and training in evidence-based methods, including meta-analysis. All of these factors support the incorporation of evidence-based themes in formal teaching which have been described here.

In summary, we believe that evidence-based concepts are important for clinicians, a view that is supported by the institutional environment. In teaching, we find that the use of EBP concepts and methods assists with illustration and critique of both research design and statistical analysis elements. There are ample materials available, and the approaches appear to be well-received and motivating. Finally, we make the observation that statisticians can make a considerable contribution to such training efforts, and they should not be confined to trainees! Elucidation of these concepts and methods to faculty can certainly be expected to have salutary effects on clinical practice within the institution and beyond, but should also foster the type of institutional milieu that we have found so beneficial.

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