# Treatment Plan for Integrating Evidence-Based Decision Making into Dental Education

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The aims of this paper are to present the findings from the scientific literature that discuss strategies that can contribute to a "best practices" treatment plan model for effectively integrating Evidence-Based Decision Making (EBDM) into curricula. MEDLINE, CINAHL, and HealthSTAR databases were searched, as was the Cochrane Database of Systematic Reviews. Studies and articles, ranging from systematic reviews to articles proposing models and recommendations for how to implement EBDM into curricula and faculty development were reviewed. Several common themes emerged and form the basis for a treatment plan model.

The first step in developing any treatment plan is a thorough assessment of the current situation or problem. Recognizing that there are multiple phases to the assessment of an educational system, the focus of this paper will be to understand which teaching and learning strategies are most effective. These, in turn, will inform faculty of needed curricular changes and skill development training, requisites in order for them to prepare students to be successful in providing patient care using the best available evidence. Elements of a suggested treatment plan will be presented with the caveat that each dental school will need to develop an implementation plan based on an assessment of its own environment and needs.

## INTRODUCTION

Preparing students as critical thinkers and lifelong learners are 2 challenges faced by educators. Recently, some dental schools have embraced the use of such active teaching-learning techniques as problem-based or case-based learning. Theoretically, when based on actual patient encounters, these approaches facilitate a better understanding of the science supporting patient care decisions and the development of the skills required for graduates to become lifelong learners. These skills also parallel those of evidence-based practice by teaching students to find, evaluate, and incorporate current evidence into their clinical decision making, thus closing the gap between what is known (research) and what is practiced.

Support for evidence-based dentistry (EBD) can now be found within the American Dental Association (ADA) Accreditation Standards for dental education. The standards broadly describe the competencies for general dentistry, expect each school to develop specific competency definitions and assessment methods, and specifically state that, "These competencies must be reflective of an evidence-based definition of general dentistry."[1(p. 6,7)] In addition to the ADA, the American Dental Education Association's Competencies for the New Dentist identifies general skills that reflect an evidence-based approach.[2] These include being able to continuously analyze the outcomes of patient treatment to improve that treatment, evaluate scientific literature and other sources of information to make decisions about dental treatment, and manage oral health based on an application of scientific principles. The clear intent of the accreditation standards and competencies contained within these documents is the focus on the importance of comprehensive patient--centered care and the need for adding evidence-based decision making to the traditional experienced-based approach.

## EVIDENCE-BASED DECISION MAKING

Using evidence from the medical literature to answer questions, direct clinical action and guide practice was pioneered at McMaster University in the 1980s. As clinical

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research and the publication of findings increased, so did the need to use the medical literature to guide practice. This new methodology was termed Evidence-Based Medicine (EBM)[3] and is defined as "the integration of the best research evidence with clinical expertise and patient values."[4]

The use of evidence in practice is not new. What is new is the nature of the clinical evidence itself in terms of the methods for gathering it (randomized controlled trials and other well-designed methods), the statistical tools for synthesizing and analyzing it (systematic reviews and meta-analysis), and ways for accessing (electronic databases) and applying it (evidence-based decision-making and practice guidelines).[5,6]

Along with these changes has evolved the understanding of what constitutes the evidence and how to minimize sources of bias,[7] as well as the realization that the evidence from clinical research is only one key component of the decision-making process and does not tell a practitioner what to do.[8] In other words, the use of current best evidence does not replace clinical expertise or input from the patient, but rather provides another dimension to the decision-making process[9-11] that is also placed in context with the patient's clinical circumstances. It is this decision-making process that we refer to as Evidence-Based Decision Making (EBDM).

As a result of these advances, EBDM requires that students and faculty have an understanding of new concepts and develop new skills, such as asking good clinical questions, conducting an efficient computerized search, critically appraising the evidence, applying the results in clinical practice, and evaluating the outcomes. Translating these requirements into action requires the ability to[4]:

1. Convert information needs/problems into clinical questions so that they can be answered
2. Conduct a computerized search with maximum efficiency for finding the best external evidence with which to answer the question
3. Critically appraise the evidence for its validity and usefulness (clinical applicability)
4. Apply the results of the appraisal, or evidence, in clinical practice
5. Evaluate the process, your performance, and outcomes of care

The question then arises as to how to best teach evidence-based theory and skills so that it becomes the norm for practice. Commentaries on EBDM curricula, however, cite the lack of good evidence to support its effectiveness in changing long-term behaviors that ultimately benefit patient outcomes.[12,13] Several reasons mentioned include the limitations in educational research and lack of valid outcome measures, brief time allotted for a given intervention, small sample sizes, and evaluation of subjective variables such as self-reported attitudes and knowledge, rather than clinical skills or improved patient outcomes. In addition, most of the research has focused on critical appraisal skills instead of all aspects of the EB process.[12,13] On the other hand, difficulty in measuring patient outcomes is acknowledged as complex due to the many variables that can affect it. Consequently, suggested methodologies for assessing optimal educational approaches include both quantitative and qualitative approaches that are well designed and rigorous, ie, when possible, randomize participants into experimental and control groups, and use valid measures of important outcomes.[12]

## IMPLEMENTING EVIDENCE-BASED DECISION MAKING INTO CURRICULA

Findings from systematic reviews (SRs), randomized controlled trials (RCTs), and qualitative studies that addressed both predoctoral and postgraduate medical and dental education were reviewed. In addition, peer-reviewed articles proposing models and recommendations for how to implement EBDM into education and practice provided insight into the overall development of a treatment plan. The following sections highlight the questions investigated and the findings from these sources.

### What outcomes are affected by teaching EBM?

The objective of the SR titled "What is the evidence that postgraduate teaching in EBM changes anything? A systematic review," by Coomarasamy and Khan[14] evaluated the effects of standalone versus clinically integrated teaching in EBM. Outcomes of interest were knowledge, critical appraisal skills, attitudes, behaviors, and patients' health, although none of the studies evaluated this last outcome. Their search resulted in the selection of 23 studies: 4 RCTs and 19 nonrandomized studies (7 controlled studies and 12 pre- and postcomparison studies). Of the 23 studies, 18, including 2 RCTs, evaluated standalone teaching, which consisted of such methods as workshops, seminars, and journal clubs alone or in various combinations. The remaining 5 studies, including 2 RCTs, evaluated clinically integrated teaching and included methods focused on teaching EB skills in real-time clinical ward rounds, or basing them on encounters with patients.

Results from this SR indicated that of the 17 studies that assessed knowledge, improvements were found using both teaching methods.[14] Regarding improvements in critical appraisal skills, the evidence from 1 RCT and 6 nonrandomized studies in the standalone group was weak, whereas the evidence from 1 RCT and 1 nonrandomized study using the clinically integrated approach was good. Of the 6 studies that assessed change in attitude, no change was found in the 3 standalone teaching group studies, whereas all 3 clinically integrated teaching group studies found an improvement in attitudes. Finally, 14 studies assessed behavioral change. Of these, 2 RCTs in the standalone group did not find a change in behavior, nor did 4 of the 7 nonrandomized studies. For the clinically integrated group, 2 RCTs found improvements in behavior as did all 3 nonrandomized studies. Behavior changes were related to reading habits[15] and choice of

information resources,[16] and in patient management[17,18] and guidelines.[18]

As previously mentioned, none of the studies evaluated health outcomes, however the authors note that with changes in behavior, there is potential for change in health outcome. Also, acknowledged was that translating behavior into better patient care is not necessarily linear and that EBM is only one factor that may influence health outcomes.[14]

In summary, findings from this SR reinforce the need to integrate evidence-based decision making into routine clinical practice to affect positive changes in knowledge, critical appraisal skills, attitudes, and behavior, which ultimately may benefit patient care. Teaching should take place in "real time" versus in a standalone course so that both EB skills and application of the best available evidence are used in direct patient care building upon what might have been taught in a classroom case or simulation.[19]

## What is an effective methodology for establishing EBDM as the norm for clinical practice?

The objective of a second SR, "Implementing Evidence--Based Practice in Undergraduate Teaching Clinics: A Systematic Review and Recommendations,"[20] was to identify effective strategies for promoting and implementing EB clinical practice in undergraduate dental education.[21] Twelve studies met the inclusion criteria, including 9 original research studies and 3 SRs. Of the 9 original research studies, only 3 examined the application of EB skills in real-time patient situations. The first study evaluated a focused educational intervention on the use of MEDLINE and critical appraisal skills in undergraduate medical education.[22] During a 4-week course, students developed and applied EB skills, eg, formulating focused clinical questions from patient care problems encountered in their clinical rotation, conducting an efficient MEDLINE search, critically appraising retrieved articles, and applying the evidence to the patient problem.

Pre- and postassessments were conducted of students' reading/library behaviors, skills, and attitudes on issues relating to EBDM. Significant differences were found between intervention and control groups in self-assessed MEDLINE and critical appraisal skills ($P < .002$ and $P < .0002$, respectively).[22] Although skills retrieving journal articles were not statistically significant, the tendency to use original research articles to answer patient care questions was statistically higher in the intervention group ($P < .0008$). Success of the course was credited to the active involvement of faculty and students, the clinical relevance of learning exercises, and the integration of all EBDM skills into clinical practice.[22]

The goals of a second original study, "An evidence-based physical diagnosis curriculum for third-year internal medicine clerks."[23] were to improve knowledge, skills, and confidence in physical diagnosis as well as reinforce EB concepts by applying them to physical diagnosis. Small groups of students and a preceptor met for weekly rounds on evidence-based physical diagnosis. One student was assigned the responsibility of leading the group discussion and identifying a patient with the related abnormality to examine. Knowledge about physical diagnosis increased significantly when rounds required an EB approach in comparison to traditional authoritative practices.[21] Reasons for success of this curriculum were similar to those in other studies in that active learning strategies were used and there was continuity between theory and application to patient care.

Finally, Werb and Matear's[21] review highlight findings from Sackett et al,[4] who reported the different opportunities available for teaching and implementing EBM in outpatient clinics. Objectives, evidence of highest relevance, restrictions and strategies are summarized for different types of outpatient rounds including preclinical conferences, preceptorship during initial and follow-up visits, and ambulatory morning report. Examples of objectives range from reviewing the diagnosis and management of common disorders, deciding on a working diagnosis and initial therapy, follow-up, and making needed adjustments to reviewing the case of an individual outpatient (p.196). Sackett et al[4] also discuss their teaching-learning philosophy and propose strategies that emphasize patient-centered, interactive, and learner-centered activities for teaching the practice EBM.

Other SRs of teaching EB skills primarily focus on critical appraisal skills[24,25] rather than on the complete 5-step process that begins with formulating a good question through evaluating performance. Outcomes measured in these SRs were critical appraisal knowledge,[24,25] and attitudes toward medical literature,[25] which did positively increase. Again, the process of care and impact on patient outcomes were not measured and recommendations for improving the methodological quality and rigor of studies were made.

Werb and Matear's[21] SR concludes with recommendations for a model for teaching evidence-based practices in a clinical setting based on strategies identified in the different studies. These include introducing EB principles through scenarios in the classroom, and incorporating a clinical component and related faculty development. In addition, they describe the model applied by the Faculty of Dentistry at the University of Toronto. This includes having students use a standard form, EBD Rx, for complex treatment options in order to facilitate learning during patient care and to have students demonstrate that the proposed treatment is based on current best evidence.[21(p. 1002)] This is similar to Sackett et al's[4(pp. 24-25)] Educational Prescription Rx used to formulate a clinical question that initiates the rest of the steps in the EBDM process that students then use for presentation.

## What can we learn from barriers to adopting EBDM so that integrating into curricula is successful?

Following an RCT on investigating the use and perceived utility of EB support tools, findings from a nested longitudinal focus group study examined medical undergraduates' attitudes, opinions, and perceptions of barriers to the

adoption of EBM practice.[26] Although attitudes were positive, motivation to use EB skills was not due to 4 main barriers: (1) learning environment, (2) limitation of evidence, (3) lack of opportunity for applying EB skills, and (4) time constraints. Characteristics of the learning environment perceived as barriers were lack of support from instructors who rarely asked for supporting evidence and perceptions that instructors would rather students come to them with questions. Also, students believed that their teachers relied more on their own clinical experience than on research evidence so that reliance on those behaviors was imitated rather than EBDM.[26(p. 991)]

Limitations of evidence were related to PDA software and failing to obtain needed evidence, whereas lack of opportunity was related to infrequent continuity of care and not being able to evaluate the outcomes of EBM-based decisions.[26] Time constraints in looking for evidence to answer questions and perceptions that teachers would criticize this were items identified under the fourth barrier.

To address the barriers, some of the strategies proposed by Lam et al[26] were to encourage faculty to act as role models, introduce EBM-based assessments that measure EBM learning, and provide opportunities to use EB skills in clinical settings (p. 996).

## What evidence is there that faculty development programs work?

Several articles report on the development and implementation of workshops to train faculty in EBDM.[27-30] To establish an evidence-based approach, faculty need to facilitate the development of critical-thinking and problem-solving skills, which may represent a dramatic departure from how faculty members currently prepare students to solve clinical problems. Faculty roles shift from directing what to do and how to do it, to helping students clearly define clinical problems, access relevant literature, appraise that literature and apply it to patient care.[31] Teaching techniques that incorporate active learning and problem-solving are needed to engage students in this process.[32]

It is this combination of facilitating self-directed learning with the use of current best evidence that is needed for EBDM. This approach served as the focus of a national 4-day faculty development institute (FDI) on Integrating an EBDM Approach into Curricula, sponsored by the National Center for Dental Hygiene Research through a 3-year HRSA project grant.[30] As part of the grant, an interdisciplinary project team involving individuals with an expertise in the health sciences, evidence-based methodology, educational psychology, and library science was established to develop, implement, and evaluate a 3-phase program.

Each year, 20 teams of 2 from institutions across the country were selected to participate. Phase I included several pre-Institute assessments of the faculty's EBDM knowledge, skills, and teaching strategies. Baseline data indicated that faculty were unfamiliar with EBDM methodology as a framework for teaching clinical decision making, however 60% were incorporating related skills, such as having students perform database searching and critiquing the literature. Completion of the pre-Institute case scenario revealed faculty had difficulty formulating clear, concise questions that would provide good key words for conducting an efficient search of the literature. Consequently, for faculty to be effective role models they needed to learn these skills.[30]

Phase II was the 4-day onsite program that involved hands-on experience learning basic evidence-based principles and skills and developing an educational action plan to implement at their home institution. Phase II post-assessments at the FDI indicated a statistically significant increase in EBDM knowledge ($P < .001$) and in formulating PICO questions and database searching skills ($P < .01$). Also, all agreed or strongly agreed that they were prepared to integrate EBDM into their courses. Although familiar with and using active teaching/learning strategies, 93% of the faculty reported that they now were better prepared to use these strategies as well as new ones. For example, prior to the Institute, 60% indicated that they incorporated database searching in their courses and after the program 80% of those faculty indicated that they now were better prepared to use this strategy. Of the 40% who reported prior to the Institute they did not have students conducting searches, all indicated that they now were going to include this strategy.[30]

Phase III involved faculty teams implementing their action plan at their home institution and participating in ongoing follow-up. Since the Institute, 93% of the faculty confirmed they are incorporating aspects of EBDM strategies into didactic, laboratory, and clinical courses currently being taught or planned. When asked what "new" strategies they were incorporating related to their educational action plan, 70% reported database searching, 64% reported critical analysis, and 60% reported formulating a PICO question.[30] Finally, all but one participant reported sharing the Institute materials and training colleagues in how to teach and integrate principles of EBDM into the curricula. This is being achieved through formal and informal faculty meetings, faculty in-service sessions, retreats, or multiple meetings. Also, over 50% have given school-wide presentations on EBDM, been invited to present EBDM sessions or continuing education courses, and have had presentations accepted for presentation at local, state, and national conferences.

Other faculty development programs share similar characteristics in recognizing that the culture within the institution, department, or program needs to change so that EBDM is applied clinically[27] and structural elements need to be in place to sustain an effective effort.[28] This requires that faculty have the computer skills required for EB practice and on-site experts available to assist when needed. Other common characteristics of successful faculty development programs included the following[28-30]:

- Having a multidisciplinary project team consisting of health professionals, medical librarians, and education, research, and computer specialists

- Incorporating the "hands-on" nature of the training program
- Having hardware and databases required for EBDM
- Having sufficient blocks of time, often 2 to 4 days, specifically devoted to teaching the workshop
- Making a commitment to implementing change and having time to do so
- Providing support and follow-up after the workshop

Differences between programs were seen in whether they were national, regional, or local. For example, national workshops tended to have less time devoted to hands-on patient care learning due to such factors as hospital requirements, logistics, and patient confidentiality. Consequently, mentoring could not take place during "real-time" delivery of patient care, whereas faculty in-service programs within the local home institution of faculty did not encounter this issue.

## TREATMENT PLAN MODEL

Common themes running throughout the literature include the need to teach EB theoretical principles and all 5 skills in the process, the need to use relevant clinical scenarios in teaching the application of skills, and most importantly, the need to transition classroom simulations to routine practice on the clinic floor in making patient-care decisions. Faculty development and support for making and implementing curricular changes were identified as crucial elements, as was the importance of having the needed resources, time, and infrastructure.

These themes comprise the "best practices" or major elements or of a treatment plan model. Aspects of the model can be implemented concurrently, while other elements need to happen sequentially. This will vary among schools and faculty members based on their level of knowledge and skills, and the available resources. The following framework outlines the major elements while Figure 1 captures them in a flow chart.

### Major Elements

Faculty Development Programs Integration of EBDM is dependent on faculty who must have the expertise and requisite skills to facilitate student learning and serve as mentors and role models. Categories of knowledge and skill include the following:

Theoretical principles

Evidence-based skills

Computer literacy, database-searching skills including EB features and Limits feature

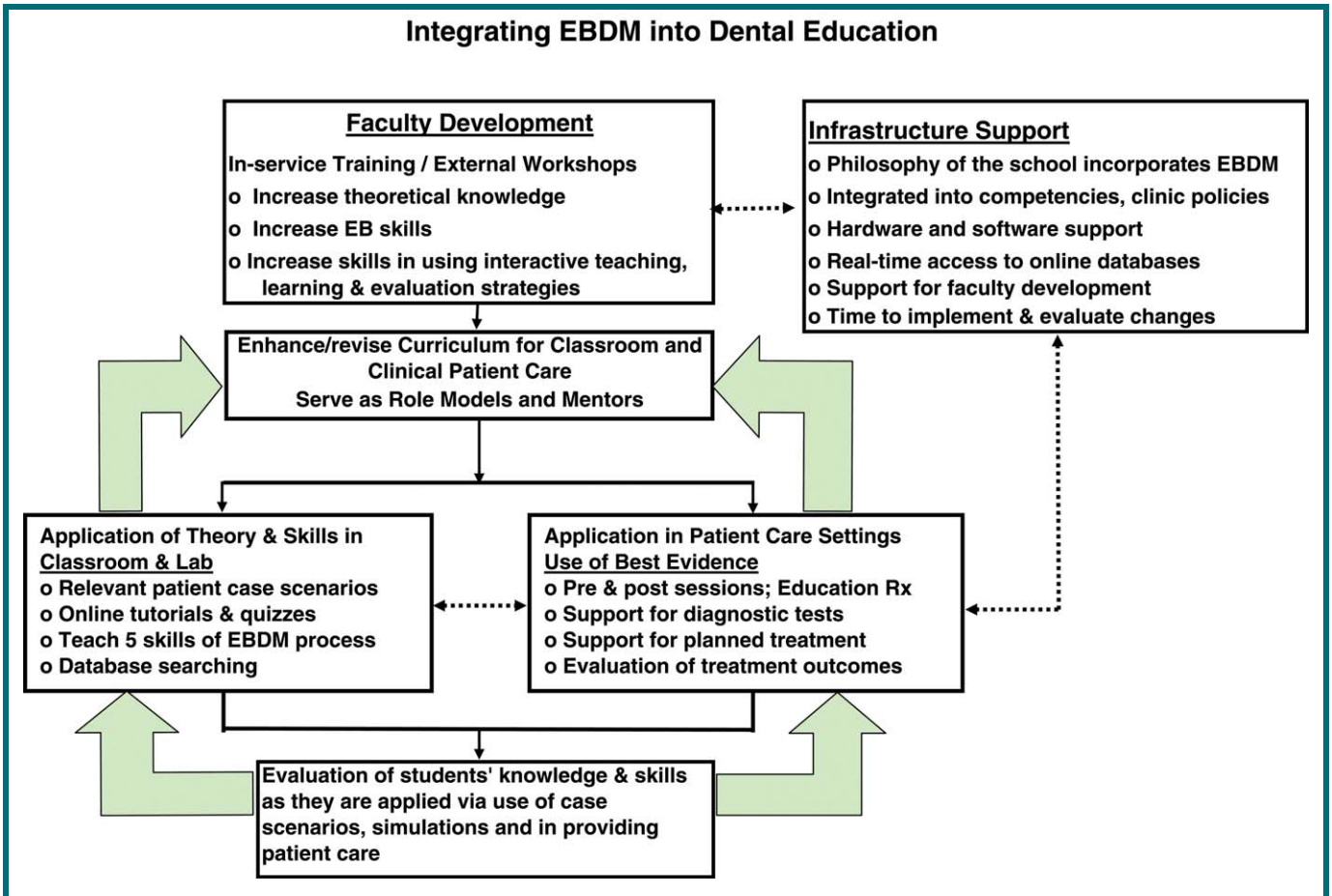


**Figure 1.** Treatment plan model for integrating EBDM into Dental Education.

Interactive teaching, learning, and evaluation skills

Application of skills on the clinic floor, eg, asking students to provide evidence to support their diagnosis and proposed treatment, evaluating treatment outcomes, and self-assessment of applying EB skills

Theoretical Principles The principles of EBDM require learning new concepts. Knowing what constitutes the evidence and how to integrate it with clinical expertise and patient values increase the potential for improving patient care. Important concepts and areas of knowledge for faculty and students include

EBM definition

EBDM philosophy:

- Evidence alone is never sufficient to make a clinical decision, and
- A hierarchy of evidence exists to guide clinical decision making

What constitutes the evidence

Levels or hierarchy of evidence

- Knowledge of research design

Evidence-Based Skills EBDM requires that students and faculty develop new skills and just as learning other skills, EB skills take time and practice to master. Online tutorials and quizzes and case scenarios applying all 5 EB skills can be used in multiple courses throughout the curricula. Teaching should then transition to "real time" so that both EB skills and application of the best available evidence is used in direct patient care. EB skills include

1. Asking good clinical questions
2. Conducting an efficient computerized search
3. Critically appraising the evidence
4. Applying the results in clinical practice, and
5. Evaluating the outcomes

Active Teaching, Learning, and Evaluation Strategies Self--directed learning involves the learner as an active participant and encourages the development of a deep approach to learning. Deep learning is an active search for understanding whereas surface learning merely encourages students to reproduce what has been learned.[33-35] If students are to learn how to think, problem-solve, analyze, and apply scientific evidence, then they need to be in situations where they have an opportunity to do so. Faculty must revise curricula to incorporate EBDM and use strategies that engage the learner, such as

1. Problem-based learning (PBL), case-based learning (CBL), online tutorials
2. Clinically integrated teaching in "real time" with a patient in the chair
3. Presession (morning review) and postsession evaluations
4. Use of structured forms, ie, Educational Rx, to support patient care decision making and case presentations
5. Evaluation of EB skills as they are applied, initially using case scenarios and then in providing patient care

Infrastructure Support Infrastructure support is needed to provide the systems and resources to sustain an effective effort.[28] Visible support by administration and faculty leadership teams reinforce the importance of desired changes. Structural elements that need to be in place that can be developed in parallel while implementing faculty development programs include

1. Philosophical support reflected in the strategic plan, goals, and objectives of the school
2. Integration of EBDM in competencies defined for accreditation and graduation
3. Clearly defined clinic policies, procedures, and evaluation requirements for EBDM
4. Computers, software, health science librarian, and Information Technology support
5. Real-time access to databases (eg, OVID MEDLINE, CINAHL, HealthSTAR, and EBM databases such as the Cochrane Database of Systematic Reviews) with full-text
6. Resources (financial and time) for faculty development programs
7. Time to implement changes and evaluate their effectiveness

Needed Research Long-term change in student decision-making behaviors and patient-care outcomes as a result of EBDM need to be evaluated. As faculty enhance or develop new curricula and structure new evaluation measures, they should

Evaluate the effectiveness of implemented strategies to change behaviors

Evaluate how the use of scientific evidence influenced patient-care decisions (eg, diagnostic tests and procedures, treatment options)

Evaluate patient outcomes

Use rigorous methods that will yield high levels of evidence, eg, use of RCTs

Use qualitative research to provide more depth to quantitative studies

## CONCLUSION

There is a growing body of research related to implementing EBDM into curricula for predoctoral students and postgraduate residents. Consistent themes have emerged identifying characteristics of programs that are effective in changing knowledge and using the scientific literature and critical appraisal skills, however most of these studies provide weak evidence and none

have looked at long-term behaviors that ultimately benefit patient outcomes.

It is important that faculty members have the EBDM skills expected of their students and create an environment in which students become self-directed learners. Faculty are key to the success of implementing change, both in the classroom and on the clinic floor, so the proposed treatment plan model focuses on developing a critical mass of faculty who can initiate change and mentor other faculty. For an EBDM approach to become the norm for practice it must be integrated throughout the educational program and reinforced every day when students are providing patient care. Students must learn how to learn for a lifetime of practice so that current best evidence is considered and patient outcomes are optimized.

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