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# Should We Be Teaching Information Management Instead of Evidence-based Medicine?

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**Abstract**
*Background* To encourage high-quality patient care guided by the best evidence, many medical schools and residencies are teaching techniques for critically evaluating the medical literature. While a large step forward in many regards, these skills of evidence-based medicine are necessary but not sufficient for the practice of contemporary medicine and surgery. Incorporating the best evidence into the real world of busy clinical practice requires the applied science of information management. Clinicians must learn the techniques and skills to focus on finding, evaluating, and using information at the point of care. This information must be both relevant to themselves and their patients and be valid.
*Where are we now?* Today, orthopaedic surgery is in the post-Flexner era of passive didactic learning combined with the practical experience of surgery as taught by supervising experts. The medical student and house officer fill their memory with mountains of facts and classic references 'just in case' that information is needed. With libraries and now internet repositories of orthopaedic information, all orthopaedic knowledge can be readily accessed without having to store much in one's memory. Evidence is often trumped by the opinion of a teacher or expert in the field.
*Where do we need to go?* To improve the quality of orthopaedic surgery there should be application of the best evidence, changing practice where needed when evidence is available. To apply evidence, the evidence has to find a way into practice without the long pipeline of change that now exists. Evidence should trump opinion and unfounded practices.
*How do we get there?* To create a curriculum and learning space for information management requires effort on the part of medical schools, residency programs and health systems. Internet sources need to be created that have the readily available evidence-based answers to patient issues so surgeons do not need to spend all the time necessary to research the questions on their own. Information management is built on a platform created by EBM but saves the surgeon time and improves accuracy by having experts validate the evidence and make it easily available.

## Introduction

In the past 10 years, two major changes have occurred in the processing of information in medicine: the widespread and easy availability of the medical research literature to both clinicians and their patients and movement away from expert-led medicine to practice directed by patient-centered, outcomes-based research. Evidence-based medicine (EBM) is a process by which outcomes that matter to the patient are derived by the surgeon from a 5 step paradigm. This has become the approach developed to help clinicians manage patient-centered information, and many schools and residencies are using EBM to help their learners

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achieve the practice-based learning and improvement competency mandated by the Accreditation Council for Graduate Medical Education [1]. However, teaching clinicians EBM as a means to answer clinical questions and then expecting them to be expert information managers may be a setup for failure by providing skills that are not relevant to their day-to-day practice [25]: EBM is time-consuming and not all clinicians are good evaluators of conflicting information since medical literature is rarely uniform.

Current lack of success in teaching and implementing EBM [38, 41, 43] suggests a framework of information management may be the necessary tool for clinicians to practice in a way that is called for by the Institute of Medicine [8]: safe, effective, efficient, and, most important, patient centered [43]. This change in orientation from traditional EBM to information management will require a new approach to teaching medical students, residents, and practicing orthopaedists.

## Evidence-based Medicine as an Information Framework-Background

The concept of teaching information management is taken from work by Slawson and Shaughnessy [41, 43, 44]. In fact, the title for this presentation at the workshop comes from one of these publications: "Teaching Evidence Based Medicine: Should We Be Teaching Information Management Instead?" [43]. The content of this manuscript is similar, with more substance added concerning application of information management to training orthopaedic residents, fellows, and practicing surgeons. EBM consists of a five-step process: (1) developing a question using the populations-intervention-comparison-outcome format; (2) finding research that may answer the question; (3) evaluating the research for validity, impact, and applicability; (4) applying the information to clinical decision making; and (5) periodically evaluating one's outcomes after implementation and performance of the previous four steps [33]. The EBM process creates a cybernetic loop which, after Step 5 (evaluation in performance), improves the quality of the initial question and all the steps leading to patient care.

As has been noted by supporters and critics of the EBM process, there are problems with both the teaching and implementing of EBM as a point of care clinical tool [16, 33, 34, 41]. EBM does not work as a process during a busy clinical practice: it demands considerable time gathering and analyzing information. "Keeping up helps the clinician find some of the material more quickly but doesn't speed up the process to be useful in clinic time. A common shortcut in information management has been called "satisficing", "where busy clinicians will be satisfied with the information they can readily summon, while sacrificing quality for convenience" [3, 15, 42]. Schilling et al. [43] found internal medicine residents pursued about 30% of their questions during a typical office session and pursued the other 70% only when intentionally given time during their office sessions to answer the questions they developed [17]. And, instead of striving to find the best evidence, most busy full-time clinicians report they do very little critical reading, instead relying on summaries and practice guidelines, regardless of whether these are evidence based [24, 29, 30]. Similar data on point-of-care information gathering has not yet been obtained for practicing orthopaedic surgeons and is unlikely to be gathered in the near future due to the pressures placed by financial reality in the current practice environment. An orthopaedic surgeon is just as likely to need ready information to answer a patient query as any other specialist and will need rapid access to accurate and valid information.

In one clinical trial evaluating the application of the EBM process, the only way practicing clinicians were able to answer their questions at the point of care in the real world was to rely on predigested information, such as that provided by the abstracting services or previously self-developed evidence-based summaries [32]. In the absence of guidelines, the cost of simply obtaining the original research articles can be substantial, estimated to be in one example on finding information about ACL reconstruction from 2002 approximately $800 in interlibrary loan costs to answer the question [46].

Since the basic EBM process cannot be applied at the bedside, the use of critical appraisal has been recommended only for select questions encountered in one's practice, based on frequency [16, 33]. For common problems, the EBM approach suggests each individual clinician, working independently, or at best with a small group, should set aside 1 or 2 hours per week to critically appraise all the existing primary literature and/or systematic reviews and come up with his or her own conclusions regarding its validity and relevance [23]. Orthopaedists should have at their disposal information that is synthesized from high-level evidence that is predigested, giving an evidence-based answer to their questions for diagnosis or treatment issues infrequently encountered in practice. For problems that occur very infrequently, clinicians should "… seek, accept, and apply the recommendations we receive from authorities (consultants) in the relevant practice of medicine" [33]. In this frequency-based approach to problem solving at the point of care, critical appraisal skills are infrequently used to answer common questions in office practice and are less frequently used during the surgical treatment of patients. That is, most evidence is not put into practice for reasons that primarily have to do with the outlook and approach taken by the surgeon.

The EBM process requires that each individual surgeon has sufficient critical appraisal skills and the ability to choose the right article(s) to evaluate, the confidence in these skills to rely on the derived answer, the tools or ability to recall the information when needed, and, perhaps most important, the courage to base practice on this evidence-based foundation. This process is not a patient-centered approach; in fact, it is surgeon-centric. To the patient, the prevalence of the problem they currently have is 100% and thus of high importance and deserving of the greatest amount of intellectual determination his or her surgeon can supply. There is a further deficiency in the classic EBM approach: by relying on recommendations of experts for unusual problems in orthopaedics, if the injury or condition is uncommon in the clinician's practice, it is less likely the clinician will receive or process updates, making it even more likely he or she will have information that is outdated and likely incorrect. A knowledge gap is created by the surgeon who does not forage for up-to-date, valid information, possibly increasing the likelihood of an error in judgment or decision making when a subspecialist is not available or not consulted.

The EBM process also requires clinicians in practice to stay current, not only with clinical content but also with changes in critical appraisal techniques. As an example, the value of concealed allocation- a potential issue with randomization in controlled trials- when conducting prospective research has only recently entered the EBM literature [28, 36]. For the evaluation of guidelines or review articles, the Strength of Recommendation Taxonomy (SORT), which includes relevance and validity assessments, has fairly recently been introduced [37]. Clinicians unaware of these most current evaluations would be using out-of-date methods. Thus, while trying to keep up to date, a less than diligent clinician may inadvertently fall behind in best practices.

## Patient-centered Information Management

The reason for teaching information management rather than EBM stems from the needs of clinicians in active practice to get and apply EBM in the clinic and in the hospital. The focus of information management is on the usefulness of information to patient care, defined in formula as:

$$\text{Usefulness (of any information source) [13, 19]} = \frac{\text{relevance} \times \text{validity}}{\text{work}}$$

Relevance of information is defined in terms of its direct applicability to the care of patients and involves three qualifications: (1) Does the information focus on outcomes patients care about? Will the information help patients to live better? (2) Is the treatment feasible and is the problem common in one's clinical practice? (3) Would the information, if true, require a change in clinical practice? That is, the information should show an intervention helps patients live better, is feasible to implement, and would require a change in a clinician's practice.

Slawson and Shaughnessy developed the term "Patient-oriented Evidence That Matters" (POEM) to characterize research findings that meet these criteria [33]. Validity is the technical effort that is the aim of EBM, and work can be defined in terms of the time or effort required to produce an answer to a clinical question.

There are several factors that would determine the approach a surgeon takes to the orthopaedic literature. Some of the elements are (1) the clinician's awareness that new information is available; (2) the belief that current options are unacceptable or did not work; (3) the availability of familiar sources; (4) the perceived likelihood that an answer can be found; (5) the fear of liability if the standard of care is not followed; and (6) the time available to search for the answer [14, 17, 41]. In a study of 103 physicians with a total of 1101 questions during clinical practice, the physicians pursued answers to only 36% of their questions. When attempting to get the information needed to answer their questions, more than ½ of the participants spent less than 60 seconds before either finding their answer or quitting their search [17].

Information management focuses on using readily available information tools to remain up to date with new valid information that is relevant to the diagnosis and care of patients and is accessible while taking care of patients. These information tools can be divided into "foraging tools" that clinicians can use to be alerted to new, relevant, and valid information and "hunting tools" that allow clinicians to quickly find that information again when needed (Table 1) [12]. Both foraging and hunting tools are needed for effective practice. The best of these tools provide information that is filtered for relevance to clinical practice, is critically appraised for validity using EBM techniques, and is presented in a style that is easily understood by busy clinicians, which greatly reduces the amount of work expended to deliver the best information [14].

Foraging tools, or current awareness services such as Daily POEMs [39], Journal Watch [22], OWL [26], and others, are available to alert clinicians to new information that should influence their care of patients. However, information obtained in this way rarely results in the clinician's learning more than simply that the actual information exists (life would be so much easier if we could read something once, reflect on it, and then

**Table 1.** Criteria for high-quality hunting and foraging tools [27, 41, 43]

| Criteria |
|---|
| Foraging tool |
| Filters out disease-oriented research and presents only patient-oriented research outcomes |
| Demonstrates a validity assessment has been performed using appropriate criteria |
| Assigns levels of evidence, based on appropriate validity criteria, to individual studies |
| Provides specific recommendations, when feasible, on how to apply the information, placing it into clinical context |
| Comprehensively reviews the literature for a specific specialty or discipline |
| Coordinates with a high-quality hunting tool |
| Hunting tool |
| Uses a specific, explicit method for comprehensively searching the literature to find relevant and valid information |
| Provides key recommendations supported by patient-oriented outcomes when possible and, when not, specified as preliminary when supported only by disease-oriented outcomes |
| Assigns levels of evidence† or strength of recommendation‡ to key recommendations using approved criteria |
| Coordinates with a reliable foraging tool |

These are currently available tools that enable clinicians to remain up to date with new valid information that is relevant to patient care and is accessible while taking care of patients.

remember it flawlessly when it is needed). Thus, a hunting tool is needed to retrieve relevant and valid information quickly when it is required in the care of patients. A number of hunting tools exist, but most do not provide an answer in less than a minute, and only a few such as Dynamed [11] and InfoRetriever [39] have both specific patient-oriented evidence criteria and validity ratings (levels of evidence) for included information.

## Skills Needed

With the focus on information management, rather than simply the basic tenets of critical appraisal, clinicians can focus on understanding, interpreting, and applying the information in their own clinical situation. Good information tools will provide a variety of levels of information, where available, to suit the individual needs of the clinician. Several investigators have had success teaching information management using point-of-care tools that provide prefiltered, prevalidated information to medical students [11, 18, 23].

Not all sources provide the same degree of relevant and valid information. Information in newsletters often is not complete [21], current awareness services vary widely in their presentation of patient-oriented information [38], and review articles often selectively omit or skew crucial information that might affect the care of patients [45]. Clinicians need to be armed with the skills to identify sources of accurate and relevant information at the point of care. These are not information evaluation skills but information management skills.

Slawson and Shaughnessy [40] have created and tested a curriculum to teach the principles of information management. The curriculum has three levels [43]: Level 1 is for clinicians who can use the concepts to make better patient care decisions; Level 2 is for teachers and writers who teach clinicians the curriculum and provide evidence-based reviews of original research; and Level 3 is for researchers who are adept at conducting decision analysis, meta-analysis, and other techniques of synthesizing raw research information into useable clinical information. The modules in this curriculum for each level are shown (Table 2).

### Level 1: Manage Information at the Point of Care

At Level 1, the goal of the curriculum is to elevate all clinicians to a level of information management proficiency whereby they can recognize, obtain, and use the highest-quality information available for everyday clinical decision making. In contrast, only a fraction of clinicians from each specialty need detailed training in critical analysis of the original literature, and even fewer need training in Level 3 activities.

The specifics of the curriculum are outlined in print and online resources [31, 40, 44], and workshops are regularly presented [20]. The curriculum introduces students to the concepts, prepares residents to meet the practice-based learning and improvement competency [1], and equips practicing clinicians for lifelong learning and performance in practice aspects of the maintenance of certification [40] process [2]. It also allows physicians to take advantage of the newly developed point-of-care continuing medical

**Table 2.** Modules in the three levels of an information mastery curriculum developed by the authors [27, 44]

| Modules |
|---|
| Level 1: For all practicing clinicians |
| Information mastery: finding the best evidence for everyday practice |
| Is it patient-oriented evidence that matters (POEM)? Assessing relevance before rigor |
| Is it true? Evaluating information about therapies |
| Don't panic: basic statistics you need and can understand |
| A pocket full of possibilities: "just-in-time" information at the point of care |
| Evaluating expert-based information systems, including colleagues, continuing medical education presentations, reviews, and practice guidelines |
| Handheld computers in medicine |
| The true mission of information mastery: using "medical poetry" to reduce health disparities |
| Is it true? Evaluating information about diagnostic tests and clinical decision rules |
| Using computerized clinical decision rules to make clinical decisions and obtain CME credit at the point of care |
| Separating the wheat from the chaff: obtaining useful information from pharmaceutical representatives |
| Bumps in the road to practicing information mastery |
| "Clinical jazz"—harmonizing clinical experience and evidence-based medicine |
| Level 2: For a small percentage of clinicians in each specialty |
| Critical appraisal and interpretation of research on: |
| Therapies |
| Diagnostic tests |
| Prognosis |
| Critical evaluation and interpretation of: |
| Systematic reviews, including meta-Analysis |
| Decision analysis |
| Practice guidelines |
| Pharmaceutical advertising, including pharmaceutical representatives |
| Assigning levels of evidence to research findings to |
| Teaching Level 1 skills |
| Written communication of research findings |
| Physicians |
| Patients |
| Level 3: For a few researchers in medicine |
| Performing systematic review |
| Performing decision analysis |
| Performing cost analysis |

education credit, which is useful for both maintenance of certification and medical license renewal.

## Level 2: Select the Appropriate Hunting Tool

The surgeon should have the skill to apply a hunting tool, accessible at the point of care, that presents information prefiltered for relevance, preappraised for validity using explicit criteria, marked with a level of evidence, and placed in the clinical context of the user [47]. "Just-in-time" [7] hunting tools are available that reduce work by using decision support tools, calculators, and other means to make information more accessible and easier to use.

## Level 3: Develop Patient-centered, Not Evidence-centered, Decision Making

The goals of orthopaedic surgery are to relieve or prevent suffering [5, 7] and to prevent, treat, or cure diseases and injury of the musculoskeletal system. EBM is able to help achieve orthopaedic goals by making the surgeon aware of better evaluation and treatment than may be in current practice. Thus, the best evidence is only a factor in the recommendations (perhaps including a number of alternatives) the surgeon gives to the patient: it is not the decision itself. The patient-centered model of care focuses on empowering the patient to be the best decision-maker possible as well as viewing the patent in the standard

biomedical model as a person with a condition in need of treatment [4]. The clinical decision is based on combining the best patient-oriented evidence with patient-centered care in the mind of the physician, who puts the evidence in perspective with the needs and desires of the patient.

## Teaching Applied Information Management

A growing number of informatics researchers and clinicians have documented clinicians infrequently use medical literature for answers, instead relying on their own background knowledge or intuition (ie, educated guessing) [10, 15, 17, 48]. It is not realistic to expect orthopaedic surgeons to develop a "searchable" question, find the information, evaluate it, and make a decision on it, all at the point of care with an office full of patients or an emergency patient going to surgery. This "educational high ground" of theory and technique EBM contrasts sharply with the "swampy lowland" of typical clinical practice, where corners must be cut, an answer must be found, and relevance is valued over academic rigor [9, 35, 45]. We now have technology, information sites and search engines that enable clinicians to search for the type of information they choose, when they need it, knowing the process has filtered out everything except information that is both relevant and valid. EBM is a necessary but not sufficient basic form of knowledge that is part of the platform on which information management can be practiced [6, 43]. That is why we believe it is preferable to master the applied science of information management- than to go through the process of EBM for each query- that allows clinicians to maximize the value of the usefulness formula (see above) in the information age [19, 43].

## Discussion

Orthopaedic surgeons work in a world in which access to medical information can provide rapid answers to queries. Taking that information access a step further would be to have access to high quality information that gives answers based upon EBM, that is relevant to the patient, has been analyzed and validated by EBM experts and is now ready to use. Information management is the engineering science that connects the surgeon to the high quality information when and where it's needed. Working backward toward our orthopaedists in training, learning to apply information management to patient-centered care requires a shift. That shift is away from wrestling with the 5 steps of EBM and moving to the appropriate level of IM.

Teaching IM is limited by the current shortage of professionals in the IM field with adequate experience with orthopaedic surgery. An additional limitation of the hunting and foraging needed for IM is the cost- both direct and indirect- created by the need to have ready access to the internet; there will be charges incurred from proprietary information sources**.** Ultimately these costs will be part of the expense of caring for patients as IM goes mainstream in the information age.

*Where are we now?* Teaching and implementing EBM as a way of improving the quality of orthopaedic care has been perceived as an improvement over the reliance upon expert opinion and case series. Though there are new experts in EBM, they serve a different purpose. The expertise required by the research workers in level 3 brings back the notion that there are again experts creating content in the information management scheme. The main difference from the contemporary expert giving level 4 evidence is the role of the new 'expert'- validating research methods, evaluations and conclusions rather than giving a personal opinion as to diagnosis or treatment.

*Where do we need to go?* All students, residents, and practicing physicians need three skills to practice the best medicine: (1) the ability to select foraging—"keeping up"—tools that filter information for relevance and validity; (2) the skills to select and use a hunting—"just in time"—information tool that presents prefiltered information easily and in a quickly accessible form at the point of care; and (3) the ability to make decisions by combining the best patient-oriented evidence with patient-centered care. This places the evidence in context of the needs and desires of the patient-promoting patient-centered care. This teaching of information management skills will prepare students and residents for a practice of medicine that includes lifelong learning.

We must first improve the quality of orthopaedic surgery there should be application of the best evidence, changing practice where needed when evidence is available. To apply evidence, the evidence has to find a way into practice without the long pipeline of change that now exists. Evidence should trump opinion and unfounded practices.

*How do we get there?* Starting with residency programs that have information management systems and staff, a pilot project could begin with a limited number of residents. Metrics developed by outcome questionnaires would demonstrate whether the usefulness of IM warrants full scale implementation of IM teaching during residency, and beyond.

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## References

1. ACGME Outcomes Project, General competencies. Available at: http://www.acgme.org/outcome/comp/compFull.asp. Accessed November 12, 2009.

2. American Board of Medical Specialties Maintenance of Certification. Available at: http://www.abms.org/MOC.asp. Accessed November 18, 2009.
3. Carter BS, Leuthner S. Decision making in the NICU—strategies, statistics and "satisficing." *Bioethics Forum.* 2002;18:7–15.
4. Cassel EJ. Diagnosing suffering: a perspective. *Ann Intern Med.* 1999;131:531–534.
5. Cassel EJ. The nature of suffering and the goals of medicine. *N Engl J Med.* 1982;306:639–645.
6. Center for Information Mastery, University of Virginia. Available at: http://www.healthsystem.virginia.edu/internet/familymed/docs/info_mastery.cfm. Accessed November 18, 2009.
7. Chueh H, Barnett GO. "Just-in-time" clinical information. *Acad Med.* 1997;72:512–517.
8. Committee on Quality Health Care in American, Institute of Medicine. *Crossing the Quality Chasm: A New Health System for The 21st Century.* Washington, DC: National Academy Press; 2001:5–6.
9. Curley SP, Connelly DP, Rich ED. Physicians' use of medical knowledge resources: preliminary theoretical framework and findings. *Med Decis Making.* 1990;10:231–241.
10. Curley SP, Yates JF, Young MJ. Seeking and applying diagnostic information in a health care setting. *Acta Psychol (Amst).* 1990;73:211–223.
11. Dynamed. Available at: http://www.dynamicmedical.com. Accessed November 29, 2009.
12. Ebell MH, Shaughnessy AF. Information mastery: integrating continuing medical education with the information needs of clinicians. *J Cont Ed Health Prof.* 2003;23:S53–S62.
13. Ebell MH, Siwek J, Weiss BD, Woolf SH, Susman J, Ewigman B, Bowman M. Strength of recommendation taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. *Am Fam Physician.* 2004;69:548–556.
14. Ely JW, Osheroff JA, Ebell MH, Bergus GR, Levy BT, Chambliss ML. Analysis of questions asked by family doctors regarding patient care. *BMJ.* 1999;319:358–361.
15. Gigernenzer G, Todd PM. *Simple Heuristics That Make Us Smart.* New York, NY: Oxford University Press; 1999.
16. Grad R, Macaulay AC, Warner M. Teaching evidence-based medical care: description and evaluation. *Fam Med.* 2001;33:602–606.
17. Green ML, Ciampi MA, Ellis PJ. Residents' medical information needs in clinic: are they being met? *Am J Med.* 2000;109:218–223.
18. Helwig AL, Flynn D. Using palmtop computers to improve students' evidence-based decision making. *Acad Med.* 1998;73:603–604.
19. Hurwitz SR, Slawson DA, Shaughnessy A. Orthopaedic information mastery: applying evidence-based information tools to improve patient outcome while saving orthopaedists' time. *J Bone Joint Surg Am.* 2000;82:888–895.
20. InfoPOEMs, Inc. Available at: http://www.InfoPOEMs.com/. Accessed November 18, 2009.
21. Johnston JM, Leung, GM, Tin KY, Ho LM, Lam R. Evaluation of handheld clinical decision support tool for evidence-based learning and practice in medical undergraduates. *Med Educ.* 2004;38:628–637.
22. JournalWatch Online. Available at: http://www.jwatch.org/. Accessed November 18, 2009.
23. Leung GM, Johnston JM, Tin KY, Wong IOL, Ho LM, Lam TH. A cluster randomized trial of clinical decision support tools to improve evidence-based medicine learning in medical students. *BMJ.* 2003;327:1090.
24. McColl A, Smith H, White P, Field J. General practitioners' perceptions of the route to evidence-based medicine: a questionnaire survey. *BMJ.* 1998;316:361–365.
25. Menzel H. Sociological perspectives on the information-gathering practices of the scientific investigator and the medical practitioner. In: McCord D, ed. *Bibliotheca Medica: Physician for Tomorrow.* Boston, MA: Harvard Medical School; 1966:127–128.
26. Orthopaedic Web Links. Available at: www.orthopaedicweblinks.com/news. Accessed November 30, 2009.
27. Oxford Center for Evidence-Based Medicine. Levels of evidence and grades of recommendation. Available at: http://www.cebm.net/levels_of_evidence.asp. Accessed November 30, 2009.
28. Oxman AD, Sackett DL, Guyatt GH. Users' guides to the medical literature. I. How to get started. *JAMA.* 1993;270:2093–2095.
29. Putnam W, Twohig PL, Burge FI, Jackson LA, Cox JL. A qualitative study of evidence in primary care: what the practitioners are saying. *CMAJ.* 2002;166:1525–1530.
30. Riordan FAI, Boyle EM, Phillips B. Best paediatric evidence: is it accessible and used on-call? *Arch Dis Child.* 2004;89:469–471.
31. Rosser WW, Slawson DC, Shaughnessy AF. *Information Mastery: Evidence-Based Family Medicine.* 2nd ed. Hamilton, Ontario, Canada: Decker Inc; 2004.
32. Sackett DL, Straus SE. Finding and applying evidence during clinical rounds: the "evidence cart." *JAMA.* 1998;280:1336–1338.
33. Sackett DL, Straus SE, Richardson WS, Rosenberg W, Haynes RB. *Evidence-Based Medicine. How to Practice and Teach EBM.* New York, NY: Churchill Livingstone; 2000:3–6.
34. Schilling LM, Steiner JF, Lundahl K, Anderson RJ. Residents' patient-specific clinical questions: opportunities for evidence-based learning. *Acad Med.* 2005;80:51–56.
35. Schon DA. *The Reflective Practitioner. How Professionals Think in Action.* New York, NY: Basic Books; 1983:42.
36. Schulz KF, Chalmers I, Hayes RJ, Altman DG. Empirical Evidence of Bias- Subverting randomization in controlled trials. *JAMA.* 1995;273:408–412.
37. Schulz, KF, Grimes DA. Allocation concealment in randomized trials: defending against deciphering. *Lancet.* 2002;359:614–618.
38. Shaughnessy AF, Schlicht JR, Vanscoy GJ, Merenstein JH. Survey and evaluation of newsletters marketed to family physicians. *J Am Board Fam Pract.* 1992;5:573–579.
39. Shaughnessy AF, Slawson DC. Are we providing doctors with the training and tools for lifelong learning? Interview by Abi Berger. *BMJ.* 1999;319:1280.
40. Shaughnessy AF, Slawson DC. What happened to the valid POEMs? A survey of review articles on the treatment of type 2 diabetes. *BMI.* 2003;327:266–269.
41. Shaughnessy AF, Slawson DC, Bennett JH. Becoming an information master: a guidebook to the medical information jungle. *J Fam Pract.* 1994;39:489–499.
42. Simon HA. *Models of Man, Social and Rational: Mathematical Essays on Rational Human Behavior in a Social Setting.* New York, NY: Wiley; 1957.
43. Slawson DC, Shaughnessy AF. Teaching evidence based medicine: should we be teaching information management instead? *Acad Med.* 2005;80:685–689.
44. Slawson DC, Shaughnessy AF. Teaching information mastery: creating informed consumers of medical information. *J Am Board Fam Pract.* 1999.12:444–449.
45. Slawson DC, Shaughnessy AF, Barry J. Which should come first: rigor or relevance? *J Fam Pract.* 2001;50:209–210.
46. Sloane PA, Brazier H, Murphy AW, Collins T. Evidence based medicine in clinical practice: how to advise patients on the influence of age on outcome of surgical anterior cruciate ligament reconstruction: a review of the literature. *Br J Sports Med.* 2002;36:200–203.
47. Smith R. What information do doctors need? *BMJ.* 1996;313:1062–1067.
48. Steward M, Brown JB, Weston WW, McWhinney ML, McWilliam CL, Freeman TR. *Patient-Centered Medicine. Transforming the Clinical Method.* Thousand Oaks, CA: Sage Publications; 1995.