Teaching Information Mastery: Creating Informed Consumers of Medical Information

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Background: The concepts of evidence-based medicine are permeating all specialties, including family practice. This article describes a curriculum to teach residents the principles and practices of information mastery, a derivation of evidence-based medicine that is more relevant to family physicians.

Methods: The curriculum is a 2-year longitudinal experience consisting mainly of didactic presentations and demonstrations in the first year followed by small-group sessions in the second year. Residents are taught the concepts of the previously described approach of information mastery and the application of these concepts to the variety of information resources available to them. Specifically, residents are taught how to find, evaluate, and apply information available from original research literature, review articles, meta-analyses, translation (controlled-circulation) journals, continuing education lectures, experts and colleagues, pharmaceutical representatives, and clinical experience.

Results: Using a before-after design at two institutions, the curriculum improved residents' attitudes, confidence regarding the medical literature, their perceptions of their ability to evaluate the published literature, and their use of information sources.

Conclusions: Offering a structured curriculum to family practice residents creates dynamic, confident, and independent clinicians skilled in the art of information mastery. (J Am Board Fam Pract 1999; 12:444–9.)

Everyone who teaches learners at any level can be thought of as being in the business of delivering information. The goal of the business is to deliver one's product –the information to be taught –to the learner-buyers. Effectively packaging information for clinician consumers to use for delivering high-quality care to their patients requires the coordination of four divisions of the information business (Figure 1).

The overall concept of medical information management can be illustrated using a business analogy involving an oil company. Just as the production division of an oil company has to drill for oil in the ground, the production division in medical information has to use original research to drill for new information. Like crude oil, information derived from research has to be refined into systematic reviews, cost-effectiveness analyses, decision analyses, meta-analyses, practice guidelines,

and consensus statements. Informatics is the distribution division of our medical information company, getting the refined information out to the clinician consumers.

The last division of the medical information business, consumer education, has the goal of making consumers aware of the product – new and better information for use in the care of their patients – and how best to acquire, evaluate, and use this information. To address the need for an effective method of marketing new medical information, we developed a longitudinal residency curriculum that provides specific strategies for acquiring active, ongoing, and confident approaches to managing new medical information. It is designed to equip residents with the ability to specify their information needs, select strategies for choosing appropriate sources of information, evaluate the new information, and apply the results of these processes in coordination with their existing knowledge. Both authors attended a workshop on learning critical appraisal skills to read the medical literature at McMaster University. Based on this information, the current curriculum was designed and specifically oriented to family physicians.

The curriculum was developed at the Harrisburg Family Practice Residency from 1992 to 1994.
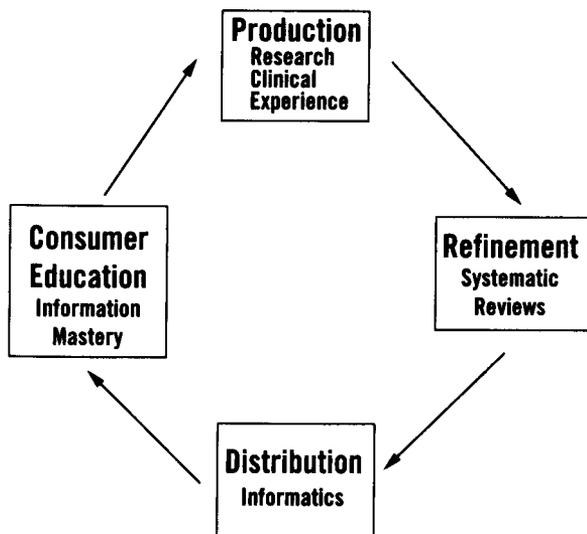
Figure 1. The information business

In 1994, the same curriculum was then initiated de novo (by DCS) at the family practice residency program of the University of Virginia to 24 residents and 8 faculty, again supported in a similar fashion by both the chair and faculty. At that time an evaluation process was developed and implemented at both sites.

Conceptual Framework of the Curriculum

The core concepts taught in this curriculum have been described in a series of articles.[1,2] Briefly, the basic premise is that different types and sources of information are of variable usefulness to the clinician, and that by using strict criteria, the clinician can choose sources that will be most useful for different clinical situations.

Useful information must have the following three attributes: it must be *relevant* to the patients and problems seen in everyday practice, it must be *true* (valid), and *easy* to obtain. These three factors can be related in the following formula:

Usefulness of medical information

$$= \frac{\text{Relevance} \times \text{Validity}}{\text{Work}}$$

The relevance of any information is based on the *frequency* of one's exposure to the problem being addressed by the information, the *type of evidence* presented, and whether the information should lead to a *change* in clinician behavior. Medical information can be categorized as either disease-oriented (ie, evaluating intermediate or surrogate endpoints) or patient-oriented (final outcomes of importance to patients). The most relevant information is patient-oriented evidence focusing on medical problems common to clinicians in a particular specialty. Patient-oriented evidence that justifies a change in practice is termed *patient-oriented evidence that matters* (POEM).

The validity of information defines the extent to which the information represents the truth. Work consists of factors such as time needed to obtain the information, monetary cost of the information, and mental energy required to track down the answer.

These three factors from the usefulness equation are explored in depth in the curriculum. In addition, the mechanics of information retrieval are presented and practiced, and ethical issues are explored, building a foundation of responsible information management by each future clinician.

The course is a 2-year longitudinal curriculum taught during 45-minute lunch-time sessions. In the first year of the cycle, sessions are held twice each month. Didactic presentations (see Table 1 for content) are used to introduce the concepts and critical evaluation techniques. Following each didactic presentation is a session devoted to critiquing an assigned article or other source of information. We have developed specific information mastery worksheets for critiquing and evaluating articles on therapy, prognosis, diagnosis, reviews, practice guidelines, qualitative research, and decision-cost analysis, all of which have an emphasis on relevance (copies available on request).

The second year of the cycle consists of small-group sessions that allow participants to practice the techniques of selecting an information source and evaluating its validity. Two to three sessions each month then focus on a clinical question or a recently published article. Residents assigned to each session are responsible to provide either a clinical question with evidence to be evaluated or a potentially valid POEM from the recent medical literature. In addition to the lunch-time sessions, the concepts and practice of information mastery are integrated into other teaching activities, including inpatient rounds and office-based teaching, as well as during conferences and pharmaceutical representative presentations.

Table 1. Outline of Information Mastery Sessions Presented in the First Year.

Session	Contents
I. Overview of concepts of information mastery and introduction	1. Reasons for developing information mastery 2. Necessity, as patient advocate, of accepting personal responsibility for managing information 3. Description of medical information system 4. Explanation of usefulness equation 5. Recognizing and contrasting POEMs (patient-oriented evidence that matters) with DOEs (disease-oriented evidence)
II. Focus on work and how to minimize it	Accessing the medical information system; hands-on training in MEDLINE searching, use of the Cochrane Library, Best Evidence, and InfoRetriever, and use of handheld computers
III–X. Validity assessment of original research and academic reviews	Specific information mastery worksheets used. Methods to appraise critically research and review articles modeled after those developed by the Evidence-Based Medicine Working Group[3]
XI–XV. Application of the usefulness equation	Similar concepts used to evaluate the medical literature are applied in the context of the usefulness equation to medical education lectures, nonsystematic review articles[4] pharmaceutical representatives[5] experts[6] newsletters, practice guidelines and consensus statements, and decision and cost analyses
XVI. The interplay of clinical experience, evidence-based medicine, and outcomes research	Relevance of clinical experience blended with the rigor of the scientific method[7]
XVII. Controversies with information management	Large-group discussion co-moderated by a behavioral medicine faculty member addresses the ethical implications of managed care and the personal responsibility for maintaining clinical competence

Questions and potential POEMs brought to the sessions are varied and usually reflect dilemmas of importance to residents. The curriculum leader or other faculty members work with residents to create questions that can be answered.[8] Articles are chosen carefully to ensure that they provide patient-oriented evidence suitable, if valid, to answer the question being asked.

The articles evaluated in the sessions are usually original research articles, but they also can be review articles, meta-analyses, textbooks, or even the recommendations of a local expert. Appropriate worksheets are provided, and the course moderator serves as a facilitator. Residents are encouraged to develop a course of action, if appropriate, based on their evaluation of the information.

The curriculum was evaluated by using a before-after design of residents from both sites who had completed the 2-year curriculum. The following three domains were measured by means of an anonymous, self-administered, 24-item questionnaire: (1) general attitude toward the use of the medical literature to improve patient care (7 items); (2)

self-perceived ability to evaluate clinical research trials (5 items); and (3) self-reported use of information sources either to keep-up or to answer specific patient questions (12 items).

The self-administered questionnaire consisted of statements with a five-point Likert scale for residents to indicate their degree of agreement. Questionnaire development began with a long list of survey items adapted in part from Landry et al,[9] Linzer et al,[10] Seelig,[11] and Stern et al.[12] This extensive questionnaire was pilot tested among family practice residents and faculty not involved in the evaluation. Items that were found to discriminate well among high and low scorers were selected, and the survey was again pilot tested. To assure internal validity, several directionally opposed statements were included. The questionnaire was administered to all residents of both programs at the beginning and at the end of the 2-year curriculum. For tallying, the responses to each item were given a number from 1 to 5, with more desired responses receiving higher scores. The sum scores for each domain were used for comparison.

Table 2. Effectiveness of the Curriculum.

Domain	Site 1 (n = 15)	Site 2 (n = 14)	Combined Sites (n = 29)
General attitude toward the use of medical literature (maximum score: 35)			
Pretest average score	22.1	20.6	21.1
Posttest average score	28.1*	25.6*	27.0*
Self-perceived ability to evaluate clinical research trials (maximum score: 25)			
Pretest average score	18.5	17.7	18.3
Posttest average score	22.3*	20.5*	21.3*
Self-reported use of information sources (maximum score: 110)			
Pretest average score	25.5	26.4	26.0
Posttest average score	36.5*	35.7*	36.1*

*P value for both the unpaired t test and the Mann-Whitney U test was less than .05.

To test for significance, both the unpaired t test and the Mann-Whitney U (Wilcoxon rank sum) test were performed on the data from each test site as well as the data combined from the two groups.

Curriculum Effectiveness

Results of the evaluation are presented in Table 2. After being exposed to the complete curriculum, learners at both sites had significantly improved attitudes toward the use of medical information and had significantly increased their assessment of their ability to evaluate a research paper. They also significantly improved the mix of information sources they used to keep up or answer patient-related questions, increasing their use of evidence-based instead of expert or anecdotal-based information sources. Specifically, the learners rated their confidence more highly in choosing which journals to read; reading and understanding the medical literature; retrieving, evaluating, and using medical information; comfort about disagreeing with expert interpretation of medical information; and deciding when to incorporate the results of clinical research into their practice.

Discussion

Richard Smith[13] has written that, despite the overwhelming amount of published information available, clinicians usually turn to the advice of colleagues to solve patient care dilemmas. To encourage the use of the medical literature in clinical decision making, excellent guides have been developed.[3] We used these guides for 3 years in our residency program before implementing the curriculum described above. Informal feedback from graduates and private practitioners in the community confirmed our belief that using the medical literature to stay up to date and answer clinical-based questions remains largely impractical and is rarely done by clinicians in private practice.

Other investigators have reported similar findings. Although most clinicians rate journal articles as their preferred source of new information, busy clinicians rarely use them, even when computer access is provided.[4,14–16] Because of the considerable time constraints of private practice, the necessary 1 to 2 hours per week of uninterrupted time evaluating clinical trials is unrealistic.[3] An evidence cart[17] could be a way to bring quick access to relevant evidence to the point of care, but perhaps a more practical approach will be information provided through handheld computers.[18,19]

Additionally, using the original literature to answer specific patient problems within narrow time constraints could actually be harmful. Whereas researchers evaluate articles in their area of expertise and are usually familiar with previously published research, the busy clinician using the research literature to answer clinical questions might stop searching before all the relevant information is found and evaluated. The possibility of not getting the whole story and thus relying on medical gossip[1] is high.

When accessing the medical information system, practicing clinicians are often interested in updating their current practice patterns as well as answering a particular patient-related question. This curriculum focuses on teaching a practical evaluation of all sources of medical information available to busy clinicians. We have shown an

increase in resident-learner confidence, comfort, and skill with evaluating and using medical information sources to make clinical decisions.

Residents in both programs were required to attend at least 75% of the conferences. The curriculum was taught independently in the two separate institutions. Each of the instructors have different teaching styles and roles in their respective departments (one is an clinical faculty physician and the other is a pharmacologist). Thus, we believe it is unlikely that cohabitation of the instructors with the residents, and not the curricular instruction itself, is responsible for the observed changes.

We believe, however, that our efforts to encourage evidence-based practice are slowed by two factors. First, this curriculum conveys concepts that are in conflict with the expert-based learning methods emphasized in traditional medical schools, and residents are hesitant to abandon this model. Second, insufficient role model activity by resident faculty who also continue to rely on expert-based and anecdotal or experiential learning and teaching could inhibit acceptance of these methods. To address these issues, we have developed a formal faculty development workshop, and future plans include designing and testing a predoctoral curriculum. We plan to continue to evaluate resident attitudes, behaviors, and skills.

Other researchers in addition to ourselves are continuing to evaluate the effects of this curriculum. Stevermer and colleagues[20] have reported success with using a short one-on-one session with residents to improve their performance in evaluating the relevance of the research literature. Flynn and Helwig[21] are evaluating the effects of this curriculum on resident attitudes as well as their specific information mastery skills.

Evaluating the practical implementation of these techniques in the real-world setting will be important. Ideally, we would like to determine whether this curriculum meets the goal of improving patient-oriented outcomes. Intermediate outcomes, such as improved compliance with guidelines, appropriate choices of medications, and appropriate use of ancillary services can be measured by chart reviews. Further research into evaluating outcomes will tell us whether this curriculum is successful. Offering this same information to practicing clinicians as well as practitioners in other primary care disciplines will be important as well.

Academic family medicine has successfully contributed to the creation of a new information base; now is the time to embrace the concept of responsibly managing and disseminating new information. Offering a structured curriculum to all residents is crucial for training dynamic, confident, and independent information masters of the future. Practicing physicians who stay abreast of rapidly changing medical information in a deliberate and skilled manner will cement their position as the true patient advocate when making medical decisions.

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