

The wisdom of Evidence-based Medicine: Reflecting on more than 20 years of learning and practice experience

Ayman A.M. Afify*

Family Medicine Administration, Prince Sultan Military Medical City, Riyadh, Saudi Arabia ORCID ID: 0000-0002-2059-3726

ABSTRACT: Evidence-based medicine is a process of self-directed learning in which caring for patients utilizes the systematic search for and application of valid and clinically useful information. Originally, David Sackett and his colleagues established the five famous steps of evidence-based medicine. Since then, many junior trainees have considered the first three to be very tough and many others have perceived them to be impractical. Due to these perceptions, educators often experience challenges while teaching the first three steps. In this study, I presented a reflective effort based on my teaching and learning experiences to demonstrate the practical applications of these steps and help others overcome the challenges associated with their implementation. This effort was the result of hundreds of workshops that I have attended, conducted, or coordinated since 2004. It was also based on the summaries of my communications with several medical schools in the field. The article targets both trainees and trainers. For each of the first three evidence-based medicine steps, I explain the problem, concepts, and underlying principles before providing practical recommendations for their implementation. The result is a concise elucidation of insights that could help trainers better guide their learners. I recommend that trainers utilize these principles from the very beginning of the implementation to capture the essence of each step. This work was an introduction to teaching the foundational steps of evidence-based medicine (particularly for beginners) and might foster a lifelong learning spirit among trainees.

KEYWORDS: Reflection, teaching experience, evidence-based medicine, self-directed life-long learning

I. INTRODUCTION

The term evidence-based medicine (EBM) was first coined by Gordon Guyatt and colleagues at McMaster University in 1991 [1]. Since then, millions of studies have used the term, and it has been adopted by nearly all scientific organizations worldwide. Today, the EBM field has many specific subdivisions beyond clinical practice, including evidence-based (EB) medical education, EB public health, and EB policymaking. In 1997, David Sackett opined, “The practice of evidence-based medicine is a process of life-long, self-directed learning in which caring for patients creates the need for clinically important and updated information about diagnosis, prognosis, therapy, and other health care issues, and in which we [Step 1] convert these information needs into answerable questions; [Step 2] track down the best evidence to answer them; [Step 3] critically appraise that evidence for its validity and clinical applicability; [Step 4] integrate this appraisal with our clinical expertise and apply it in practice; and [Step 5] evaluate our performance” [2].

It is estimated that “we may need to take 5 important clinical decisions for each inpatient and 2 decisions for every 3 outpatient encounters” [3]. However, for such decisions, we probably know only **one third of the best** updated medical answer (a best-case scenario in Canada and the United Kingdom, which is the birthplace of the movement). Hence, EBM advocates are calling for Step 0 to be implemented first, which includes awareness about yourself, your current patient, and the best immediate decision you want to make with respect to the patient’s clinical problem (i.e., one gets only a few seconds for reflection) [4]. If you do not know the answer, then five recommended steps are redesigned to help solve your patient’s problem, make an appropriate decision, update your knowledge, and proceed safely and scientifically through your career. Many articles discuss the first three steps of EBM, particularly steps one and three, which are simultaneously considered the most difficult and most fundamental of all the steps [5]. This has created anxiety and internal resistance toward learning among learners, senior professionals, and educators. I have more than 20 years of experience with EBM, including my time as a trainee and my last 8 years as a senior trainer. During this period, I have remained an active clinician, as well, sometimes even performing administrative duties. I understand the difficulty experienced by clinicians in inserting step one (i.e., the clinical question) into the entirety of our work while striving to become up-to-date and evidence-oriented physicians. I have also experienced the puzzlement and chaos created by step two (i.e., the search), particularly since it involves a vast number of medical databases. Moreover, we must all

endure the difficulties and details associated with step three (i.e., the critical appraisal step), which is almost always perceived as a research course. In this study, I have attempted to clarify the difficulties and problems associated with each step, particularly from the perspective of a busy practitioner. Subsequently, I link these problems with major principles and values that optimize the adult learning experience to extract practical steps that can be easily and rapidly implemented. I believe that every physician should stay up-to-date on new medical evidence (at least in their own specialties), rather than furthering their practice based on anecdotes or even their own specific experiences alone. I believe that EBM steps, when applied wisely, can help merge experience and evidence in a coherent manner for any dedicated physician in his or her journey to achieve clinical improvement and realize endless experiential learning. This paper is intended to benefit both trainees and trainers alike.

II. METHODS

From my experience of training many physicians from different specialties, the main obstacles to the physicians' easy application of the foundational steps of EBM are as follows:

- 1- The busy nature of clinics
- 2- Limitations in the available time for reading or be acquainted with new skill (due to item 1 in part, and also due to endless other non-medical commitments)
- 3- The availability of a plethora of (sometimes contradictory) medical information
- 4- Difficulty in understanding EBM terms, particularly during critical reading

Using certain concepts and principles, we can overcome these obstacles by following some simple practical tips, which are detailed in the following pages, and invent our own unique model, from which we can extract extended values to regulate any scientific knowledge.

First EBM step (ask an answerable clinical question)

Problem: Learning while maintaining busy practice

Concepts/ Principles: 1- Life is the main source of learning (this concept is relevant when we practice with passion, so we can practice with passion and alertness). 2- Do not feel embarrassed when you do not know something. One aspect of a successful EBM journey that may distinguish it from the ideal research life is that EBM can be practiced while working, that is, you should be self-aware of and focused on the fact that you may not have the most updated evidence for a current patient problem in your clinic or during surgical practice. The question is how to remain self-aware and focused while having a busy clinical schedule.

Why does the EBM process start with questioning?

1. As we all know, children learn through a built-in system of inquiry (here, we refer to it as the why system). As we grow older, we lose this system. Hence, our golden opportunities to learn occur when we face problems for which we do not have solutions. Since we encounter clinical problems in our own clinics, we believe that the best way of learning—from the perspective of a busy clinician—is facing situations of inquiry during practice. This is what we call “opportunistic learning,” or the “just-in-time way of learning,” which results in solutions that are up-to-date, relevant to current patients, and unforgettable because they address issues that are painful to the practitioner.

2. It is recommended to transform a solved scenario or problem into a question, since the question format helps focus your inquiry by default. The question will then become the objective of your journey toward an answer.

Why should we practice PI(E)CO (Patient-Intervention/Indicator (**Exposure**)-Comparison-Outcome)?

PICO is a standard format that will help you focus on your question. Here, the questions are asked in a series of sections, and sometimes not all sections are necessary. Accordingly, you must have a system for your inquiry that highlights key terms related to each section. These will be processed using a computer during the second step, in which you will seek an answer.

N.B. It is highly advisable (at least initially) to write the question down since a written statement will alert you to the specific elements of your search. Moreover, writing augments thinking; it will continually remind you to search for an answer as soon as you can. See Fig. 1 for an educational prescription.

Extracted values:

- To perfectly complete any process, you should have a sharp, clear, and focused *Objective*.

- *Questioning* helps gain beneficial **focused** knowledge.
- *Writing* help for organized thinking.

Second EBM step (find the best available evidence)

Problem: As clinicians, we are always seeking knowledge while drowning in information (we are living in the era of information explosion and experiencing a reduction in our available time). For example, imagine that a main database (e.g., PubMed) is publishing more than 1,000 articles per day, that is, “you may need to read 17 articles per day to remain up-to-date in certain medical specialties” (general, general pediatric, internal medicine, and family medicine disciplines) [6]. This information may sometimes be contradictory. Further, a large number of medical databases are forthcoming and expanding, which may require many new classifications.

Concept/ Principle: Regardless of the search tool, your specific search strategy and technique are the key factors of any online search.

Practical steps (suggested search strategy):

1- Provide time for PICO

- Construct the appropriate PICO question (for your current patient).
 - Write it down.
 - Determine the question type (therapy, prognosis, etc.), which will guide you to the type of study (randomized controlled trial, cohort, etc.) and specific electronic database to search for.
 - Identify exact key terms (using appropriate medical synonyms, if needed).
- Example:

➤ Patient Scenario:

A 4-year-old child had a temperature of 40°C and developed febrile convulsions in the emergency room (ER). This occurred for the first time in his life. He was treated conservatively and discharged from the ER after a few hours. His mother was concerned about the risk of recurrence.

➤ Clinical Question Statement:

In children who have had one febrile seizure of unknown cause, compared with children who have had no seizures, what is the increased risk of further seizures?

- P: children
- E: with one febrile convulsion
- C: without
- O: further seizures

➤ Question Type: Prognosis

- **Key Terms:** Children-Pediatric/Febrile Convulsion-Fever-Seizure-Hyperthermia-High Temperature/Recurrence

2- It is highly recommended to a) access medical information mostly in a problem-solving mode (hunting mode) than a browsing mode[7], that is, when you have a specific PICO for one of the clinical problems that you eagerly want to solve, then b) start searching for your answer first in the secondary resources, for example, EB guidelines, high valid systematic reviews, or evidence summaries (e.g., Cochrane collaboration, NICE guidelines, best practices, and the **ACP Journal club**). If you do not find the answer in this step, then go to the primary resources. c) Do not use generic search engines such as Google or Yahoo while making decisions, **In EBM, we have certain search engines in you want like TRIP database or Sum Search** d) Concentrate as much as you can in **the articles with POEM (patient-oriented evidence that matters) as primary outcomes.** e) Target higher evidence first.

3- Create your own trusted online resource list and master the tips related to each resource: a) Use free trials and read their online help sections. b) Start with at least two different databases in addition to PubMed before proceeding (N.B. you may look into specific databases for certain specialties, such as Pedro for physical therapy or CINAHL for nursing, **or when you look for certain databases for complementary medical practice**). c) Store your search results and subscribe, or sign in.

My Information Mastery equation

- PICO + POEM + secondary resources = easily and rapidly obtained useful, valid and relevant information
- If no 2ry resources available to answer your clinical question; equation will be:

PICO+ relevant primary resources + POEM + higher evidence= useful relevant information

N.B. Most secondary resources are pre-appraised and user-friendly (**i.e., mostly you are not in need to apply step 3**).

Extracted values:

How to be a *Clever Information Seeker*.

Third EBM step (critical appraisal—especially of primary resources)

Problem: Most primary medical literature is of little clinical importance. Often, we come across many flaws in famous articles in prestigious medical journals. Our experiences with COVID-19 highlight such occurrences. Hence, whatever evidence you are dealing with, you are not supposed to be affected by such factors, and should only apply the rules you know by heart as a physician who is dealing with human beings. Further, you should not take any claim, paper, or evidence at face value, and should not be satisfied by a title or conclusion provided by a famous author or editor.

Concept: In this step, your job is similar to that of a typical reviewer of a narration, a movie or a sporting event. In such a situation, researchers resemble actors, writers, or players, and you are an expert critic of their performance. The researchers are like inventors showcasing their talents and creativity, whereas the critics must apply scientific principles to assess the researchers' efforts. This is important while seeking better future creations. Therefore, you are not expected to be a researcher or statistician. You are simply required to remain research-oriented while quickly and proficiently interpreting relevant data.

N.B. Many medical and EBM schools offer worksheets to be used in article appraisals.

Practical steps to divide tough theories into minute pragmatic parts:

1- Two hands and two eyes: Your appraisal worksheet will be in one hand and the article for appraisal in the other. Read one question after the other, with one eye on the questions and guide for answering them and the other on the relevant section of the document.

2- Only method and result: You will appraise two major parts of a document:

- a. Validity: Mainly by reading the methodology section
- b. Results: Mainly by reading the results section

Many people become bogged down with reading because they attempt to read complete articles. However, only two sections of an article are critical. Therefore, it is recommended that the appraiser (particularly busy practitioners and EBM novices) only read the methodology and results sections of any given article. Further, one can read the abstract to familiarize oneself with the main objective of the trial (PICO), and thereby, reflect on its relevance to the current problem.

3- Validity comes first, and the importance of the first two questions: After finding an article that is relevant to your current patient problem (PICO), it is important to understand that its validity is more important than all its other aspects. If you consider the article valid (by marking it even a 6 out of 10), then you can continue reading and accepting its results. The most important questions to assess validity are typically the first two or three questions (e.g., the concept of the primary guide in the user guide series). If the answer to each question is a resounding "no," then do not continue reading the article (except for training purposes or when you do not have other evidence on the given topic). If the answer to each question is a definite "yes," then you can generally accept the article and consider other possibilities. On the other hand, a "yes" to one question and "no" to another (or an unclear answer) requires additional consideration from the appraiser. In this respect, the ability to make a rapid assessment indicates whether the article is worth reading.

4- Do not assume something to be true or false: To determine whether the authors conducted the appropriate work, think about "what is not documented, not done" at the same time. In general, we do not become suspicious of written words as long as they are transparently written and comprise the required details. This is

why I sometimes consider the “cannot tell” and “yes, but” situations in the worksheet optional, particularly while encountering limitations or concealed reporting.

5- Critical appraisals as individual efforts: Critical appraisal is always an individual effort. Therefore, the results of critical appraisals may vary across appraisers based on the appraisers’ medical background, experience with EBM, and knowledge of the critical appraisal process. Hence, one appraiser may answer “yes” to a question, whereas another may answer “yes, but” or “cannot tell.” Such responses are acceptable and may even be considered healthy (in an educational atmosphere) when justified. Therefore, more than one appraiser must conduct this process. However, apart from when appraisers have minimal skills and the previous principle is applicable, we usually do not encounter differences in answers (e.g., one “yes” and one “no”) for the same question. Similar to any skill, the ability to appraise becomes sharpened over time and with practice.

6- Diagrams: When they are available, always refer to tables and figures, which often summarize the results section and offer an easy method to read and interpret text. Further, it is highly recommended to draw a diagram describing the study design after reading the abstract. In this diagram, you should label each aspect using relevant numbers and primary outcomes. This will be very helpful in interpreting text, particularly in therapy, prognosis, and diagnosis papers.

N.B. Most well-written articles already contain these types of diagrams.

Fig. 2 and Fig. 3 depict the scratch drawings for a simple therapeutic article design and a diagnostic design, respectively.

7- Interpretation only: While perusing the results section of articles, you are only concerned with interpreting the meanings of all the depicted numbers and values. Hence, you can ignore all equations or calculations. An example of this type of interpretation is reading the width of a confidence interval (CI), rather than its calculation method, also the value of the likelihood ratio (LR), when assessing a diagnostic paper (either positively or negatively). It is better to follow this interpretation method for all article types, instead of overloading your mind with information regarding the formula and/or other similar elements.

N.B. You may optimize the use of the EBM Calculator software for all required calculations following the appropriate construction of a relevant 2×2 table.⁽¹²⁾

Extracted values:

- Critical reading helps one to avoid being fooled by the author or statistician; similarly, a reader should not be affected by the journal or publisher.
- Practice makes perfect regardless of the perceived difficulty of acquiring a skill

III. RESULTS

Almost all practicing physicians work in a busy clinical practice with a busy schedule, which means that many clinical problems and questions arise. At the same time, this means they have less time available for reading and learning new skills (which in EBM are sometimes unfortunately misperceived as only theoretical and impractical). These difficulties are in addition to the endless explosion of new medical information, which is sometimes contradictory and frequently relies on difficult jargon. All these factors result in many physicians practicing without a solid base of EBM skills and practice. This may affect their clinical decision making. In this paper, I tried to tackle these obstacles by suggesting practical steps based on my own experience as both practitioner and teacher. Most significantly, I suggested the search equation to be used in step 2 of EBM (search), and the 7 practical steps for critical reading to be used in step 3 of EBM (appraisal). These pragmatic steps respect certain general principles and values that should govern any learning process, especially when it comes to andragogy. Adult learning must build upon prior knowledge and be based upon real practice. Adult learners can solve their daily problems by linking them with abstract values, concepts, and principles. This can be done by utilizing the model below (Figure 4). Table 1 tries to summarize all the practical problems from the perspective of busy end-user clinicians, their values and principles, and the suggested practical steps.

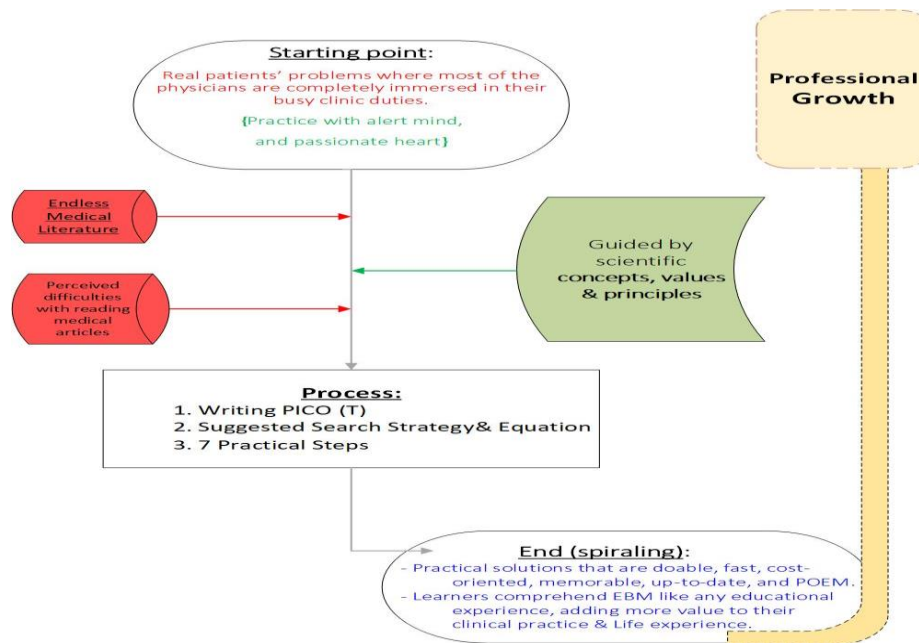
Table 1 Summary of the model’s solutions to practical problems, along with the relevant concepts, principles, and values

EBM Step	Real Problem	Concept/ Principle(s)	Practical Steps	Extracted Value(s)
0 <i>(The most Important)</i>	Practice clinic as routine duty	Practice with passion & alertness	Prepare yourself for duty (with every patient)	Medical practice is an honorable profession that deserves total commitment, mind , heart & soul
1	Learning while working	1. Practice is the main source of learning 2. One should not feel embarrassed when one does not know something	1. The PI/ECO method 2. Educational prescription	- Questioning is the key to learning - Any undertaking in life should start with a clear <i>objective</i> - The importance of <i>writing</i>
2	“We are drowning in information while starving for wisdom,” as stated by Edward Osborne Wilson	The critical thinking process matters more than the thoughts themselves .	1. Search strategy 2. Mastery equation	- Health care practioner should be a clever information seeker
3	. Most of the literature is not valid, important, or relevant as yet . step 3 is difficult	Do not take any evidence at face value {all that glitters is not gold}	7 practical steps	- Critical reading - Practice makes perfect

EBM, evidence-based medicine; PI(E)CO, Patient-Intervention/Indicator-Comparison-Outcome.

EBM Step 0 [9]

Fig. 1 Conceptual framework for a successful EBM learning experience (**Afify** Proposal)



IV. DISCUSSION

This study conceptualizes the three fundamental steps of EBM within its major principles to help adult learners understand each step in any specific context. Further, it highlights the importance of augmenting active participation in the learning process, which should always be the case in any adult training activity. In this respect, we hope that learners can continue their practice while improving their EBM methods over time. These practical steps should facilitate EBM implementation, particularly by busy junior physicians, who can thereby enhance their self-directed learning capabilities with the ultimate goal of improving health care. Finally, this study builds on prior EBM knowledge. Hence, the author assumes that readers already know some EBM jargon (terms such as PICO, evidence levels, **primary and secondary** resources, POEM, and EBM steps). The same principles can be applied **-with few modifications- in the other relevant subspecialty, like Evidence based medical Education, Evidence Based Public Health, or even Evidence Based Policy making.** Further, I believe an

effective thinking process is more important than the thoughts and ideas themselves, **especially critical appraisal schools are multiple, sometimes diverse, not to mention also the infinite medical databases.** In this study, I specify a way to systematize and prioritize the learning and practice of EBM **especially for busy doctors & junior trainees.** It is noted that EBM was originally developed to translate evidence (research) for use in practice. It was created to make our clinical life easier and safer by avoiding the overloading of physicians' brains with tough research and/or statistical terms and conditions. I hope that this study helps readers proceed further along the same path. However, this proposition (Afify Proposal) is to be investigated through practical (better interventional) studies. This can be performed through the practice of fundamental steps of EBM by junior doctors on clinical work, using educational prescription, and application of the suggested Search Strategy and the 7 practical steps for appraisal. In conclusion, adults learn best when they identify some value in what they learn and can comprehend its relevance to their lives [8]. Therefore, I hope this study makes the EBM trainer's job easier and helps EBM trainees to begin their learning journey. I believe this is best done by linking the first three fundamental steps of EBM to the logic and major principles that govern them. This also requires the linking of these principles to practical steps from the perspectives of our end-users (that is, busy clinicians).

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FIGURE CAPTIONS

Fig. 1 An example of an EBM prescription to write a PICO, including patient identification and the date to be filled. The use of a prescription helps one memorize the problem, and the prescription is a particularly good tool for self-improvement, since it encourages an attitude of lifelong learning (from Oxford Centre of EBM, 2019) [10]

Rx

Educational Prescription

Patient's name: Learner:

3-part clinical question

Target disorder:

Intervention (+/- comparison):

Outcome:

Date and place to be filled:

Prescription will cover:

1. Search strategy;
2. Search results;
3. The validity of this evidence;
4. The importance of this valid evidence;
5. Can this valid, important evidence be applied to your patient;
6. Your evaluation of this process;

Fig. 2 Simple diagram representing a randomized controlled trial design that can be used by trainee appraisers to simplify methodology and results sections while reading the article for appraisal

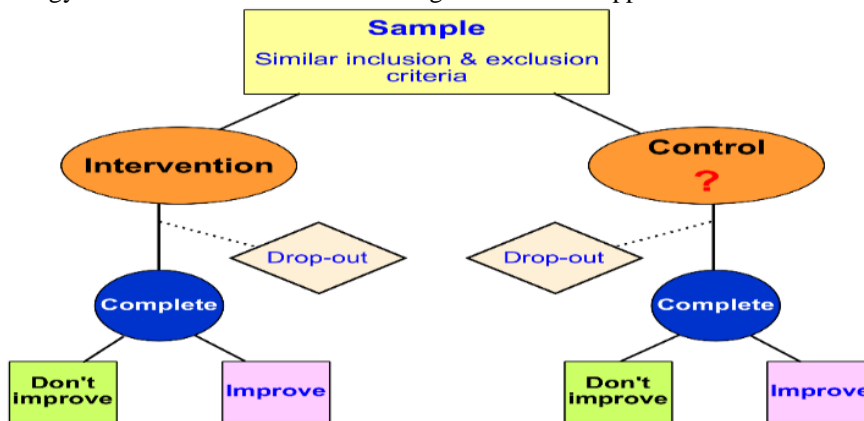


Fig. 3 Simple diagram representing a diagnostic study design (from the Users' Guide to Medical Literature, 3rd edition [11])

