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

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BACKGROUND AND OBJECTIVES: Teaching evidence-based medicine is becoming more frequent in family medicine residency education, and 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.

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of EBM are integrated into all educational activities.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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 competency, 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.\textsuperscript{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...
“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/lowyrvassarStats.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.
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 usable 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.

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.
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

**Figure 1: Changes in Confidence in Using the Medical Literature**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Pre-intervention curriculum</th>
<th>Post-intervention curriculum</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am capable of selecting and using evidence at the point of care</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>I mistrust experts’ interpretation of the literature (reversed)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>I am comfortable with using medical information</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>I have received enough instruction in reading and understanding medical literature</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>EBM creates legal problems (reversed*)</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>I have learned enough to evaluate research studies</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>I am confident knowing which journals to read</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

EBM—evidence-based medicine

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

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References