



Ability of an Information Mastery Curriculum to Improve Residents' Skills and Attitudes

Allen F. Shaughnessy, PharmD, MMedEd; Priya S. Gupta, MD; Deborah R. Erlich, MD; David C. Slawson, MD

BACKGROUND AND OBJECTIVES: Teaching evidence-based medicine is becoming more frequent in family medicine residency education, as is the teaching of information mastery, which is using techniques to answer clinical questions at the point of care and to keep up with changes in medical knowledge. The goal of this study was to determine the effect of an integrated curriculum of information mastery on residents' evidence-based medicine knowledge and skills as well as their confidence at critically appraising medical literature and using evidence to inform clinical decisions.

METHODS: We used a before-after study in a single residency over 5 years. Residents completed the Fresno Test of Evidence-based Medicine and an attitude questionnaire at the start of the curriculum and then again before graduation. The integrated curriculum consisted of intensive instruction over the course of 1 month (30 hours), followed by a longitudinal series of ongoing conferences, integrated into the teaching of clinical content. Teaching was also integrated into day-to-day clinical activities via precepting interactions.

RESULTS: Twenty-three residents completed the study. Modified Fresno Test scores significantly improved from 104.0 to 121.5. Using a pass/fail approach, nine residents (40.1%) passed the test at the start of training, increasing to 17 (73.4%) at the end of the intervention. Confidence in critical appraisal scores increased from an average 17.90 (95% CI=16.55-19.25) to 21.10 (95% CI=19.49-22.71), out of a possible score of 25. Confidence scores were significantly lower in residents who did not pass the posttest (18.5 versus 21.9). Attitudes regarding confidence in the use of evidence and a decreased reliance on experts were also improved following the curriculum.

CONCLUSIONS: A curriculum of information mastery, integrated across the greater curriculum, improved trainees' evidence-based medicine knowledge and skills and attitude toward using evidence to inform clinical decision making.

(Fam Med 2012;44(4):pp-pp.)

requires a set of knowledge, skills, and, most important, attitudes if it is to improve patient care.¹

Evidence-based medicine (EBM) has evolved to the stage where there are two teaching approaches. The classic EBM approach emphasizes the teaching of critical appraisal of the medical literature with a focus on evaluating research design and statistical methods.²⁻⁶ This approach may not, however, increase physicians' use of evidence to make individual patient care decisions in outpatient medical care.⁷⁻¹⁰ In contrast, the "information mastery" approach emphasizes evaluating and using information resources ranging from pre-digested information in the form of research synopses and systematic reviews to guidelines and expert opinion.^{11,12} We have suggested that this approach is a more practical application of the basic skills of EBM and is more likely to result in implementation in day-to-day practice.¹³

In many instances, EBM or information mastery is taught in special curriculum sessions devoted strictly to this topic.^{4,14,15} However, EBM teaching is most effective when the principles and practices are embedded in the culture of a residency and when teaching and implementation

The teaching of an evidence-based approach to medical care has progressed from a novelty to a standard feature of the

curriculum of many family medicine residencies. This approach of basing health care decisions on the best available valid and relevant evidence

From the Department of Family Medicine, Tufts University (Drs Shaughnessy, Gupta, and Erlich); and Department of Family Medicine, University of Virginia (Dr Slawson).

of EBM are integrated into all educational activities.¹⁶

The goal of this study was to determine the effect of an integrated curriculum of information mastery on residents' EBM knowledge and skills as well as their confidence at critically appraising medical literature and using evidence to inform clinical decisions.

Methods

The study was conducted from July 2005 to June 2010 at The Tufts University Family Medicine Residency at Cambridge Health Alliance, a community-based residency with eight residents in each class. This evaluation includes data from the classes of 2007, 2008, and 2010. In July 2005, the class graduating in 2007 was enrolled at the beginning of their second year, the class graduating in 2008 was enrolled in 2006 (also the beginning of their second year), and the class graduating in 2010 was enrolled in 2007 (at the beginning of their first year). In 2007, the residency moved from one sponsoring institution to another. At this time, there were drastic changes in the curriculum, with the relevant change being that the curriculum in information mastery moved from being taught in year 2 to year 1. As a result, the class of 2009 did not receive the didactic training outlined below. The study was approved by the Institutional Review Board of the Hallmark Health System.

Description of the Curriculum

The curriculum was first developed in 1992 and found to be effective in a study of implementation at two residencies.¹⁷ Since that time, the curriculum has been reworked several times to meet the evolving needs of family physicians and to take advantage of new technologies developed since that time.

The curriculum is taught in both block and longitudinal formats, in didactic sessions and during patient care, incorporating all suggested levels of teaching of EBM and

information mastery.¹ During orientation, incoming residents receive approximately 30 hours of face-to-face education in the concepts and skills of information mastery and EBM (Table 1). All incoming residents attend all of these sessions. These sessions are interactive, consisting of short presentations followed by hands-on activities. Materials used during these sessions can be found at <http://familymedicine.tufts.edu/information-mastery.htm>.

Content for our curriculum is based on the original curriculum as well as a needs assessment of residents and faculty conducted before implementation. Objectives are derived from the Society of Teachers of Family Medicine Group on Evidence-based Medicine's Global Competencies for Information Management: Information Mastery and Information Technology.¹⁸ Some topics include study design, pertinent statistics, the hierarchy of information quality, and clinical decision making (see Table 1 for complete list of topics).

Longitudinal teaching occurs via point-of-care teaching and via several formats that are part of our didactic program (Table 2). During precepting, when residents discuss their patient encounters with faculty, the expectation of residents and faculty members is to use point-of-care evidence sources in clinical decision making.

Faculty use a "three-window" method during precepting, with three software or online programs running simultaneously and immediately available on the computer screen: our electronic medical record, the online resident portfolio for documenting competence, and one (or more) evidence-based resources such as Dynamed, Essential Evidence Plus, or the TRIP database.

Early on in residency, trainees learn how to use point-of-care information from the evidence-based resources listed above and practice using them daily. Residents are encouraged, via the competency

assessment process during precepting, to find information before precepting with a supervisor; the highest assessment category of medical knowledge on our routine precepting encounter assessment forms is "Knows the information needed for decision making and also knew the evidence supporting this information."

Faculty received training through participation in the activities listed above, via ongoing faculty development, and through attending a 3-day conference on information mastery teaching and practice conducted by the Tufts Healthcare Institute.

Research Design

The study used a before-after design using each resident as his or her own control. At the beginning and end of residency, residents completed a self-administered questionnaire that evaluated their ability to apply evidence-based techniques. A second part of the questionnaire determined their confidence regarding the medical literature and their perceptions of their ability to evaluate evidence. Resident responses were anonymous but were coded so that results could be compared over time.

EBM skills and techniques and some information mastery knowledge were assessed using questions from the Fresno Test of Evidence-Based Medicine.¹⁹ This test consists of 12 short-answer items that assess residents' ability to form an answerable question, to list evidence-based resources, and to interpret research results. The items are weighted differently with a total possible score of 212 points. We deleted three questions on topics related more closely to classic EBM teaching that are not covered in our curriculum (#4, Medline search strategy; #8, calculating diagnostic test characteristics such as sensitivity; and #12, the best study design for a study about prognosis). Using the scoring system of Ramos and colleagues in the original report, adjusted for the dropped items, we used a score of 113 as

Table 1: Topics Covered During the Introduction to Information Mastery

Session	Topic
1	Introduction to Information Mastery Review of Educational Prescription Form and PICO Format
2	Group Exercise: Is It a POEM? Evaluating Articles About Therapies Group Exercise: Riboflavin for Migraine Article Group Exercise: Determining Study Design
3	Don't Panic: Statistics You Can Understand Group Exercise: Evaluating Results of Studies of Therapy Understanding Synopses of Studies of Therapy
4	Power Reading of Journals "Just-in-Time" Information at the Point of Care Group Exercise: Information Resource Practice
5	Expert-based Information Delivery Systems Finding and Evaluating Guidelines; The SORT System Review of the Information Pyramid, Evaluating Hunting Tools on the Web, Evaluating Hunting Sources for Relevance and Validity Evaluating Systematic Reviews Group Exercise: Evaluating a Review Article
6	Diagnostic Testing: Bayes' Theorem, Evaluating Studies of Diagnostic Tests Group Exercise: Evaluating a Study Evaluating a Diagnostic Test Group Exercise: Evaluating Foraging Tools
7	Evaluation of Grand Rounds Using the CME Evaluation Form Introduction to Experiential Learning Theory (the Kolb Learning Cycle), Determination of One's Own Learning Type, How to Improve Learning
8	Obtaining Useful Information From Pharmaceutical Representatives Group Exercise: Evaluating a Pharmaceutical Representative Setting up Your Own Bookmarking Website (MyHQ)
9	Using Clinical Decision Rules Review of Practice-generated Clinical Questions (Assigned on Day 1)
10	Clinical Jazz: Harmonizing Clinical Experience With Evidence-based Medicine Group Discussion: How to Implement Evidence-based Medicine in Everyday Practice

"passing" out of a possible score of 160. All tests were independently graded by two investigators, and differences in scoring were resolved by discussion.

The attitude questionnaire consisted of a set of statements with a Likert scale to indicate degree of agreement.

Results of the modified Fresno test were normally distributed, and before/after scores were compared using the paired *t* test. To test for a period effect, total scores for the three excluded questions were also compared. Pass rates were compared using the chi-square statistic. Statistics were performed using Minitab 12.1 (www.minitab.com) and VassarStats: Website for Statistical Computation (<http://faculty.vassar.edu/lowry/VassarStats.html>). All tests were two-tailed with an $\alpha=.05$.

Results

The study enrolled 23 family medicine residents in three residency classes (100% of eligible residents); paired results are available for 22 (96%) of the residents. Residents completed the test of ability and survey of attitudes prior to experiencing the Information Mastery curriculum and then again at the end of their training.

Of a possible 160 points on the EBM test, initial results were 104.0 (range 49–134) and increased to 121.5 (range 65–154) following the intervention ($P=.001$). Overall, 18 residents improved their scores by an average of 25.9 points, and four

residents decreased their scores by an average of 17 points. Using a pass/fail approach, nine residents (40.1%) passed the test at the start of training, increasing to 17 (73.4%) at the end of the intervention ($P=.025$).

On average, scores increased following the intervention for all nine items, and the number of residents "passing" increased for all items except one.

Results for the three excluded questions were also compared. Of a possible score of 48, the mean score was 27.9 on the pretest and 27.2 on the posttest ($P=.866$).

Residents were asked about their degree of agreement with seven statements regarding their confidence in using the medical literature.

Table 2: Longitudinal Integration of Information Mastery Teaching

“Is It True?” Rounds
A modified journal club, led by a resident, designed to teach searching for information using point-of-care information tools. Residents are queried for a contemporaneous clinical question from their practices. One question is converted, by the group, to an answerable question, and residents then use various electronic information resources to find answers. The group reconvenes and discusses the answers obtained from different resources.
“Mythbusters”
A method of teaching quick appraisal of new information and decision making. A group session is conducted at the beginning of the year to identify common medical practices, eg, “Men over age 50 years should be screened for prostate cancer.” These become the “myths” that are investigated at subsequent sessions with the resident group given information on the topic, already pre-assembled by the faculty leader. This information is from three to four secondary sources that can be quickly evaluated for relevance and validity. After working in groups to understand and evaluate their information, the groups come together, report their findings, and determine whether the myth has been “busted.” They also are tasked with assigning a strength of recommendation ²⁵ and discuss how they can apply the information in their own practices.
Subspecialist Conferences
The content of weekly conferences with specialists is framed around a research study, meta-analysis, or review article. A resident presents a case and a clinical question based on the case. The resident then presents information from an evidence-based resource to answer the question. During the rest of the 45-minute conference, the specialist describes how he or she applies this evidence in the care of patients.

Average scores for all seven items increased following the intervention as shown in Figure 1.

Residents were also asked about their confidence in their ability to determine five general characteristics of research studies (Table 3). Confidence scores significantly increased from an average 17.90 (95% CI=16.55–19.25, Cronbach’s alpha .60) to 21.10 (95% CI=19.49–22.71, Cronbach’s alpha .87), out of a possible score of 25, following the intervention. Confidence scores were significantly lower on the posttest for residents who did not pass the Modified Fresno Test (18.5 versus 21.9, $P=.0412$).

Discussion

Recent evidence supporting the teaching of EBM indicates that the highest level of educational effectiveness occurs when teaching is interactive and integrated with clinical activities.^{1,9} Integrated into clinical teaching throughout the entire residency curriculum, the Information Mastery curriculum has increased residents’ confidence in their use of evidence as well as their skills at evaluating that evidence.

This curriculum updates a previously evaluated version implemented in the early 1990s, which demonstrated similar improvements in

residents’ confidence.¹⁷ At the time of initial development of the original curriculum, the World Wide Web was not in widespread use, and broadband access to the Internet was slowly coming to institutions. At that time there were very few services that provided synopses of research-based information, and most of these were in paper form.²⁰

Since then, the curriculum has been adapted to incorporate the many information tools available to physicians. In addition, the focus has changed from the classic EBM model of teaching residents how to evaluate original research articles to the new Information Mastery approach of teaching residents how to evaluate information from a wide variety of sources, including current awareness services and evidence-based resources such as Dynamed and Essential Evidence Plus. The focus remains as originally described in 1994 on patient-oriented evidence that matters (POEMs).¹¹

There are three levels of education regarding EBM. At the information mastery level, clinicians, armed with the skills to identify sources of accurate and relevant information at the point of care, can use these skills to make better patient care decisions. Teachers and writers who teach clinicians the curriculum and provide evidence-based reviews of original research need thorough training in critical appraisal. At the most sophisticated level are researchers adept at conducting decision analysis, meta-analysis, and other techniques of synthesizing raw research information into useable clinical information.

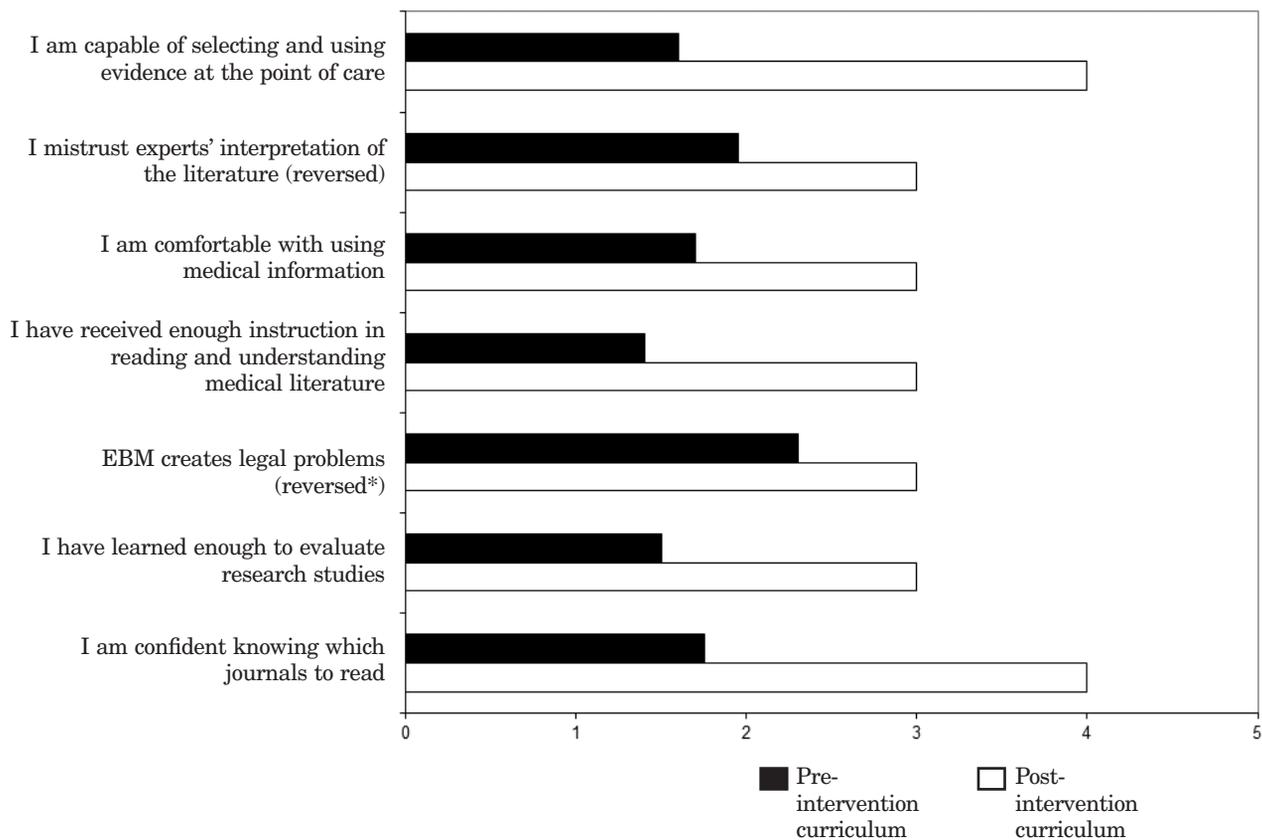
With a focus on information management, rather than simply the basic skills of EBM, clinicians can focus on understanding, interpreting, and applying the information in their own clinical situations. We demonstrated in this study a significant increase in resident confidence in their abilities as well as their skills. This

Table 3: Confidence Questions

Please rate your ability to determine whether:

- A study was controlled
- The study subjects were randomly assigned
- Intention-to-treat analysis was used
- The patients and researchers were blinded to treatment
- The results were clinically significant.

Figure 1: Changes in Confidence in Using the Medical Literature



EBM—evidence-based medicine

* Original responses reversed to make improvement in this attitude “positive.”

coupling of confidence and skills is what is necessary for an evidence-based practice.

Only a fraction of clinicians need detailed training in critical appraisal of the original literature, and even fewer need training in EBM research techniques. Focusing on teaching at these higher levels leaves graduates without the real world training to manage new information. As the adage goes, it is like teaching children how to tell time by showing them how to build a clock.

There are several limitations to this study. The curriculum was implemented only in one residency. The multifactorial nature of the intervention does not allow us to identify which elements are unnecessary, although all of the information mastery teaching involved the teaching of clinical content as well

and therefore accomplished more than simply the teaching of information mastery techniques. It may be, though, that the extensive teaching during orientation is not required, and a shorter version may be just as effective. Also, we were unable to determine from this study's data whether information use practices have changed or whether patient care has improved. Future research should evaluate information use practice and its effect on patient care.

Despite the curriculum, 26.6% of our graduates did not achieve a passing grade on the test. These residents may not be able to effectively integrate EBM approaches into their clinical practice.

We found the use of the grading rubric for the Fresno Test of Evidence-Based Medicine difficult to

apply and required several practice sessions to calibrate grading based on the general guidance given in the rubric.

Our study design was a before-after comparison of test scores and attitudes. Unlike a randomized controlled study, this approach to evaluation carries the risk that factors other than the studied intervention were responsible for the demonstrated effect. To examine this possibility, we compared the scores on the three questions excluded from the Fresno Test, finding no difference in scores. While not a precise comparator, this lack of change increases the likelihood that the intervention was responsible for the improved scores.

Most of the faculty members at our residency have received formal training in information mastery. A number of the core faculty members

have attended a 3- or 4-day workshop to learn how to teach information mastery; ancillary faculty have received one-on-one training and some faculty development. This extensive training of the faculty is in contrast to many residencies at which there is one “EBM expert” charged with teaching the skills and knowledge. We believe that for the culture of a residency to embrace an evidence-based approach to the care of patients, most faculty members will have to receive formal training.

This approach to teaching EBM techniques and the practice of information mastery can be achieved in most residencies that can devote the time to it in their curricula. It has been used in other teaching programs.²¹⁻²⁴ Materials from the Information Mastery Group are available to interested faculty members.

CORRESPONDING AUTHOR: Address correspondence to Dr Shaughnessy, Tufts University Family Medicine Residency at Cambridge Health Alliance, 195 Canal Street, Malden, MA 02148. 781-338-0507. Fax: 781-338-0150. allen.shaughnessy@tufts.edu.

References

- Khan KS, Coomarasamy A. A hierarchy of effective teaching and learning to acquire competence in evidence-based medicine. *BMC Med Educ* 2006;6(1):59.
- Sackett DL, Rosenberg WM, Gray JA, Haynes RB, Richardson WS. Evidence-based medicine: what it is and what it isn't. *BMJ* 1996;312(702):71-2.
- Dawes M, Summerskill W, Glaszian K, et al. Sicily statement on evidence-based practice. *BMC Med Educ* 2005;5(1):1.
- Epling J, Smucny J, Patil A, Tudiver F. Teaching evidence-based medicine skills through a residency-developed guideline. *Fam Med* 2002;34(9):646-8.
- Hatala R, Guyatt G. Evaluating the teaching of evidence-based medicine. *JAMA* 2002;288(9):1110-2.
- Parkes J, Hyde C, Deeks J, Milne R. Teaching critical appraisal skills in health care settings. *Cochrane Database Syst Rev* 2001(3):CD001270.
- McCord G, Smucker WD, Schrop SL, et al. Answering questions at the point of care: do residents practice EBM or manage information sources? *Acad Med* 2007;82(3):298-303.
- Coomarasamy A, Taylor R, Khan KS. A systematic review of postgraduate teaching in evidence-based medicine and critical appraisal. *Med Teach* 2003;25(1):77-81.
- Coomarasamy A, Khan KS. What is the evidence that postgraduate teaching in evidence-based medicine changes anything? A systematic review. *BMJ* 2004;329(7473):1017.
- Straus SE, Ball C, Balcombe N, Sheldon J, McAlister FA. Teaching evidence-based medicine skills can change practice in a community hospital. *J Gen Intern Med* 2005;20(4):340-3.
- Shaughnessy AF, Slawson DC, Bennett JH. Becoming an information master: a guidebook to the medical information jungle. *J Fam Pract* 1994;39(5):489-99.
- Slawson DC, Shaughnessy AF. Obtaining useful information from expert based sources. *BMJ* 1997;314(7085):947-9.
- Slawson DC, Shaughnessy AF. Teaching evidence-based medicine: should we be teaching information management instead? *Acad Med* 2005;80(7):685-9.
- Grad R, Macaulay AC, Warner M. Teaching evidence-based medical care: description and evaluation. *Fam Med* 2001;33(8):602-6.
- Kahan NR, Fogelman Y, Waitman DA, et al. Teaching evidence-based medicine in a managed care setting: from didactic exercise to pharmacopolicy development tool. *Am J Manag Care* 2005;11(9):570-2.
- Oude Rengerink K, Thangaratinam S, Barnfield G, et al. How can we teach EBM in clinical practice? An analysis of barriers to implementation of on-the-job EBM teaching and learning. *Med Teach* 2011;33(3):e125-e130.
- Slawson DC, Shaughnessy AF. Teaching information mastery: creating informed consumers of medical information. *J Am Board Fam Pract* 1999;12(6):444-9.
- Alper B. Society of Teachers of Family Medicine Evidence-based Medicine Group's Global Competencies for Information Management: Information Mastery and Information Technology, 2004.
- Ramos KD, Schafer S, Tracz SM. Validation of the Fresno test of competence in evidence-based medicine. *BMJ* 2003;326(7384):319-21.
- Shaughnessy AF, Schlicht JR, Vanscoy GJ, Merenstein JH. Survey and evaluation of newsletters marketed to family physicians. *J Am Board Fam Pract* 1992;5(6):573-9.
- Force RW. Evidence-based medicine and information mastery: application for acute gastrointestinal conditions. *Pharmacotherapy* 2003;23(10 Pt 2):61S-67S.
- Hurwitz SR, Slawson DC. Should we be teaching information management instead of evidence-based medicine? *Clin Orthop Relat Res* 2010;468(10):2633-9.
- Evidence informed decision making 2: Dealing with information overload. Less than 60 minutes e-learning events, 2011. www.npc.nhs.uk/evidence/eidm2_info_overload/less-than_sixty.php. Accessed April 6, 2011.
- Making decisions better. Information Mastery. http://www.npc.nhs.uk/evidence/eidm3_individuals/movie/info_mast_hi_res.php. Accessed March 5, 2012.
- Ebell MH, Siwek J, Weiss BD, et al. Strength of recommendation taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. *J Am Board Fam Pract* 2004;17(1):59-67.