Evidence-based Medicine in Clinical Practice

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Abstract
Evidence based medicine provides for health care providers a skill to decipher effectively the vast amount of medical literature and assist patients with health care decision making. Understanding the different types of studies performed and being able to better comprehend the strength of a particular study in its justification of a specific treatment will enhance a practitioner’s ability to care for patients. This publication will provide an introduction to primary and specialty providers in the use of evidence-based medicine to maximize communication and quality of care in their patients.

Introduction
The concept of evidence-based medicine (EBM) ensures that the physicians 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. Hence the future competence of the physician is not measured by his/her ability to recall facts, but by the ability to incorporate the best current evidence into the patient’s personal values and come to a shared decision acceptable to both the patient and the physician.

Evidence-based health care (EBHC) and its approach to the practice of medicine has gained considerable acceptance among health-care professionals. Spurred by the vision and innovative genius of Prof. David Sackett and Prof. Gordon Guyatt and colleagues from McMaster’s University, Canada and subsequently popularized by International 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 Association of American Medical Colleges (AAMC) advocates the integration of principles of EBM into undergraduate training and EBM has been incorporated into the curriculum of an increasing number of US medical schools. In a recent report, the Liaison Committee on Medical Education revealed that 122 of the 126 Liaison Committees on Medical education-accredited schools included EBM as a required course and devoted a mean of 20 hours to it [2]. Similar initiatives have been introduced in medical schools in several parts of Europe and Australia.

The benefit of evidence-based treatment is becoming increasingly evident. Adequate selection of patients with carotid artery stenosis for carotid endarterectomy, based on center and surgeon’s experience decrease postoperative morbidity and mortality[3]. Salutary benefits have been reported in delaying renal failure by using Angiotensin-converting enzyme inhibitor in treating patients with proteinuria[4], and peri-operative

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Beta-blockers use to reduce post operative cardiac complications in high risk patients[5].

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 centres. The conventional apprentice approach to imparting medical knowledge revolves 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 inpatient setting who vary considerably in their attitudes toward and 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 [7]. 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 [8]. 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.

Despite an agreement on the definition of evidence-based health care, there remains considerable debate evolving around the what constitutes an evidence-based case. 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[6]. I will discuss concepts of the steps in evidence-based medicine, identify the challenges of practicing EBHC including retrieval and critical appraisal of literature, application of EBHC to patients, examine the practicality of implementing EBHC in situations of medical uncertainty and enumerate educational interventions to enhance the practice of EBHC.

The 5- steps of evidence based medicine

The traditional model of evidence-based medicine (EBM) as proposed by the Evidence-based Medicine Working Group involves: 1) transforming the clinical problem into a 3- or 4-part question, 2) finding external evidence to answer the question, 3) critically appraising the external evidence, 4) applying the evidence to the patient in compliance with the patient's personal values, and 5) evaluating the decision-making process [1].

Hence when faced with a challenging patient's problem an EBM trained physician could convert the dilemma to a four part query using the PICO format (P- patient, I-intervention, C-comparison, O-Outcome), demonstrate aptitude for conducting a literature search, using a secondary sources (ACP Journal Club, Best Evidence, etc.) or Primary source (MEDLINE or Pub Med), possess the necessary skill to assimilate the scientific evidence, weigh in patient's problems along with their personal values and make a decision based on the current best evidence.

Sackett and colleagues [1] identified numerous misconceptions of the term evidence-based medicine among many physicians: 1) It’s what we’ve always done. Although much of medicine is based on traditional medical education and subjective judgment, this view is no longer totally correct since the widespread access to electronic databases. 2) It will replace clinical judgment. This is currently no evidence of this. 3) I don't have time for it. Lack of time is a major barrier. However, recent cost-free availability, easy access, and familiarity prompt most clinicians to access MEDLINE/PubMed (a premier bibliographic database of the US National Library of Medicine) for their scientific literature. MEDLINE/Pub Med is the world's first and probably largest biomedical literature database, containing citations from over 4600 journals dating back to 1966. Additionally, secondary analysis of evidence-based guidelines and articles, which can be assessed at a fraction of the time required to read the primary literature, are easily available. 4) It will lead to “cookbook medicine”. The process of evidence-based medicine requires the incorporation of patients’ values prior to making any medical decision.
As we will discuss subsequently the process of medical decision making is often more complicated. However, understanding the process and current limitation of evidence may allay the physicians anxiety and assist them in negotiating the almost endless barrage of medical information.

**Challenges with retrieval of medical literature**

Reading is determined, among other things, by the ease in attaining literature. Scientific articles on MEDLINE/Pub Med are available as either FUTON (Full Text on the Net) or NAA (No Abstracts Available) articles [9]. 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.

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 [1]. Nevertheless, 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 [10].

More than 50% of Internet sessions end with the downloading of a full text article [11]. 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 [24]. As more research is being communicated electronically, health-science 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 [9].

**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 1. Articles are appraised for their internal validity (closeness to truth). One can read the abstract and often decide whether the question has been well structured and if the results were collected appropriately and well summarized. 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.

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 [12]. The number needed to treat (NNT), describes the number of patients that need to be treated

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**Table 1. Checklist for critical appraisal of articles with valid results**

<table>
<thead>
<tr>
<th>Category</th>
<th>Question</th>
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<tr>
<td><strong>Diagnosis</strong></td>
<td>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?</td>
</tr>
<tr>
<td><strong>Therapy</strong></td>
<td>Was the study randomized and double blinded? Were all enrolled patients included in the conclusion of study?</td>
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<tr>
<td><strong>Harm</strong></td>
<td>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?</td>
</tr>
<tr>
<td><strong>Prognosis</strong></td>
<td>Was the patient sample selected from a well-defined point in the course of disease? Was the follow-up adequate and complete?</td>
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to avoid one adverse effect [13]. 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. The main problems are lack of physician 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 [14]. 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. Several secondary sources are available which conveniently provide summaries of critically-appraised topics. These sources include ACP Journal Club (USA), Best Evidence (USA), InfoPOEMS (http://www.infopoems.com), Bandolier (UK), and the Cochrane Library. InfoPOEMS is also available for palmtop computers (PDA), which are used frequently by residents and physicians and provided updated information on medication and medical texts. It is unclear at present how helpful these secondary sources of information are in clinical decision making. In one study, physicians reported that these sources were helpful in 15%–17% of cases [14].

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 [15]. Table 2. 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 [16,17]. A combination of quantitative (ARR, NNT, RRR) and qualitative (unlikely, very likely) terms should be applied to explain the results of a study to a patient [16]. However, over a decade of experience in teaching EBM has emphasized that the translation of medical information from journals to practice has numerous challenges[6]. It has been increasingly identified that often significant modifications have to be made before best evidence 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[18].

While explaining the risk to patients, clinicians often provide the details of the risk and the probability that it may occur (objective information), whereas the patient is also interested in knowing how important a bad outcome would be for him/her (subjective information). It is important to identify of the risk

<table>
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<th>Diagnosis</th>
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<tr>
<td>Is the test affordable, accurate, and available in my hospital?</td>
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<tr>
<td>Can I estimate the pretest probability of the disease in question?</td>
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<tr>
<td>Will the post-test probability affect my management?</td>
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<tr>
<th>Therapy</th>
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<tr>
<td>Is the patient so different from the study group that the results cannot be applied?</td>
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<tr>
<td>According to the study results, how much would my patient truly benefit from the treatment?</td>
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<tr>
<td>Are the treatment and consequences consistent with my patient's values and beliefs?</td>
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<th>Harm</th>
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<tr>
<td>Can the study results be extrapolated to my patient?</td>
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<tr>
<td>What is the patient's risk of adverse events?</td>
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<tr>
<td>Can the patient's preferences and expectations be met by an alternative therapy?</td>
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<th>Prognosis</th>
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<tr>
<td>Is my patient similar to the patients in the study group?</td>
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<tr>
<td>Will the evidence alter the choice of treatment</td>
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(death, disability, pain), its inception (early versus late), and the nature of the bad event (temporary, permanent).

The mnemonic **CARE** is often used to improve risk communication and includes: **C**ite basic risk in general terms, **A**dd estimated probabilities for positive and negative outcomes to descriptive terms, like low risks; **R**einforce effectiveness by using visual aids for risk communications; **E**xpress encouragement and hope to the patient [17].

### Uncertainty in clinical practice and the application of EBHC

Medical uncertainty is inherent in clinical practice and contributes variability in medical practice[19]. Physicians have a differing levels of tolerance to uncertainty. Gerrity et al. [20] using a validated physician-response-to-uncertainty scale demonstrated that primary-care physicians (psychiatry, general medicine, family medicine, pediatrics, and OB/GYN) are more tolerant to uncertainty than anesthetists, orthopedists, and urologist.

Despite well defined, evidence-based guidelines, physicians often fail to implement these in their clinical practice. In a qualitative study conducted in the UK, six themes were identified which seem to affect the implementation of evidence-based guidelines. These included: the personal and professional experience of the physician, the patient-physician relationship, perceived tensions between primary-care physicians and specialists, physicians' attitudes towards their patients and evidence, the language used by the physicians, and the logistics of general practice [21].

There is a tendency to continue current therapy to which patient is accustomed rather than prescribe a new drug based on the best available evidence. Physicians reported that perceived patient stress surrounding initiation of new therapy as it lead to frequent home visits for dose titration and reassurance of patient. Also being aware of patient's domestic situation, few physicians were hesitant to anti-coagulate their elderly patients.

The complexity of medical problems, along with variability in individual physician reaction to uncertainty, might alter the perception of a problem (Fig. 1). Application of the principles of EBM, while not completely eliminating uncertainty, could provide a common language to discuss causes for disagreements.

![Factors which influence physicians' uncertainty and behavior (adapted from Gerrity)[20]](image)

**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 [23].
In spite of a few enthusiastic reports about using EBM in the inpatient medical wards, pediatrics, and general practice [24,25,26], 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 [27], have described the usefulness of medical information as:

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\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.

Numerous recent developments have made the practice of evidence-based health care more practical. Ebell and colleagues found that 85% of family physicians were willing to carry a hand-held computer [28]. Among the most desired software were: drug information, current treatment recommendations, ability to update information, and ability to print patient educational material. Many hospitals currently provide computers at or near care units. The development of organizations like the Cochrane Collaboration, development of evidence-based journals of secondary publications (ACP Journal Club, Best Evidence, Evidence-based Nursing), availability of information systems which bring relevant evidence in seconds (InfoPOEMs), and learning the strategies of EBM for lifelong learning have created an invigorating environment to bring EBM into the mainstream of medical education.

**Future Directions in EBM**

Increasing efforts are currently in place to ensure that physicians are able to go beyond the evidence presented in literature and demonstrate that they are able to apply that evidence within the practical realm of their local communities. The Internal medicine residency programs accredited by the Accredited Council for Graduate Medical Education (ACGME) have to demonstrate that their residents demonstrate competency in practice-based learning and improvement (PBLI) and system based practice (SBP)[29,30]. For demonstrating competency in PBLI the residents must be able to investigate and evaluate their patient care practice, appraise and assimilate scientific evidence and modify or improve their patient care practices. For SBP residents must demonstrate an awareness of the responsiveness to the larger context and system of health care and the ability to effectively call on system resources to provide care that is of optimal value. Active instruction on PBLI and SBP are in effect in all residency programs in the US, and periodic reviews by the Residency and Review Committee (RRC) - an independent review body, is performed to ensure that programs have an effective and consistent modality of instruction on these topics. Lack of compliance with providing effective program could result in loss of accreditation for residency programs. Although it well recognized that the ability to critically appraise an article forms the premise of understanding the evidence, it is often impractical to review original articles due to time constraints. Prof. Brian Haynes of McMaster University, has recommended the 4S hierarchical approach with original ‘studies’ at the base, articles that ‘synthesize’ evidence from other articles (systematic reviews) just above the base, ‘synopses’ of studies and synthesis, and the highest form of evidence based on computer decision support ‘systems’ (CDSS) on the top [31]. The CDSS would attempt to integrate all relevant and important research about clinical problems and link it automatically through an electronic medical record (EMR) to the patient’s unique problem. Currently, these systems are available in research settings, although with advances in biomedical informatics and EMR could make CDSS a reality in the near future. The one factor that remain the main focus of EBM is the patient’s well being. While numerous advances continue to be made and new modalities of evaluation and dissemination of new information develop, one needs to be mindful of the needs of the ailing patient and involve them to find out their values and preferences and involve them in their decision making process. Having this central focus, i.e., patient-centered care, should direct all subsequent research and educational innovation. 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 care, could greatly enhance the practitioners ability to keep up with the ever changing medical information and the answer questions posed by the patient.

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Autobiography of A Fanta Bottle Chip

Dr. Elizabeth John MS, DO, Dr. Mohammed Haneef MS, DO, Dr. Radha Nair MS, DO, Dr. Mini PA MS, DO, Dr. Manoj Venugopal MS, DNB, FRCS Ed

Introduction

Though portrayed in a lighter vein, this is a true-life incident of a forty-year-old male with history of alleged assault who reported to the busy casualty of the Medical College Hospital, Alleppey with a retained orbital foreign body that was overlooked at the time of primary wound closure, getting it subsequently removed intact. The foreign body was a chip off a Fanta bottle, which measured a whooping 5.5 cm x 3 cm x 1cm! It had entered the orbit through a lacerated wound below the lateral end of the right lower lid and was seen below the eyeball in the orbit without damaging it and extending up to the middle turbinate of left nasal cavity.

What more to expect from the autobiography of a Fanta bottle than getting filled up with that bubbly orange drink again and again only to quench someone's thirst. The cycle continues until its life ends tragically due to careless handling.

My autobiography was to be no different until it happened. An experience, a unique one which I never dared to dream even in my wildest dreams- to be trapped with in the orbit of a human for almost three days!!!. Yes, believe me, it did happen.

On that fateful November night, my life took an unexpected turn. It was 10 in the night. I was in the stands of a shop at a busy junction near MCH Alleppey. All of a sudden, two men appeared in front of this shop. A dispute resulted in quarrel and before I realized, one of them pulled me out from the stands and banged me against the others face. I broke into pieces injuring his face. He started to bleed profusely. People at once gathered around him and he was rushed to the casualty of MCH Alleppey. Little did anyone realize that a large portion of me bearing my name was lodged in his orbital cavity.

10:30 PM Casualty MCH : We (me within the patients orbit) were duly received by an intern who informed the duty Medical Officer. She arrived to examine ‘us’ and me heard her tell the intern that there were multiple soft tissue injuries on the cheek, preauricular and infra orbital regions of right side of his face and that the wounds being contaminated with glass particles, needed to be cleaned well before being sutured.

The intern carried out the order immediately and began to suture the wound in the casualty while the duty MO was busy with medico legal documentation. The intern copiously washed the wounds. I hoped that I would be spotted. However, it didn’t happen. I guessed I was not visible because I was at a deeper plane. He began to suture the wound. Oh God! Am I destined to be here for the rest of my life! The very thought send shivers down my ‘spine’. I cried out for help, but my desperate cries felt on deaf ears. The enthusiastic intern continued suturing while I hoped against hope that at some point I would succeed in making my presence felt. The last nail was also driven into my coffin! Yes, the last suture was also in place. The wound was cleaned with spirit which burnt my ‘eyes’ and my spirits. A pad and bandage was given and the patient was admitted to ward. I was in a dark world amidst warm blood and flesh.

Day 2; 8.30AM: I woke up to a team of doctors narrating the incident to Chief. The patient complained of severe pain in his right eye. The chief’s examination reveals a

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