CHAPTER

4

Clinical Applications and Update on Evidence-Based Medicine

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Introduction

Evidence-based medicine (EBM) and its approach to the practice of medicine has gained considerable acceptance among health-care professionals. Spurred by the vision of Prof. David Sackett, Prof. Gordon Guyatt and colleagues from McMaster's University, Canada and subsequently popularized by EBM workshops conducted by Oxford University, University of London and McMaster University instructions on teaching EBM has become a global phenomenon. In fact, the introduction of EBM in the medical school curriculum can definitely qualify as one of the greatest innovations in medical education in the past 2 decades.

The concept of evidence-based medicine (EBM) ensures that the physician are familiar with the calculated estimate of the patient's probability of having a disease and understand the estimated risks and benefits of tests and treatments[1]. These estimates are derived from the physician's ability to locate critical information from the current medical literature and their willingness to incorporate the patient's relevant values in the decision-making process. Despite an agreement on the definition of evidence-based health care, there remains considerable debate evolving what constitutes an evidence-based care. Physicians are encountering difficulties in entrenching EBM in mainstream clinical practice due to conflicting attitudes, different degrees of appreciation, onsite applicability, and ability to critically appraise articles. There remains numerous challenges and many physicians have difficulty in translating evidence – based information into effective communication[2], additionally there exist several factors that are not evidenced –based that determine physician behavior[3]. Physician's test ordering tendencies are based on Bayesian and several non-Bayesian factors.

In the present review we will discuss progress in EBM under two main headings;

1. **Clinical application of EBM**
    - *Challenges with retrieval of medical literature*
    - *Critically appraising medical literature*
    - *Applying evidence to patients*
    - *Patient-physician communications – opportunities and challenges*
2. **Update in Evidence-based medicine**
    - *The '5 S Model,' of finding best evidence*
    - *Use of Hand held computers for point of care.*
    - *Promises for the future- from computer decision support to ehealth and electronic health records*
    - *Combining best evidence to improve patient care: Evidence-based management*

Table I : Primary and Secondary sources of medical literature

PRIMARY SOURCES: These sources directly report findings from investigators

Medline maintained by National Library of Medicine (NLM). available free through the internet. PubMed and Grateful Med. are user friendly sites available at http://www.nlm.nih.gov. Medline is also available in CD ROMs sold by companies Ovid, Silver Platter Information Ltd.(WinSPIRS), Knight-Ridder, and EBSCO.

EmBase: Commercial database sponsored by Elsevier Science, includes articles from journals, monographs, conference proceedings, dissertations and reports. The web site is http://info.embase.com/embase_com/about/index.shtml Current Contents: Contains most recent information of any source. The web site to obtain Current Contents is http://www.isinet.com

SECONDARY SOURCES: Collection of articles, selected and critically appraised by an editor or an expert.

Cochrane Library: contains systemic reviews of over 70, 000 controlled trials http://www.cochrane.org/index.htm

ACP Journal Club: Periodical published by American College of Physicians, also available in Internet. http://www.acpjc.org/

Evidence-based Medicine: Periodical published by BMJ Publishing, also available on the Internet.

Best Evidence: A CD ROM containing articles from ACP Journal Club and Evidence-based Medicine, contains excellent comments by expert reviewers.

Up To Date: A CD ROM containing latest evidence and expert opinion on renal topics which is continually updated and is reissued every 4 months (www.uptodate.com)

- *Educational interventions to enhance evidence-based practice.*

Clinical application of EBM

The quality of medical care in most countries remain poor. It has been estimated that 45% of patients in US do not receive recommended care[4]. While the problems of decreased quality of care may be severe an effort to improve quality complex[5], it is felt that a thorough understanding of the patients medical condition, their personal value and efficient use of medical evidence could go a long way in lower practice variability.

In the following review we will identify the challenges of practicing EBM including retrieval and critical appraisal of literature, application of EBM to patients, examine the opportunities and challenges in patient- physician communication.

Challenges with retrieval of medical literature

There are numerous primary and secondary sources of searching the medical literature (Table 1). Recent reviews have stressed the need for all physicians in training and physicians in practice to master the technic of searching for primary (original articles) or secondary sources (systematic reviews, meta-analysis) of medical information using PubMed.[6] We will describe later in this chapter the current trend of literature retrieval using the 5 S model.[7]

EBM in its effort to keep abreast with rapidly-evolving scientific findings, relies on seeking current best evidence from virtual libraries or online sources and integrating them into patient values after ascertaining the validity of the evidence by critical appraisal. This process helps avoid relying on obsolete and archaic information from traditional textbooks. Reading is determined, among other things, by the ease in attaining literature. Scientific articles on MEDLINE/PubMed are available as either FUTON (Full Text on the Net) or NAA (No Abstracts Available) articles[8]. The innate tendency to pick the low-hanging fruit greatly enhances the odds that a FUTON article will be read or cited. This can create a bias, the FUTON or NAA bias, which may influence the visibility of research. It is probable that visibility and easy user availability may determine whether "available evidence" is adopted as "current best evidence" in health care. "Invisible" research may be ignored or overlooked. Ignoring relevant NAA articles may limit the use of medical literature just as publication bias or citation and language bias do.

More than 50% of Internet sessions end with the downloading of a full text article. Articles which are available either as full text or abstract only in the Online have been found to have a higher impact factor than articles which are available without any abstracts[9]. As more research is being communicated electronically, health-science

Table 2 : Checklist for critical appraisal of articles with valid results

Diagnosis	was there an independent, blinded comparison with a gold standard?
	Did the patient sample include an appropriate spectrum of patients similar to those found in general practice?
Therapy	Was the study randomized and double blinded?
	Were all enrolled patients included in the conclusion of study?
Harm	Were the exposures and outcomes measured similarly in both groups?
	Was the comparison group similar to the outcome group in all respects except for the variable in question?
Prognosis	Was the patient sample selected from a well-defined point in the course of disease?
	Was the follow-up adequate and complete?

libraries have increasingly adopted the policy of online subscriptions. This trend in conjunction with the FUTON bias may have broad implications on future medical education. Residents and medical students tend to rely heavily on articles that are available online for selective reading on a subject.

Critically appraising medical literature

Critical appraisal of articles is an essential part of the EBM curriculum. The appraisal of articles in medical schools is taught in small focus groups as team learning and in journal clubs. Several institutions use standard worksheets for critical appraisal, summarize them as CATs (critical appraisal of topics), post them on their departmental web-sites[1]. Acquiring skill in critical appraisal is an essential part of EBM workshops worldwide. Having finally identified a suitable article, the physician ought to be able to critically appraise the paper. The common questions one needs to ask while interpreting an article on primary studies (those that provide original data on a topic) are summarized in Table 2.

Articles are appraised for their internal validity (closeness to truth). One can read the abstract

Table 3 : Glossary of terms used to describe a diagnostic test

Sensitivity	The proportion of patient with the target disease who have a positive test
Specificity	The proportion of patient without the target disease who have a negative test
Likelihood ratio (LR)	The ratio of the probability of a specific test among patients with the target disorder to the probability of the same test among patients without the disorder
Positive predictive value	The proportion of individuals testing positive who actually have the disease being tested for
Negative predictive value	The proportion of individuals testing negative who actually donot have the disease being tested for
Odds	Probability of having a disease / probability of not having a disease
Pre-test odds	The odds that the patient has the disease before the test is ordered (pretest odds = probability/{1-probability})
Post-test odds	The odds that the patient has the disease after the test results (post test odds = pretest odds X LR)

and often decide whether the question has been well structured and if the results were collected appropriately and well summarized. Against an myth based mainly on folklore, evidence-based medicine is not restricted to randomized trials and meta-analyses. To be able to answer our question, one needs to identify the best article, check the validity, and see if a more detailed review is indicated to answer the two important questions, i.e., what were the results, and will they benefit my patients? Interpretation of the results often requires a knowledge of basic statistics and familiarity with EBM terminology. Some commonly-used terms in describing the results of a new diagnostic test include sensitivity, specificity, positive predictive value, and likelihood ratio (Table 3).

In therapy questions, randomized control trials (RCT) and systemic review of several randomized trials provide the best information to aid in the management of a patient. The number needed to treat (NNT), describes the number of patients that need to be treated to avoid one adverse effect.[1]

Table 4 : Evidence-based Medicine – Important websites

University of Sheffield (ScHarr)
Core Library
http://www.shef.ac.uk/scharr/ir/core.html
Appling Diagnosis, Etiology, Prognosis, and Therapy Methodologic Filters, University of Sheffield
http://www.shef.ac.uk/scharr/ir/adept/
Center of Evidence-based Medicine (CEBM), Oxford, Tool kit
http://www.cebm.net/toolbox.asp
Center of Health Evidence- User's guide to Evidence-based Practice
http://www.cche.net/usersguides/main.asp
SUM Search - San Antonio Texas
http://sumsearch.uthscsa.edu/
National Guideline Clearing House
http://www.guideline.gov/
Number needed to treat–Annals of Internal Medicine article
http://www.annals.org/cgi/content/full/126/9/712
POEMS- Relevance and Validity
http://www.infopoems.com/
Evidence-based Nursing
http://ebn.bmjjournals.com/

This useful parameter considers the patient's baseline risk, as opposed to risk reduction (RR) and relative risk reduction (RRR), which don't tell us the magnitude of the absolute risk.[1]

Among the barriers to understand and perform critical appraisal are lack of physician's time to conduct primary appraisal of each paper and information overload. A survey of physicians conducted in UK revealed that only 5% believed that identifying and appraising the primary literature or systemic reviews was the most important step in moving from opinion-based medicine to evidence-based medicine.[10] The majority of physicians (57%) thought that the most appropriate method to adopt an evidence-based practice was to apply evidence-based guidelines and protocols developed by colleagues.

Physicians and medical students have also been found to have limited understanding of EBM statistical terms like NNT, sensitivity, specificity, positive and negative predictive value among others.[2] Despite self- assurance of physicians in their confidence to understand these statistical terms direct observation and surveys have consistently revealed that many physicians have limited understanding of EBM terms.[11]

Several secondary sources are available that conveniently provide summaries of critically-appraised topics. These sources include ACP Journal Club (USA), Best Evidence (USA), InfoPOEMs, Bandolier (UK), and the Cochrane Library. It is unclear at present how helpful these secondary sources of information are in clinical decision making though in one study, physicians reported that these sources were helpful in 15%-17% of cases.[10]

Table 4 provides a list of useful EBM websites that provide more information on how to critically appraise an article using worksheets.

Applying evidence to patients

Having carefully evaluated the patient's condition and the best available evidence, clinicians need to understand the patient's preferences to identify the best available treatment for that particular patient. Table 5 provides some common rules to aid the clinician in assessing the external validity of a paper. It is increasingly becoming clear that evidence alone is not enough to make a good clinical decision. Patients may vary quite widely in their tolerance of side-effects, thus nullifying anticipated therapeutic benefit. Communicating risks and benefits language understood by patients could greatly influence their decision in making a well-informed choice.

Although much of the progress in medical education and health care has been attributed to the increasing popularity of evidence-based medicine, there still seems to be considerable resistance in many academic centers. The conventional apprentice approach to imparting medical knowledge revolves

Table 5 : Application of the result of a study

Diagnosis
Is the test affordable, accurate, and available in my hospital?
Can I estimate the pretest probability of the disease in question?
Will the post-test probability affect my management?
Therapy
Is the patient so different from the study group that the results cannot be applied?
According to the study results, how much would my patient truly benefit from the treatment?
Are the treatment and consequences consistent with my patient's values and beliefs?
Harm
Can the study results be extrapolated to my patient?
What is the patient's risk of adverse events?
Can the patient's preferences and expectations be met by an alternative therapy?
Prognosis
Is my patient similar to the patients in the study group?
Will the evidence alter the choice of treatment

around the authoritative decision-making process of a well-meaning senior physician. A diagnostician's brilliance is measured by the speed by which s/he can make a diagnosis rather than by a careful, reflective, open, and shared process of decision making as stressed in EBM. Medical students and residents might face numerous hurdles when trying to learn the principles of EBM. The students are exposed to numerous medical educators in the in- and inpatient setting who vary considerably in their attitudes toward an expertise in EBM. Application of the tenets of EBM could be perceived as a challenge to authority. A recent survey of surgical residents from McMaster University in Canada indicates there are several barriers that limit the application of EBM in daily rounds. Residents perceived a lack of training in EBM, time constraints, lack of priority, and staff disapproval of EBM as major challenges to applying EBM. They also felt that there was a lack of readily available surgical EBM resources in their hospitals.[12] In a study performed in the USA, 33% of community physicians as compared to 5% of full-time academic faculty did not apply EBM principles in teaching students in outpatient settings.[13] Community faculty considered EBM skills to be less important in daily practice than full-time academic faculty and were less confident about their knowledge of EBM.

However, over a decade of experience in teaching EBM has emphasized that the translation of medical information from journals to practice has numerous challenges[2]. It has been increasingly identified that despite awareness of best evidence, significant modifications have to be made before the information is applied to patient. These modifications are often dictated by clinical state of the patient, to their unique circumstances, their personal preferences and the clinical expertise of the medical practitioner. In addition, there is considerable center to center variability in the EBM instruction provided to students. Students often fail to pursue patient-focused question due to lack of access to medical information, skills in searching medical literature, time, personal initiative and institutional culture. Also several schools lack qualified instructors in EBM and don't possess resources to practice EBM at the point of care.

Practising EBM in a developing countries also present unique challenges including limited resources, library facilities, lack of role models, inability to attend workshops. There may be a tendency to in developing countries to trivialize evidence-based medicine as just another western innovations which is expensive and of little use[14].

Patient-physician communications – opportunities and challenges

Studies have shown that communication of risks of disease and treatment modalities remain central to patient-physician relationship and an essential determination of patient's satisfaction. Understanding risk remains germane to patient's desire to inducing change by behavior modification and ensure treatment compliance.

We performed a systematic review to identify the modalities by which risk is communicated to patients and determine its effectiveness.[2,15] The authors of

these articles used quantitative, qualitative or a combination of both methods to describe risks.

Among the quantitative methods terms used to explain risks included relative risk reduction (RRR) and absolute risk (AR), Number needed to treat (NNT) along with ARR and NNT, pictorial display of risks, decision aids, survival curves, Calman Risk chart, written instructions, probabilities, acceptable regret technic, and natural sampling frequency.

Among the qualitative studies used to study risk communication included; focus group interviews (using audiotape and videotape technics), questionnaire and close circuit TV. The qualitative and quantitative studies included study of focus groups (audio-tape) with graphical display and percentages.

Majority of the studies were conducted to study using a single disease model. Patients expressed more desire to follow therapy when reductions of risks were presented as RRR rather than ARR and NNT. Additionally risk taking behavior of physicians and patients determined their communication style and choice of therapy respectively. Educational level, age of patients, cultural differences, errors in risk estimation and technic of expression (quantitative versus qualitative) were all related with overall perception of risk.

Despite a large body of evidence there seems to be lack of consensus regarding the most appropriate method to communicate medical risks.[2] Appropriate techniques to present accurate information about actual risks in multiple disease models can be challenging. At present, combination of quantitative and qualitative technic along with pictorial display of data maybe helpful in explaining risks to patients. Understanding the complexity of current medical decision process remains germane in managing patient's problems. Recent literature indicates that evidence available full text online might be cited more often by being more visible.[16] Hence physician's should be able to critically appraise evidence to assess the credibility of information and not inadvertently accept evidence just because it is easily available.

Epstein et al[17] recommended 5 communication technics to convey evidence to patients: 1) understand the patient's and their families experiences and expectations, 2) building a partnership, 3) providing the medical evidence including a discussion on uncertainties, 4) present recommendations based on consensus, and 5) check for understanding and agreement.

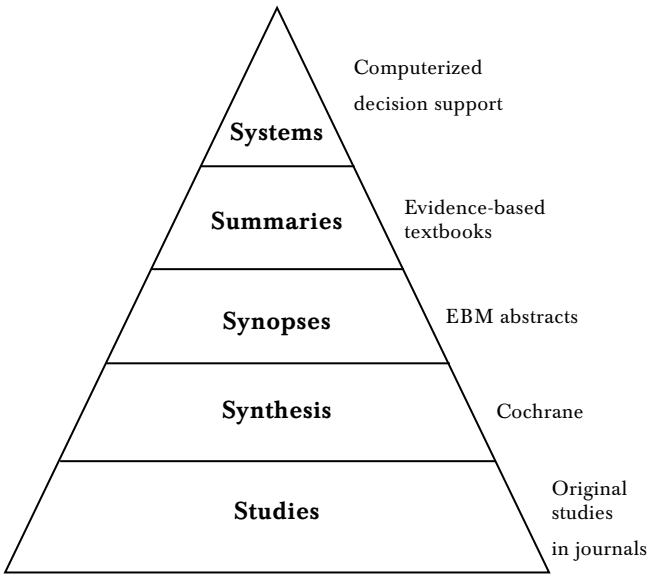
One of the many strategies for communicating about risk is known as CARE: Cite basic risk in general terms. Add estimated probabilities for positive and negative outcomes to descriptive terms like low risks. Reinforce effectiveness by using visual aids. Express encouragement and hope to the patient.[18] Having carefully evaluated the patient's condition and being aware of the efficacy of the best available evidence, clinicians also need to incorporate patients' values, needs and preferences into the process of identifying the best treatment plan for the patient. Finally physicians need to be able support their patients in when the diagnosis and treatment options remain uncertain despite reasonably exhaustive evaluation.[19]

Update in Evidence-based medicine

The '5 S Model,' of finding best evidence

5 S pyramid model (figure 1) for finding evidence starts with the original *Studies* at the foundation (using search engine like PubMed), *Synthesis* (like systematic reviews or Cochrane Reviews) in the next level, then *Synopses* (brief description of the original articles and reviews as they appear in evidence-based journals, ACP Journal club), *Summaries* integrate best available evidence from lower layers (syntheses) to provide full range of evidence-based management options for a health problem (evidence-based textbooks, like Clinical Evidence, PIER) and finally the *Systems* such as computerized decision support that link individual patient characteristics to relevant evidence.[7]

Figure I : The 5 S approach to selecting best evidence



ACP Journal Club. 2006; 145::A8-A9

As opposed to the lower three rungs of the 5 S that usually deal with one particular aspect of management, *Summaries* usually summarize the relevant *synopses, studies* or *synthesis* on various issues of a health condition and is currently considered to be more helpful (when it exists) to the busy physicians. The most advanced form of evidence would be a system like an computerized decision support, for example and electronic medical record, that would automatically patient's specific abnormalities with current best evidence. However, these kind of systems are currently unavailable in most medical settings and the few that are available are uniformly and constantly updated with the best evidence. Physicians who are using data other than original *studies* for the care of their patients should verify that the sources that produce the *synthesis, synopses* and *summaries* have used explicit criteria's for selection of the article that has been described in these text and use the highest standards of evidence

It is recommended that physicians start looking for evidence at the top of the 5S pyramid and work their way down. In case a physician is unsure where to start we recommend to either use the TRIP database (www.tripdatabase.com) and / or SUMsearch (http://sumsearch.uthscsa.edu) that provide access to several sources of evidence. A physician would still need to be trained in critical appraisal of articles to ensure that the article retrieved by these sources are evidence-based.

Use of Hand held computers for point of care

With the increasing complexity of medical education and proliferation of guidelines, medical students, residents and practitioners have to obtain, understand and deliver their care in a timely fashion. Fortunately handheld computers also know as personal digital assistants (PDA) has evolved as a very useful resource to deliver information at point of care. These devices are small and easily fit into a coat pocket or purse. A recent systematic review revealed that 60-70% of US medical students and residents are using PDA's for either educational purposes or patient care.[20] Students are increasingly using PDA to consult references, check drug to drug interactions, medical calculators, clinical prediction rules, and also in patient care by electronic order entry and patient tracking application. Resident doctors can now document clinical procedures, work hours, and accurate diagnostic coding, using their PDA. One study has also demonstrated improved educational outcomes, in the form of enhanced learning and application of EBM when students used PDA.[21] Wireless devices now allow users to send electronic mail and access internet through their PDA. Many residency programs in US are now distributing PDA's to all first year residents for use during their 3 years of residency training. Overall satisfaction with hand held computers are high.

Drawbacks of hand held computers are cost, technical difficulty of learning how to use a PDA, difficulty handling a small device, resistant to change, concern about data loss and security. It has been postulated that with initial training and technical support, the use of PDA's could enhance medical education and point of care to patient.

Other hand held devices like Tablet PC's that combine both laptop and note pad abilities are in use in may hospitals, though common this device has not been widely adopted.

Promises for the future- from computer decision support to ehealth and electronic health records

The development of health informatics has opened many future opportunities for research and enhanced patient care. It is postulated that informatics will eventually close the gaps of medical knowledge and effective practice among physicians within a health care organizations and also across different health care organizations thereby decreasing practice variability. Many of these methods are at any early stage of development undergoing several alterations prior to acceptance in routine patient care.

Health informatics is defined as the study and application of methods to improve the management of patient data, medical knowledge, population data and other information relevant to patient and community health care. There are several branches of Health informatics including bioinformatics, clinical informatics consumer health informatics and public health informatics.

Computer decision aids is a clinical decision tool that uses two or more items of patient information to generate case or encounter based advise. A recent study showed that the use of computer decision support system used in a rural primary care setting improved the appropriateness of anti-microbial use and also reduced overall antimicrobial use in patients presenting with acute respiratory infection.[22] Despite the numerous papers published on this area future studies are indicated to study whether CDSS will influence physician behavior especially in the management of complex cases.[23]

'ehealth' is the use of internet by the public, health care workers and others to access health and lifestyle information, services and support. Among its benefits lie better information for patients and their families and improved communication of patient information between the primary care team, fewer phone call and improved adherence to medical treatment. The concerns about ehealth include little information about cost effectiveness of ehealth, problem with health literacy and patients ability to use computers, education, support and supervision of health care staff, and acceptance by patient.[24]

Electronic health records (EHR) is a summarization of the patient electronic health records and other relevant data and is being increasing used by hospitals to replace all paper records. EHR is felt to improve the safety and quality of care of patients.

Among the perceived benefits of EHR include reduction of adverse drug events in inpatient and outpatient setting, improved coordination of long term chronic disease management and long term savings in health care.[25] However only 20-25% hospitals have adapted EHR in US. Barriers of EHR implementation include, increased start up cost, concern of privacy, lack of standardization and ability of hospitals to recover costs in implementation of EHR from patient care.

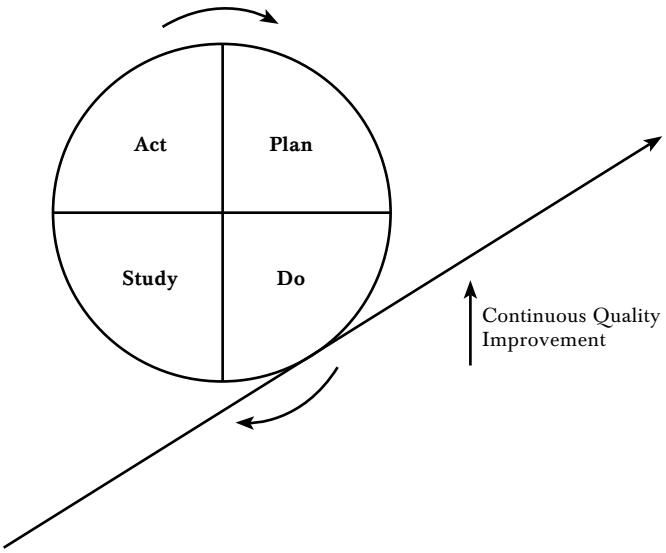
Combining best evidence to improve patient care: Evidence-based management

Earlier in the chapter we discussed how physician differ in their ability to understand evidence and also vary in their ability to deliver evidence-based care despite wide dissemination and awareness of evidence.

Glasziou and Haynes[26] describe this phenomenon with a model of 7 A's, and call it, *'the evidence pipeline'*. The 7 A's determine seven stages in the flow of evidence-based information from physician awareness of the data to patient's adherence to an agreed plan of action (i.e., *aware, accepted, application, able, acted on, agreed, adhered to*). It has been calculated that at every step there is a 'leak in the pipeline,' so much so that 80% transfer at each of the 7 stages would result in 21% at the level of patient's adherence ($0.8^7 = 0.21$)!

Increasingly, it has been recognized that quality of medical care depends not only on excellent

Figure 2: The PDSA (plan-do-study-act) cycle can be repeated several times to and the process studied with new variables learned from previous cycles to enhance quality



clinical studies that lead to advances in EBM but, advances in technics to implement these findings in clinical practice. The latter is called, Evidence-based management(EBMgt), and identifies, innovative ideas, organizational and change management structure to implement change.[27] Without the symbiotic association of EBM and EBMgt, it is unlikely to expect a meaningful improvement in quality of health care.

While EBM depends on interpretation of the generalizability of results of a randomized control trial (RCT), EBMgt studies the organizational juggernaut that influence the delivery of health care. Unlike the rigid methods used by trialist's to conduct an RCT that excludes several everyday variability of clinical practice, EBMgt studies rely on human factor engineering, social and behavioral science and use observational quality improvement studies incorporating PDSA (plan-do-study- act) technic[28] (Figure 2).

Despite a deluge of primary and secondary articles that emphasize the use of β-blockers after myocardial infarction, outcome based studies indicate substantial variability of use among hospitals. Surprisingly, four organizational characteristics of hospitals are associated with highest use of β-blockers after myocardial infarction. These include shared vision for quality improvement, strong physicians leadership, reliable feedback and increased administrative support.[29] Hence, both the availability of best information and integration into practice, requires substantial organizational input to improve quality.

Management of patient with complex multiple chronic medical condition usually require a team of health care individuals. Effective health care teams share some common characteristics, including awareness of best current information, autonomy to selected individuals best suited for the task, autonomy to try new innovations, have adequate resources and availability of timely feedback to track progress. EBMgt uses current management techniques of Six sigma principles[30] and Lean Production process engineering methods[31] to bring in change. Health care teams that acknowledge and learn from mistakes, share process innovation and engage in continuous quality improvement, have been demonstrated to have the better patient outcomes. Future trends in medical care is moving towards a team approach to health care and will be increasingly adopting evidence-based management principle along with best evidence to optimize patient outcome.

Educational interventions to enhance evidence-based practice

Numerous workshops and training sessions on how to teach and learn EBM have been developed at various local, national, and international levels. These sessions are mainly directed towards improving technical EBM and cognitive skills. The main focus of these sessions has been to enhance specific aspects of EBM skills, especially asking a clinical question, conducting literature searches, and critical appraisal of topics. While most of these sessions test the EBM knowledge and skills of learners, there is good evidence to show that there are other factors which inhibit practitioners'

ability to practice EBM, i.e., time pressures, lack of peer support, limited accessibility to quality sources (articles and secondary critically appraised topics). Hence recent efforts have been dedicated not only to the EBM curriculum, but also to the learning environment. Although there exist several validated tools to assess EBM knowledge and skills of learners, the attitude of learners towards EBM (KAB, Knowledge, Attitude, behavior) must also be understood.[32]

In spite of a few enthusiastic reports about using EBM in the inpatient medical wards, pediatrics, and general practice, numerous personal, interpersonal, and institutional barriers still impair the uniform application of EBM in many institutions. Strategies to overcome this inertia could include hiring preceptors and role models who are experts in EBM, improving EBM training, reducing innumeracy among physicians and patients, implementing strategies for improving patient-physician communication, and improving attitudes towards evidence-based medicine. Shaughnessy and colleagues,[33] have described the usefulness of medical information as:

$$\text{Usefulness of information} = \frac{\text{relevance} \times \text{validity}}{\text{Work}}$$

The most relevant information should be relevant to the practice, highly valid, and should take very little work to acquire.

In summary physician's test ordering tendencies are based on Bayesian and several non-Bayesian factors. Despite a recent increase in focus on evidence-based medicine, physicians might demonstrate a widely variable understanding of probabilistic terms and NNT. Patients similarly vary in their ability to grasp information on risk presented as numbers and percentages. It is unclear, at present whether the variability of medical management could to some extent be contributed by variability of understanding of current evidence by physicians and patients. At present both qualitative and quantitative approaches to risk communication, seems to be most appropriate approach. Further research is indicated in identifying the most appropriate 'specific risk' communication technique that is tailored at answering the patient's problems. For the present, a thorough understanding of the strengths and limitations of current best evidence and understanding of patients' values, will steer the physician towards the most optimal care of the patient. Self reflection and evaluation of ones' attitude towards critical inquiry of medical problems, and periodic checking ones' skills in practicing and communicating evidence-based health case, could greatly enhance the practitioner's ability to keep up with the ever changing medical information and the answer questions posed by the patient.

Summary

Despite an agreement on the definition of evidence-based medicine (EBM), there remains considerable debate around what constitutes an evidence-based care. In the current review, we discuss the clinical application of EBM including challenges in retrieving relevant medical information, critically reviewing the data and applying it to the patient. Also discussed are the technics and issues surrounding patient- physician communication. Among the current updates in EBM we highlight the '5S' model of retrieving best evidence, use of hand held devices for point of care information and describe future directions and use of computer based decision support, ehealth, electronic medical records and evidence based management to improve quality of health care. Several methods are described to enhance risk communication and evidence-based practice.

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