Evidence-based Teaching and Learning in a Post-Graduate Dental Education Program

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ABSTRACT
This article discusses evidence-based teaching and learning, and implementing change in a one-year general practice residency program. The paper is presented in 3 sections: Part I will focus on evidence-based (EB) dentistry among the 8 dental residents at Illinois Masonic Medical Center (IMMC); Part II will deal with the literature on EB change in the workplace, educational interventions, and the effects of EB teaching; Part III will examine the process of implementing EB change in the dental residency program at IMMC.

The dental residents at IMMC are generally unfamiliar with EB terminology, find EB skills difficult to master, and have identified a lack of quality evidence in dentistry. The literature is rich on implementation of EB changes in the workplace and educational interventions that are effective. However, there is little quality evidence that the teaching of EB skills, especially critical appraisal, changes practitioner behavior or improves treatment outcomes. Change implementation is possible with careful planning and preparation. The effects of these findings on the future of EB healthcare are addressed.

PART I: EVIDENCE-BASED DENTISTRY AT IMM C

Introduction
An evidence-based (EB) approach to clinical medicine was first described in the literature in the early nineties. Evidence-based practice (EBP) is defined as the integration of research evidence with clinical expertise and patient values, and dentistry is just beginning to embrace EB concepts and principles. Whether EBP can become part of the fabric of dental practice is a multi-faceted question, because there are many political, social, economic, and technological factors and barriers associated with its acceptance.

Because EBP encompasses teaching, research, and clinical practice, its success depends on ensuring that newly trained practitioners are educated in its principles. Currently, US dental school curricula contain some elements of EBP, but the Commission on Dental Accreditation of the American Dental Association does not mandate teaching EB principles.

General practice residency programs, also accredited by the American Dental Association, require dental residents to critically review the literature but do not mandate other requirements for dissemination of EB knowledge. The dental residency program at IMMC has a journal club, which has switched in recent years from emphasizing the scientific method to an EB approach as recommended by Sackett. That is, in lieu of a small research project on a dental topic, residents now do two EB projects, which include identification of a clinical question or problem, search for evidence, critical appraisal, and application of evidence into practice.

Evidence-based Terminology
The dental residents at IMMC are generally unfamiliar with EB terms. To comply with accreditation standards, pre/post testing is employed for all didactic sessions as a method of outcomes assessment. Based on pretest results, no resident has correctly defined such research designs as cohort, cross-sectional, or case-control studies since the test’s inception in July 2001. Some residents could define features of a randomized clinical trial, but none could identify any steps in the EB process used to answer clinical questions or problems or define such EB terms as PICO format, critical appraisal, or number needed to treat. Residents are generally unaware of the hierarchy of evidence or the appropriateness of various research
designs. Our dental residents have required approximately 6 hours of didactic sessions to become comfortable using EB terminology.

Evidence-based Skills

Evidence-based skills have generally been difficult for the dental residents. Pre/post testing has shown that residents are unfamiliar with PICO formatting of clinical questions and often have difficulty with question formulation for their EB projects. An action research project (to be described later) showed that although residents generally felt positive about EBP, they found search for evidence and critical appraisal to be skills that were difficult to master.

Our findings on EB skills and terminology seem to mimic results of published studies. Iqbal and Glenny used a survey to assess attitudes and knowledge of EBP among 300 general dentists in the northwest of England. 81% of respondents were interested in finding out more about EB, but only 29% of respondents could define evidence-based practice correctly, and 72% were unaware of the Cochrane Collaboration. Interestingly, nearly half of the dentists surveyed could define a systematic review correctly. Other authors have observed barriers to EBP as including the difficulty of searching for and critical appraisal of research evidence.

Our action research also revealed a general lack of teaching of EB concepts in dental school. Because evidence-based dentistry (EBD) incorporates a new set of definitions and skills, the effectiveness of its implementation in residency training is hampered by the limited teaching of EB principles in the undergraduate curriculum. Research evidence validates the importance of EB teaching at the undergraduate level. A recent review found that teaching critical appraisal skills to medical students resulted in a 17% increase in knowledge of clinical epidemiology, as compared with a 1.3% gain among medical residents.

Scientific Evidence in Dentistry

A lack of quality evidence in dentistry has been identified by IMMC dental resident’s EB projects and by action research involving both the IMMC dental faculty and residents. Niederman found very few meta-analyses in the dental literature as compared with 8 medical specialties. Bader and Shugars have identified few randomized controlled trials or outcomes studies in dentistry and concluded that high quality evidence in dentistry is badly needed and should be supplied by the research community in the future. Others have also identified a shortage of consistent, coherent scientific (medical) evidence as a barrier to EBP.

Residents and Clinical Decision-Making Skills

Dental residents tend to be very treatment oriented, and are generally skilled at rendering most types of dental treatment. This may be because of both the nature of undergraduate dental education and dentistry as a surgical discipline. Dental schools have traditionally based fulfillment of graduation requirements on performing a certain number and type of clinical procedures. Thus, dental students monitor their clinical progress on rendered treatment as opposed to diagnostic, treatment planning, or prognostic proficiency. Secondly, dentistry, as compared with other medical disciplines, is generally considered to be a surgical subspecialty in that most diseases are treated by surgical manipulation of diseased tissue. Like other surgical fields, dentistry is essentially a discipline where technical abilities are highly valued, as opposed to primary care medicine, where emphasis tends to be placed on diagnostic skills.

Regarding diagnosis, treatment planning, and assessing disease susceptibility, dental residents tend to fare poorly. This seems to be because of a rather linear approach to clinical decision making. In lieu of establishing a diagnosis, dental residents typically identify a presenting dental condition as needing a specific treatment to achieve or avoid a certain outcome. For example, residents generally view impacted wisdom teeth as requiring extraction to avoid future pathologic development, or missing teeth as needing replacement to avoid arch collapse in spite of evidence to the contrary.

This linear, or cookbook, approach to dental treatment could lead to successful outcomes, but it raises the question of overtreatment. EB skills may help to reach more appropriate clinical decisions by incorporating a more cyclical pattern of research evidence, clinical
expertise, and patient values, as suggested by Sackett (Fig 2).

IMMC dental residents are taught that the decision to intervene is critical and should be the third step in a 4-step process (Fig 3). Residents are encouraged to attempt to establish a diagnosis first, before decisions are reached regarding intervention. If a diagnosis is reached, the resident may elect to intervene depending on the EB pattern of decision making illustrated in Figure 2. If no diagnosis is established, residents may or may not recommend treatment based on these same principles. By delaying decisions on intervention, residents are taught to emphasize a diagnostic phase, which helps with familiarization of various pathologic conditions in dentistry. Residents are also encouraged to consider the long-term outcomes with or without intervention. What are the outcomes of not replacing missing teeth or not extracting wisdom teeth? In-depth discussions of this type tend to heighten the value of treatment decisions. This differs somewhat from Bader and Shugars’ 3-step model of clinical decision making in which decisions to intervene immediately follow the initial assessment phase.

### Summary of Evidence-based Practice at IMMC

The IMMC dental residents are typically unfamiliar with EB terms, find EB skills difficult to master, and have identified a lack of quality evidence in dentistry. Residents’ decision-making skills tend to be linear in nature, as opposed to incorporating research evidence, clinical expertise, and patient values, as suggested by Sackett.

### PART II: OVERVIEW OF CHANGE MANAGEMENT AND EDUCATIONAL INTERVENTIONS

#### Change Management

Change management is a complex topic and there are no simple answers to bring about effective healthcare change. There are many theories on how to best accomplish change, but no universal agreement. Some of these changes are based more on beliefs than on valid research evidence, but most agree a combination of different interventions is most effective.

There are a multitude of factors influencing EB change in the workplace. The EBM Working Group found a lack of time for and faculty skill in critical appraisal, along with faculty skepticism of EB and a lack of high quality evidence, as major barriers to EB. Organizational or participant orientation and resistance to change can also be formidable barriers. One of the first steps before change is to be initiated is a literature review, expert input, and an analysis of the organization in which change is to occur. Change may be impossible if it conflicts with individual or organizational beliefs. Once this analysis is complete, involvement of the participants in the project is crucial. When the elements to elicit change have been identified, a strategic plan must be implemented, because certain vehicles for change may be ineffective. One must be flexible and alter the plan if necessary, based on research findings. Finally, evaluation and monitoring of change throughout the process is essential for effective change.

On the basis of the evidence on curricular change, evaluation drives curricular development and needs to be done early with a variety of assessment tools. Faculty members are key team members and need to be involved early in curricular change. Leaders need to define a vision of change, and change should be circular rather than hierarchical, empowering others. That is, consensus building and teamwork is needed for effective change. Change requires good evidence, context, and facilitation and, if not monitored and evaluated throughout, is likely to fail.

#### Learning Theories

There are several theories on learning:

1. Behavioral – student is passive recipient of knowledge, (ie, “empty vessel” to be filled with knowledge); transmission of known facts by the “dominant” teacher; this is how children learn (pedagogy)
2. Cognitive – the mind has cognitive faculties that can be developed over time
3. Experiential – based on one’s experiences; learning by doing
   a. Lewinian model – concrete experiences lead to observation and reflection, forming abstract concepts, then testing these concepts in new settings
   b. Dewey’s model – a more explicit transformation of impulses and feelings of experiences into action

EBP has generally embraced experiential learning, which is most like adult learning (andragogy), because adult learning typically encompasses internal
motivation, learning what is not known (as opposed to facts), and learning by doing. Experiential learning also has inherent EB concepts such as decreased emphasis on expert opinion, teacher as facilitator, and accepting a higher level of uncertainty. However, EBP requires learning of research design and definition of terms, which encompasses behavioral and cognitive skills as well.

Types of Knowledge
Eraut described explicit and tacit knowledge, the former obtained from facts and the latter gained from one’s observations and experiences. Sackett described background and foreground knowledge. Background knowledge is composed of the basic sciences and general facts in our profession, whereas foreground knowledge is patient oriented and gained from clinical experience, which continues to develop throughout one’s career.

Summary of Learning Theory and Types of Knowledge
Dental students are taught basic sciences in their first 2 years, which is pedagogical in nature (ie, the transmission of known facts). This continues in the clinic where instructors are dominant and render opinions to the “submissive” student. Confusion may arise as instructors’ comments may be scientific or anecdotal in nature, with little ability to discriminate which is which. With dental residents, faculty act more as facilitators rather than dispensers of knowledge, and this andragogical approach is difficult because residents want and are used to being “spoon fed” factual information.

Thus, though their educational career has essentially been a behavioral/pedagogical approach, dental residents at IMMC are taught in a more experiential/andragogical method by being asked open-ended foreground questions. Residents frequently express their discomfort with this teaching style, because they must be self-motivated and face clinical uncertainty. As EBD is taught in this method, this represents yet another barrier to its implementation.

Educational Interventions
From the education literature, much has been written about educational interventions and their effectiveness on changing practitioner’s behavior. These interventions have generally been categorized as being either minimally, moderately, or highly effective. Multifaceted interventions such as audit and feedback and interactive educational meetings are more effective than passive dissemination of information, lecture, or guidelines. Davis et al also found that continuing medical educational activities such as small group work and practice-based interventions were more effective than lectures or passive diffusion.

Lomas has proposed 3 theories to promote change in healthcare:
1. Passive Diffusion Model – this states that as health professionals hear or read about research evidence, they will adopt it into practice. This model has now been widely discredited because it takes more than published material or guidelines for science transfer to occur.
2. Active Diffusion Model - this refers to the compilation of quality evidence by experts such as the Cochrane Collaboration, ACP Journal Club, and EB journals. This model has been researched and is moderately effective.
3. Coordinated Implementation Model – this model refers to healthcare professionals becoming involved with public policy makers, professional associations, and community interest groups in an effort to collaborate with others to form a consensus involving all stakeholders. This method appears to be essential in promoting lasting change when it includes the active diffusion model.

The Cochrane Effective Practice and Organization of Care Group have done several systematic reviews in this area. These reviews have also concluded that continuing education lectures and printed educational materials are generally ineffective at changing the behavior of health professionals. They have found that audit and feedback, the summary of clinical performance over time, is moderately effective, and interactive meetings and workshops (problem-based learning) are highly effective. These results tend to resonate with what is known about adult learning. That is, adults learn via a cycle of learning and doing and by solving problems by drawing on existing knowledge and prior experiences in a non-threatening, non-hierarchical environment. Thus, the standard continuing education lecture, being non-interactive and pedagogical in nature, has generally not been shown to change practitioner’s behavior.

On the basis of the education literature, residency programs should be successful in implementing effective educational interventions, because they typically involve small, interactive groups as the environment for learning.

Teaching Evidence-based Skills
There is a substantial body of literature on the effectiveness of teaching EB skills on practitioner behavior and treatment outcomes. Much of the literature focuses on critical appraisal at the expense of other EB skills.
such as question formulation and searching. Sackett and Parkes\textsuperscript{29} concluded that the teaching of critical appraisal has not been well studied and that other methods of teaching evidence-based medicine (EBM) should be explored to find those that are most effective.

A systematic review of critical appraisal, clinical epidemiology, and EBM revealed few studies, which adequately evaluated their curricula.\textsuperscript{30} This study found that most programs had “free-standing” journal clubs that did little to integrate EBM with clinical care, and many journal clubs chose recent or landmark papers, which did not have current clinical relevance. Positive reports from this study include the curriculum evaluation, which used pre and post testing and control groups linking the improvement to the intervention.

Parkes et al\textsuperscript{31} completed a Cochrane review to assess the effects of teaching critical appraisal skills to health professionals. Interestingly, only one study\textsuperscript{32} met the inclusion criteria, and only critical appraisal was measured. The authors concluded that major gaps in evidence exist as to whether teaching critical appraisal has an effect on decision-making or treatment outcomes.

Hatala and Guyatt,\textsuperscript{33} pointed out some interesting observations as to why such poor evidence exists for the teaching of EBM. Quantitative research may not be adequate for studying educational outcomes, because students and residents change frequently, making observational study difficult. Sample sizes are generally small, and reported outcomes are too subjective such as self-reported changes as opposed to improved skills or patient outcomes. That only critical appraisal is typically evaluated adds to the limitations on teaching EB skills. An increase in qualitative research may be helpful in this area.

**PART III: IMPLEMENTING EVIDENCE-BASED CHANGE AT IMMC**

**Action Research with Dental Residents**

Action research is a type of qualitative research that typically involves the participants in an effort to implement change. A confidential questionnaire was sent to our 8 dental residents regarding their attitudes and knowledge of EBP. With input from faculty, it was felt that a confidential questionnaire was the most appropriate method of assessing each resident’s attitude toward EBD. We had discussed both formal and semi-structured interviews as well as group discussions, but felt that residents may not feel comfortable in an atmosphere that fostered complete candor with their answers. Input was obtained from our research coordinator and our department chair, and the questionnaire was pilot-tested on several of the family practice (medical) residents as to content, clarity, and appropriateness. Before distribution of the questionnaire, action research was explained to the residents, asking for their confidential attitudes toward EBD. They were instructed to answer as honestly and thoughtfully as possible. The questionnaire was e-mailed to and back from all 8 residents (100% response), with only randomly assigned number (1 - 8) at the top, ensuring confidentiality.

Results of the action research revealed that residents generally felt positive about EBD and would like to improve their knowledge in this area. When asked about the current best evidence on bounded edentulous spaces, 4 of the residents had a general understanding of the evidence, 2 did not know, and 2 stated answers that contradicted the current best evidence on this topic. The residents were extremely varied in their perception of how frequently they incorporated best evidence into their clinical practice, and some felt frustrated because of a lack of quality evidence. Comments included, “Sometimes the research available for a certain subject may be controversial or very limited, so it is up to the practitioner to use his/her own knowledge and expertise to decide on right treatment...,” and, “I only want to perform treatment on patients because valid research has shown this treatment to be beneficial, rather than on what another dentist has told me....” Yet another resident countered with, “...having sound research on which to base decisions is important...but I think strict adherence to evidence based dentistry may hinder growth and stymie dentistry’s creativity...I applaud those individuals in their effort to embrace new approaches”.

Generally, residents felt EBD was important and relevant and wanted to base their practice on current evidence, but felt frustrated by the lack of evidence. Other perceived barriers of EBD included lack of time, difficulty of searching and critical appraisal, lack of faculty participation, and lack of EB skills in dental school.

**Action Research with the Dental Faculty**

A confidential questionnaire regarding knowledge and attitudes toward EBD was also sent to the 25 dental faculty at IMMC, and 70% of the surveys were completed and returned. Faculty generally felt positive about EBD; comments included, “fantastic,” and, “very promising,” and another wrote, “nice idea, but dental research generally bad”. Ninety-two percent of faculty could adequately define evidence-based practice, and 58% could define such EB terms as Boolean operators or numbers needed to treat. Yet only 30% of the faculty were aware of the current evidence on
bounded edentulous spaces. Faculty generally felt positive about EBD, and most felt teaching of EB principles was important. However, most faculty members were hesitant about attending journal club, and many were concerned about the lack of quality evidence in dentistry.

**Planning for Change**

The change process has now begun as the dental residents and faculty have completed a survey on EBD, and information on attitudes and knowledge of EBD has been obtained. Overall, faculty were able to define EBD and seemed receptive to the idea of its incorporation into the residency program yet were less inclined to attend journal club. They seemed tentative regarding ways to improve EB skills. Faculty development can be frustrating because it is difficult to get faculty members to give up their time, and they typically may not feel rewarded for these activities. This again raises the issue of problems with faculty development. That is, how difficult will it be to facilitate change with the faculty? What forum should be used? The answers come from the literature on education. Small interactive group work with consensus building will be more effective than hierarchical management decisions or dissemination of guidelines on EBD. Change, in the form of faculty development, has begun, but it is anticipated that this process will be structured, slow moving, and egalitarian.

The project will continue with small group work to engage faculty leaders called section heads. The plan is to develop a consensus among these section heads (opinion leaders) in an effort to have them take ownership of EB principles and help with program development in EB teaching. By moving away from a hierarchical structure, section heads can influence other faculty to begin incorporating EB principles.

**CONCLUSION**

Although their knowledge of EBD is quite variable, the IMMC dental residents and faculty generally feel positive about the incorporation of EB teaching and learning into the residency program. This phenomenon is not to be discounted, because the establishment of a positive environment is necessary for effective change to occur. Both groups have identified the lack of quality evidence in dentistry as a barrier to implementation of EB principles, although the growing number of Cochrane systematic reviews should help to alleviate this problem. The residents are generally unfamiliar with EB terms and find EB skills, especially searching and critical appraisal, difficult to master. The incorporation of EB teaching in the undergraduate dental curriculum appears to be necessary to facilitate understanding of these difficult concepts.

The literature is rich on change management and advocates a vision for change, performing an organizational analysis and involving all stakeholders early in the change process. Change should be non-hierarchical and involve consensus building among the participants to take ownership of the process. Continuing education lectures and passive distribution of guidelines are relatively ineffective in changing behavior of health professionals. Small group work and interactive workshops are highly effective in promoting lasting change. However, at this time there is little quality evidence that the teaching of EB skills, especially critical appraisal, either changes practitioner behavior or improves outcomes of therapy.

Based on these concepts, it becomes understandable that changing from a traditional health care system to an EB system may take a generation to accomplish. Are we really not contemplating changing an entire educational system leading to a change in a healthcare delivery system, with all of its political and social complexities? We currently have a positive environment for EB change and know the effectiveness of various educational interventions. However, with the difficulty and complexity of EB skills, the lack of quality evidence in dentistry, and a paucity of evidence for the effectiveness of EB teaching, there currently exist formidable barriers for this transformation to occur. Expecting sweeping changes in our educational system with these deficiencies appears to be premature. If EB change is to occur, evidence for its effectiveness must precede this transformation.

**REFERENCES**


17. The Cochrane Library Issue, 1, 2003, Cochrane Effective Practice and Organisation of Care Group, Abstracts of Chochrane Reviews. 1-3 http://www.cochrane.org/cochrane/revabstr/g100index.htm


34. Rubeck RF, Witzker DB. Faculty development: a field of dreams. academic medicine 1998;73(9):S32-S37.