

Residency Education

Teaching Evidence-based Medicine Skills: An Exploratory Study of Residency Graduates' Practice Habits

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Background and Objectives: *The long-term effect of teaching critical appraisal (CA) and evidence-based medicine (EBM) skills is unknown. This study explores long-term behaviors and learner satisfaction after a 3-year longitudinal CA/EBM curriculum. Methods:* Telephone interviews were conducted with 1996–1998 graduates of an academic family medicine residency program with an established CA/EBM curriculum. The graduates were all in clinical practice. **Results:** Ten of 17 graduates met inclusion criteria and consented to be interviewed. Their age range was 31–58, and all had been in practice 3 to 5 years. Six were female. Most participants did not regularly practice CA or use EBM skills. Instead, colleagues were the most commonly used information source. Time constraints and clinical production pressure were the primary barriers to practicing EBM. Despite not practicing CA and EBM, participants generally were satisfied with their training in these skills. Respondents said they used continuing education meetings and reading journals to keep current. **Conclusions:** In this study, residents instructed in CA and EBM skills did not regularly practice these skills. Time and workload pressures appear to be major barriers to these behaviors. Those training residents to integrate EBM into clinical practice should evaluate short- and long-term clinically oriented behaviors to assure educational effectiveness.

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Basing clinical decisions on the best available published evidence—evidence-based medicine (EBM)—has become an important facet of clinical medicine and education. Locating information in the medical literature and critical appraisal (CA) of that information are considered basic clinical skills for medical students.¹ EBM is being taught at all stages of medical education,^{2–10} and Reinhold Wentz has estimated that 50,000 physicians, students and health care workers receive training in EBM each year (written communication, 2001). Despite the widespread teaching of EBM, however, information about its influence on clinician behavior is limited.

Numerous reports have described teaching elements of EBM in undergraduate, postgraduate, and continuing medical education (CME) settings.^{2–10} At least seven systematic reviews have been published on the effectiveness of teaching CA skills.^{11–17} The most extensive

of these¹⁵ found that CA teaching improves knowledge and attitudes, may improve skills and reading behavior, but found no evidence of an effect of CA teaching on clinical decision making, self-learning behavior, teacher or learner satisfaction, or patient outcomes. On the other hand, recent systematic review¹³ focusing on postgraduate CA teaching confirmed an effect of CA teaching on knowledge, skills, and attitudes as well as an improvement in participant-reported behavioral changes. It also suggested that an integrated approach to CA/EBM teaching was more effective than stand-alone interventions. Notably, we were unable to find any studies that examined clinically oriented learner outcomes of teaching beyond a year.

Despite the promise held by information technology to enhance clinician performance and patient outcomes, evaluation of the broader application of CA/EBM skills is still required since health information technology's influence on clinician performance, while generally positive,^{18,19} is limited in scope and availability,^{18,19} underused,²⁰ and evidence of its effect on patient outcomes is generally lacking.^{18,19,21,22}

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The purpose of this study was to explore ways that the long-term outcomes of an integrated CA/EBM curriculum could be evaluated by using a qualitative analysis of self-reported use of CA and EBM skills, self-learning behaviors, and clinical decision making in graduates of a residency with an established integrated CA/EBM curriculum. A secondary aim was to examine obstacles to the application of CA/EBM in clinical practice.

Methods

We chose a qualitative, semi-structured interview design²³ because we aimed to explore how the extent of in-depth learner application of CA/EBM skills could be assessed, as well as learner satisfaction with and obstacles to application of that training. We judged this approach the most appropriate one for exploring personal meaning and phenomena.²⁵⁻²⁸

Participants and Setting

Participants for the study were recruited from among graduates of a university-based family medicine residency in the Southeastern United States who were in full- or part-time clinical practice at the time of data collection. This residency established a CA/EBM teaching program in the early 1990s. The program consisted of weekly critical appraisal conferences, EBM lectures, preventive services research projects, a quality improvement project that incorporated EBM to create a guideline for the residency practice, an evidence-based inpatient manual, and "critical debates" over evidence about controversial topics. The curriculum was taught by residency faculty, the majority of whom had master's of public health degrees. Neither author of this paper was involved with development or implementation of this curriculum. The goals of the curriculum broadly stated were to (1) encourage reading and a culture of reading, (2) teach critical appraisal skills, and (3) improve care by ongoing assessment of practice. To assess the extent to which these goals were achieved in practice by our respondents, we operationalized them as shown in Table 1.

Study participants were recruited and interviewed in 2001. In consultation with the residency director, we identified the years 1996 to 1998 as a time period when residents were exposed to a consistent EBM curriculum. We also assumed that the 3- to 5-year period between residency completion and the interviews allowed sufficient time to show longer-term effects of the curriculum. EBM resources available to respondents during training included the National Library of Medicine's (NLM) MEDLINE database, using the Ovid search engine licensed by the institution, and a variety of CD-ROM-based textbooks or other secondary sources, none of which was institutionally supported. NLM made MEDLINE freely available on the Internet via PubMed in 1997.²⁹ The first widely used personal

digital assistant (PDA) was released in 1996, but PDAs were in use by only 15% of US physicians³⁰ at the time of data collection.

The residency graduated 17 residents during the study period. One was ineligible due to enrollment in a full-time fellowship. Of the 16 eligible physicians, four could not be contacted, and two were contacted but not interviewed due to participants' time constraints.

Data Collection and Analysis

The initial interview guide for the study (Table 2) consisted of questions related to EBM teaching domains drawn from the literature,^{14,15,31} including patient care, critical appraisal, searching skills, and self-learning behavior. Each of the EBM teaching domains was linked with one or more interview questions or probes that were modified with emerging understanding. The questions were designed to uncover evidence of application while minimizing social response bias. The study was introduced to participants as an exploration of their use of information in clinical practice. They were asked about practice characteristics, the influence of their residency education on their self-learning behavior, and, if the concept of EBM skills arose, their satisfaction with their training and the use of these skills. One individual conducted all interviews by telephone. They were tape-recorded and transcribed into text files for analysis.

To ground our data in participants' clinical experience, each interview began with a "grand tour" question²³ about a recent encounter with clinical uncertainty. Data analysis began after the first interview, and the interview guide was modified to reflect emerging topics as interviews proceeded. For example, as guilt over not doing all that was taught in residency emerged as a theme, additional probes were added to explore beyond professional satisfaction alone. As data collection and analysis progressed, fewer new topics emerged, and none arose in the last interview, indicating saturation.³²

Following established qualitative methods,³³ we used four strategies to enhance the validity of the results. First, authors' biases were explicated through self-reflection and ongoing feedback from a research group. Second, emerging interpretations were checked with participants. The third strategy involved the ongoing search for alternative understandings of the data and negative cases. Finally, after the first author completed data analysis, the second author compared interpretations independently to the data, and disparities were negotiated to achieve the final results.

Results

Table 3 describes the characteristics of the participants. Analysis yielded six major themes: (1) sources of clinical information, (2) CA and the EBM approach, (3) keeping up to date, (4) barriers to keeping up to date,

Table 1

EBM Teaching Domains, Linked Interview Questions (From Table 2), and Related Curriculum Goals

<i>Teaching Domains and Possible Evidence of Application</i>	<i>Interview Questions</i>	<i>Curriculum Goals or Activities</i>
Application to patient care		Encourage a culture of reading and improve patient care by ongoing assessment of practice
Medline searching	1 and 2	
Use of clinical evidence, POEMs, Cochrane database, diagnostic strategies book, other secondary EBM sources	1 and 2	
Incorporates data into patient education discussions	3	
Critical appraisal and searching skills		Teach critical appraisal skills
Chooses most appropriate study type for answering question	1	
Uses original research or systematic reviews to answer questions	1	
Is doing critical appraisal and searching	1 with Probe c and e	
Statistical knowledge		Teach critical appraisal skills
Understands importance of difference between RRR and ARR	3 with Probe c and c (i)	
Understands that PPV and NPV are the clinically useful concepts and that sensitivity and specificity have more limited utility in the clinical setting	3 with Probe c and c (ii)	
Self learning		Encourage a culture of reading and improve patient care by ongoing assessment of practice
Has strategy for lifelong learning apart from required CME attendance	Question 4 and probes	
Member EBM journal club		
Is asking questions		
Writes questions to self to answer later		
Has attended CME on learning, EBM skills, or CME with focus on evidence		
Participates in chart audits linked to evidence		
Non-domain areas		
Barriers to practicing EBM	4 with Probe b	
Satisfaction	4 with Probe d	
Perceived benefits	4 with Probe d	

EBM—evidence-based medicine
 RRR—relative risk reduction
 ARR—absolute risk reduction
 PPV—positive predictive value
 NPV—negative predictive value
 CME—continuing medical education

(5) satisfaction and residency influence on practice, and (6) indicators of evidence-based practice (EBP).

Sources of Clinical Information

Consistent with prior surveys, we found that asking a colleague for information was the most common initial approach to answering clinical questions. All participants mentioned this approach, and seven indicated it as their preferred approach. When asked how a specific example of clinical uncertainty was resolved, one participant, typical of the majority, replied, "I called the consultation service and asked to speak to a specialist on call, and that is frequently what I will do."

Participants gave reasons of convenience and reliance on others' experience for this preference, each voiced by four participants. One said, "I guess [the consultation service is] easy for me and it's fairly quick." Another commented that, "Usually when I'm encountering clinical dilemmas, I don't know what's going on. That's when I rely more on the experience of other practitioners."

Of the three participants not indicating "asking a colleague" as their first approach, one was the sole physician in a rural practice, one expressed equal preference for consultants and books, and one gave books and the Internet as the preferred sources of information. All

Table 2

Interview Guide

I'm doing a research project in which I'm really interested in the way practicing family physicians use information in their clinical practice.

Demographic information: Practice type and payment form, residents or medical students, computer/Internet access

Grand Tour Questions:

1. Think back to the last time you were uncertain about what to do for a patient; how did you approach the diagnosis or treatment of this patient?
 - a. For example when you weren't sure of the best treatment or diagnostic test
 - b. What led you to do it that way?
 - c. About how frequently do you do this?
 - d. What other sources of information have you used recently?
 - e. Have you searched the Internet for medical information recently?
2. Now I'd like to recall the last time you had a patient with _____. What was your plan for diagnosis and treatment? (croup, suspected PE or DVT or MI)
 - a. What led you to this course of action?
3. Next, I'd like you to think of the last time you counseled a patient in which the best therapy or diagnostic strategy was in doubt. Can you tell me about how you counseled the patient?
 - a. What were you thinking about at that time?
 - b. What led you to do that?
 - c. In situations in which communicating numbers is required, have you found any concepts or techniques helpful?
 - i. Have you used the concept of NNT to explain benefit of therapy to patients?
 - ii. Have you used the concept of pre- and post-test probability to explain the meaning of test results to patients?
4. Lastly, I'd like you to give me an idea of how you keep your knowledge up to date.
 - a. Which one of these have you done in the past week? Month? Year?
 - b. Other than time, what are things that interfere with your desire to keep up to date?
 - c. How did you develop these habits? How did residency influence this?
 - d. How does what you do in this area affect your satisfaction as a physician? As a father/mother/friend?

PE—pulmonary embolism
 DVT—deep venous thrombosis
 MI—myocardial infarction
 NNT—number needed to treat

participants also used textbooks and drug references. Only one preferred them over consultants for their accessibility; four cited the value of pictures to confirm a dermatologic diagnosis.

Most participants did not find the Internet and computer-based resources helpful to resolve clinical uncertainty while seeing patients. When queried about recent use of the Internet, this response was typical: "Never. [It's] not useful." Another participant elaborated, "Now maybe once in a while, after hours, I may, but I really don't use the computer a lot."

Difficulties with computer-based sources stemmed from unfamiliarity with computers and perceived low benefit of computer sources in contrast to the greater familiarity of print and human sources. The two participants who regularly used computer-based sources such as CD-ROM texts and MD Consult, however, cited speed of information retrieval as their primary reason for using them. In general, these graduates used a colleague as their primary approach to resolving clinical dilemmas. Most found computer-based resources too unfamiliar and slow to be useful.

Critical Appraisal and the EBM Approach

Only one participant mentioned critical appraisal explicitly. Three others mentioned "the evidence-based approach" or "practicing EBM," defined as searching for journal articles to answer clinical questions, appraising them, and then applying the results quantitatively to patient care. None found the approach helpful in answering immediate clinical questions. As one pointed out: "You know, I'm searching through articles, and I'm not really looking for articles with that level of information in general when I'm trying to figure out what to do for a patient. I'm looking for something more specific and where to go and what to do, rather than more of the scholarly approach to things."

Participants did find, however, that this perception of EBP was useful in situations that allowed reflection, such as managing recurrent problems or assessing the validity and usefulness of drug representatives' presentations. One of them noted: "The evidence-based approach, I don't use that so much in problem solving when I'm encountering a clinical dilemma. It's more like [I use it] in approaching things like screening

Table 3
Characteristics of Interviewed Participants
and Nonparticipants

Category	Participants (n=10)	Nonparticipants (n=6)
Female	6	3
Age	31–58 years mean = 37.9	32–39 years mean = 35.0
Years in practice	3–5 years mean = 4 years	3–5 years mean = 3.8 years
Payment model		
Salaried	6	unknown
Private practice	4	
Practice model		
Multispecialty	2	unknown
Family medicine only	8	
Location		
Urban	9	6
Rural	1	0
Internet access in office	9	unknown
Learners		
Students	6	unknown
Residents	4	

tests and routine problems, not so much the clinical problems.”

In summary, participants who mentioned EBM found the approach they learned as residents helpful in situations that allowed time to search and reflect but not in resolving immediate clinical questions.

Keeping Up to Date

All participants indicated that they valued keeping up to date. As one observed: “Keeping up to date is a huge satisfier. It’s what we went into this for—to help patients.”

All participants attended CME courses, and three identified this as their primary self-learning method. All reported reading journals, and eight read their specialty society journal regularly. Only one participant mentioned more rigorously evidence-based resources (American College of Physicians Journal Club and Evidence Based Practice). Three participants who served as community preceptors for health care students listed teaching as one of their incentives for keeping up to date. These same three participants also mentioned questions arising from patient problems as an incentive to keep up to date.

Barriers to Keeping Up to Date

While all participants valued keeping up to date, they all also identified multiple barriers to finding evidence and staying up to date, the most common being time and financial pressures.

“Busy, busy, busy. And you don’t have time like you did in residency to sit around and discuss different cases, you don’t have time to go to Grand Rounds once a week to learn the newest and the best, and you don’t have time, so it’s very, very different.”

Another said, “I have seen the volume of patients that need to be seen to keep the doors open. [I believe] that there is inadequate time to care for patients properly and that this is a big downfall of the economics of primary care.”

These barriers constituted a considerable source of frustration for all participants, and they all related to the need for more efficient mechanisms to keep up to date. Despite strong motivation to keep up to date, participants perceived themselves struggling and often failing to do so while fighting against time constraints and pressure to produce clinically.

Satisfaction and Residency Influence

Despite the perceived limited utility of the EBM approach they learned as residents and the substantial barriers to its practice, only one participant expressed ambivalence about her residency training in CA/EBM, while six of the seven participants who discussed their training expressed satisfaction with it: “But, . . . it was sort of drilled in to try to stay up to date with reviewing articles in journals, and CME, we always had lots of CME during the week as well.”

Interviewer: Do you feel like that experience [in residency] gave you what you needed and equipped you for what you are doing right now?

“Yes, I think so.”

Four participants indicated that their use of evidence while counseling patients was directly related to their residency experience. An equal number, however, expressed guilt over the conflict between what they learned in residency and what they were actually practicing. One respondent, comparing her residency experience to practice, said “I really couldn’t even imagine when I was there. I thought life was hard there. But I think a residency program allows you to invest time in figuring out how to do that (keep up with the literature). That’s where the guilt comes in.”

Indicators of EBP

When asked to recall a recent diagnostic dilemma and prompted with several representative examples (Table 2), seven participants chose a patient with suspected pulmonary embolism. During the interview they described their diagnostic plan and its rationale. The coincident selection of the same diagnostic dilemma allowed us to consider the consistency of participants’ diagnostic plans with EBP based on contemporary literature. These results are reported in Table 4. Three participants described behavior inconsistent with EBP, while the remaining four described behavior possibly consistent with EBP. All participants scored as possibly

Table 4

Consistency of Diagnostic Plan for Pulmonary Embolism (PE) With Evidence-based Practice

<i>Element</i>	<i>Evidence of Application</i>	<i># of Respondents Discussing for PE Diagnosis (n=7)</i>
Assign pretest probability	1. Mention need to assign pretest probability	3
	2. Make reference to risk factors for PE	3
	3. Reference Wells Clinical Model ⁴⁰	0
V/Q scan	1. Mention utility in diagnosis	4
	2. Mention difficulty of intermediate/low probability scans	3
	3. Reference PIOPED study ⁴¹	0
	4. Indicate ability to rule out diagnosis of PE with low to moderate V/Q scan without referencing pretest probability (-1 point)	0
D-dimer	1. Mention their potential utility only when negative	1
	2. Indicate a positive D-dimer is helpful (-1 point)	0
LE ultrasound	1. Mention utility in patients with low-moderate pretest probability and non-diagnostic V/Q scan	4
	2. Mention utility of serial LE ultrasonography in excluding PE	0
Helical CT	1. Mention uncertain clinical utility of Helical CT in the diagnosis of PE	0
	2. Reference one or both systematic reviews on this topic both consistent with conclusion above. ^{42,43}	0
	3. Rely on negative Helical CT to exclude a PE (-1 point)	2
Pulmonary angiogram	1. Mention its utility in certain patients while referencing their pretest probability and V/Q scan result.	3
	2. Make specific reference to literature regarding exactly which patients should have pulmonary angiograms. ⁴⁰	0
Scoring	8–13 points: Behaviors consistent with evidence-based practice	0
	3–7 points: Behaviors possibly consistent with evidence-based practice	4
	-3–2 points: Behaviors inconsistent with evidence-based practice	3

EBP-consistent reported using a colleague or consultant as their primary source of answers for clinical questions. One participant scored as EBP-inconsistent also reported asking colleagues, while the other two indicated books as their primary information source.

Discussion

This study explored the long-term effects of an integrated CA/EBM curriculum in a family medicine residency, as well as obstacles to the clinical application of CA/EBM in clinical practice. Despite their overall satisfaction with residency training in CA/EBM, our respondents reported guilt and frustration regarding their inability to fully apply the skills learned, due

largely to the time and financial pressures of clinical practice. Colleagues were their preferred information sources. Their self-reported clinical decision making for the evaluation of suspected pulmonary embolus was, at best, only possibly consistent with EBP.

Interpretation of our results should take account of three issues. First, our respondents' CA/EBM skills and practices were not assessed at residency completion, so we have no direct evidence of the curriculum's short-term success. Each of our respondents, however, referred to practicing CA/EBM as residents, and most attributed the diminution of their CA/EBM practices to the time demands of full-time practice compared to the more thoughtful pace of residency practice. In ad-

dition, a recent systematic review¹⁵ found evidence that CA teaching generally improves knowledge and attitudes and may improve CA skills and reading behavior. Based on this indirect evidence, we think it reasonable to assume that respondents left residency with similar knowledge, attitudes, and skills regarding CA/EBM.

Second are the time gaps between our respondents' training and data collection and between data collection and reporting. As we have already noted, we chose to interview respondents 3 to 5 years after residency to emphasize long-term outcomes of training. Over the 10-year period since the first of our respondents completed residency, technological developments—particularly widespread use of the Internet and PDAs—occurred rapidly. Secondary sources of clinical information now commonly available via the Internet were largely nonexistent during our respondents' training and in their infancy during the years immediately following. Thus it could be argued that our respondents' experience of CA/EBM was substantially different than contemporary experience. A recent study by McCord et al,²⁰ however, observed 25 residents in five practices who had completed a "traditional" EBM curriculum similar in format and content to the one our respondents completed. Over the course of 328 patient encounters, residents were observed to use attending physician consultants to resolve nearly half (44%) of their clinical questions and to use books for another 20% of their questions. PDAs accounted for 24% of answers, but the vast majority (85%) of questions answered with PDAs were about drug prescribing. These findings reflect a pattern of answering clinical questions in practice similar to the one reported by our respondents. We argue, therefore, that insights gained from our study have contemporary relevance.

Third, the behavioral and attitudinal outcomes of our study were self-reported as with prior studies of CA/EBM outcomes in postgraduate settings.¹³ Our study, however, was the first to evaluate the effect of postgraduate CA/EBM teaching beyond 1 year. Its qualitative long interview design also allowed behaviors to be explored in more depth than previous survey techniques. By looking for consistency of participant responses in the context of actual clinical practice, the qualitative design provided the potential for a more accurate assessment of behavior than simple self-report. It also explores clinically oriented educational outcomes such as clinical use of CA and EBM skills, self-learning behavior, and clinical decision making, outcomes of CA/EBM teaching not studied previously.

In terms of its stated goals, we judge the study participants' EBM curriculum a qualified success. Each of them carries on the culture of reading by engaging in at least periodic reading, and each spoke of the value of keeping up to date. Likewise, each of them reported the acquisition of CA skills as residents, and several showed

evidence of applying them in current patient care. For the most part, however, respondents distinguished between "the EBM approach" that requires time for reading and reflection and the demands of clinical care that require the more immediate accessibility of consultants and books. This finding provides insight into more recent quantitative findings²⁰ and suggests that residency faculty would do well to assess learners' application of EBM skills at the point of care more frequently. Tools such as the one used in this study (see Table 4) may be helpful in this regard.

PDAs,²² electronic health records (EHRs), and computerized clinical support systems (CDSS) all offer potential to bridge the gap between the EBM approach and the point of care and are subject of ongoing study.^{18,19} Limited evidence exists for a short-term influence of PDAs for enhancing application of evidence-based interventions in learners but without evidence of an effect on patient outcomes.²² CDSS, with or without an EHR, have shown promise to improve clinician performance in diagnosis, prescribing, prevention, and chronic disease management,¹⁸ but evaluations of CDSS effects have been significantly less positive when performed by independent investigators¹⁸ and have been mainly confined to a few large institutions.¹⁹ While the results of our study underscore the need for more rapid sources of evidence and decision support, the effect of these sources on clinical outcomes still remains largely untested.³⁴⁻³⁸ The methods described by this study could form a basis for part of that testing.

Conclusions

Adequate instruction in CA/EBM may not be enough to produce clinical practice of EBM. Information management³⁹ and better point-of-care resources²⁰ have been suggested as solutions to this problem. Our study suggests that evaluating both short- and long-term clinically oriented behavioral outcomes of these proposed interventions would be required to assess their effectiveness. Knowledge and attitudinal outcomes do not appear sufficient in this arena to accurately predict behavior.²⁰ Our study suggests domains of EBP that could be objectively assessed, as well as the utility of a brief interview with objective criteria to assess recent case performance. Substantial work remains for those interested in supporting EBP. Understanding the effectiveness of proposed interventions is central to that endeavor.

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