

Evidence-Based Medicine: What Is It and How Does It Apply to Athletic Training?

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Objective: To introduce the concept of evidence-based medicine (EBM) to athletic trainers. This overview provides information on how EBM can affect the clinical practice of athletic training and enhance the care given to patients.

Data Sources: We searched the MEDLINE and CINAHL bibliographic databases using the terms *evidence-based medicine* and *best practice* and the online Index to Abstracts of Cochrane Reviews by group (*injury, musculoskeletal injuries, and musculoskeletal*) to identify reviews on topics pertinent to athletic training.

Data Synthesis: Evidence-based medical practice has 5 components: defining a clinically relevant question, searching for the best evidence, appraising the quality of the evidence, applying the evidence to clinical practice, and evaluating the

process. Evidence-based medicine integrates the research evidence, clinician's expertise, and patient's preferences to guide clinical decision making. Critical to this effort is the availability of quality research on the effectiveness of sports medicine techniques. Athletic training outcomes research is lagging behind that of other health care professions.

Recommendations: Athletic trainers need to embrace the critical-thinking skills to assess the medical literature and incorporate it into their clinical practice. The profession should encourage more clinically related research and enhance the scientific foundation of athletic training. Evidence-based medicine provides an important next step in the growth of the athletic training profession.

Key Words: best practice, clinical research

To some clinicians, evidence-based medicine (EBM) is a completely unfamiliar concept, whereas to others, it has become the current buzzword in medicine. For both groups, our purpose is to shed some light on what EBM is and is not and the steps involved in practicing EBM and to explain why it is important to athletic training. The more athletic trainers understand about EBM, the more they will see the benefits of making it a part of the profession. This article is the first in a series of articles planned for the *Journal of Athletic Training* on the concept of EBM. Although this article serves as the overview, future articles will describe in much greater detail how to perform a literature search and then appraise the evidence.

What Is Evidence-Based Medicine?

The definition of EBM comes from Sackett et al,¹ who stated that it is the "integration of the best research evidence with clinical expertise and patient values to make clinical decisions." The notion that clinical judgments should be based on the best available research is not new. In fact, this concept can be found in writings as far back as the mid-19th century.²

The evidence referred to in EBM is patient centered, clinically relevant research found in the medical literature on diagnostic tests, treatment techniques, preventive programs, and prognostic markers. Evidence-based medicine focuses on research dealing with the day-to-day practice of patient care. The evidence may prove or disprove previously accepted methods or demonstrate new ways of care that are more accurate and

effective and less harmful. Evidence-based medicine also recognizes that the research literature is constantly changing. What the evidence points to as the best method of practice today may change next year. The task of staying current, although never easy, is made much simpler by incorporating the tools of EBM into everyday practice.

For the typical athletic trainer, the task of keeping abreast of all the newest scientific information relevant to daily clinical practice is almost impossible. The amount of literature published relating to sports medicine continues to expand, whereas the time to read that literature gets smaller. The cornerstones of EBM are providing clinicians with the tools to efficiently find helpful information and then evaluate the quality of that information and apply it to their specific clinical situation.

However, it is important for clinicians to keep in mind that clinical decisions are not made by evidence alone; as such, research evidence should never be accepted blindly. Research study results must be combined with the clinician's knowledge and experiences and with what is important to the patient. It is a mistake to characterize EBM as a cookbook or blueprint on how to care for patients.

Why Is Evidence-Based Medicine Important to Athletic Training?

The foremost reason for using EBM is to improve the care delivered to our patients. Evidence-based medicine provides clinicians with the tools for finding that evidence and for an-

alyzing the quality of that evidence so they can benefit from the work of other clinicians described in the medical literature. New or different evaluation and treatment methods that are more effective in returning athletes to play sooner are increasingly being published in the literature. The literature may also provide answers to new and unfamiliar clinical problems that arise in the clinic.

Evidence-based medicine also promotes critical thinking by clinicians. It requires that clinicians have the open-mindedness to look for and try new methods scientifically supported by the literature, and it asks that clinical interventions be scrutinized and proven effective. In addition, EBM offers ways to critically evaluate the enormous amount of medical literature for value. In this way, clinical interventions and treatments are not just accepted because someone speaks of their anecdotal effectiveness, but a rigorous standard is applied to scientific data to determine whether the information has merit and applicability.

Athletic training as a profession also needs EBM to continue developing. The standard belief in the health care professions is that practitioners, for the most part, will use proven scientific methods on their patients. Despite this, athletic training still lags behind other allied health professions (eg, physical therapy, occupational therapy, nursing, etc) in published evidence on the effectiveness of treatments and interventions used in daily clinical practice.³ As athletic training embraces the concept of EBM, more attention will focus on research examining clinical practice. This, in turn, will demonstrate the effectiveness of athletic training methods, thereby giving the profession more support scientifically.

Having scientific evidence on the effectiveness of athletic training methods is essential to obtaining financial reimbursement for athletic training services. As more athletic trainers bill third parties for their services, those third-party payers will require evidence that the interventions are effective. Reimbursement may be difficult or impossible to obtain for those procedures not shown to be effective.

In addition, EBM is important for athletic training as the profession seeks to enhance its reputation within the health care field. As other professionals, such as physicians and physical therapists, embrace the concept of EBM, so too should athletic training practitioners. Otherwise, we may run the risk of gaining the reputation that we do not regard evidence of effectiveness and critical thinking as highly as other professionals. This reputation may then affect patients as they decide who will provide their care.

What Evidence-Based Medicine Is Not

As stated earlier, EBM is not a blueprint on how to practice athletic training. Decisions on how to care for athletes are not based solely on the available evidence. Factors such as personal experience, judgment, and patient preferences must be considered. Any clinician who feels restricted to behave only as the evidence dictates is missing the concept of EBM. Of note, one barrier to implementing EBM in clinical athletic training practice is the lack of outcome effectiveness studies presently available in the field of sports medicine and athletic training. Clinicians attempting to practice EBM may become frustrated with the process when they are unable to find any useful information to answer their clinical questions. In some cases, information is available, but the evidence may be inconclusive or contradicting. Fortunately, the amount of infor-

mation available to sports medicine clinicians continues to grow. Regardless, more research studies need to be conducted to assess the outcomes of clinical methods important to athletic training if the practice of EBM is to be successful.

What Is the Current State of Evidence-Based Medicine in Athletic Training?

Undertaking complex, high-quality research studies to provide evidence on effectiveness requires a significant amount of time, money, research training, and expertise. In partial response to this problem, the National Athletic Trainers' Association Research & Education Foundation has recently released a request for proposals for research supporting evidence-based clinical practice in athletic training.⁴ This funding mechanism will help to support researchers interested in athletic training-specific clinical research; however, further support is still needed to assist researchers in gaining expertise and experience in clinical outcomes research techniques.

To date, few systematic summaries have been published that are specific to clinical athletic training practice. To illustrate this, we conducted a hand search of the tables of contents in the *Journal of Athletic Training* from 1996 through 2002 and found that all published literature review articles were traditional narrative reviews and not systematic reviews or meta-analyses. Traditional narrative reviews are primarily subjective summations of published literature, whereas systematic reviews or meta-analyses use scientific methods, quality assessment, and quantitative analysis to summarize published data from multiple studies. The latter represents a more objective review of the literature in a selected topic area and may best reflect the scientific evidence.

Resources exist, although usually for a subscription fee, that conduct and collect reviews on topics in sports medicine (Table 1). The Cochrane Library is a regularly updated collection of evidence-based medicine databases, including the Cochrane Database of Systematic Reviews, and is available both online and on CD-ROM. Cochrane Reviews are developed using rigorous methods of searching, selecting, rating, and reporting of published and unpublished reports.⁵ Table 2 lists recent Cochrane Reviews on topics of potential interest to athletic trainers.

Several journals publish compilations of systematic reviews on various clinical topics. For example, *Evidence-Based Practice* in family practice medicine and *ACP Journal Club* in internal medicine each publish short synopses of comprehensive reviews published elsewhere but of interest to their profession, whereas other journals (*Physical Therapy*, *Clinical Journal of Sport Medicine*) offer systematic review sections within select issues. These journals use a meticulous selection process that reduces the amount of information retrieved to the 2% that is most methodologically sound and clinically useful.⁵

Athletic trainers should also be aware that a text has been published by MacAuley and Best entitled *Evidence-Based Sports Medicine*.⁶ However, the drawback with all textbooks is staying current. Research may have been conducted after the publication date that alters the notion of what is the best practice.

Caution should be exhibited when using general Internet search engines such as Google, Yahoo, or Excite to gather evidence on medical care information. Although attractive and easy to use, these search engines often retrieve nonscientific and low-quality information. A recent review of Internet medical information revealed that only 4 of 41 Web sites reviewed

Table 1. A Select Listing of Evidence-Based Medicine Resources

Bibliographic Databases	
PubMed (MEDLINE)	http://www.ncbi.nlm.nih.gov/entrez/query.fcgi
SPORT Discus (sports medicine/fitness)	http://www.sportdiscus.com/
CINAHL (nursing/allied health)	http://www.cinahl.com/index.html
EMBASE (international biomedical)	http://www.embase.com/
General Evidence-Based Medicine Resources	
Cochrane Library	www.cochrane.org
SportsMed Update	www.sportsmedupdate.info
ACP Journal Club/Best Evidence	http://www.acpjournals.org/?hp
UpToDate	http://www.uptodate.com
PEDro	http://www.pedro.fhs.usyd.edu.au/
Hooked on Evidence	http://www.apta.org/hookedonevidence/index.cfm
Evidence-Based Medicine Online	http://ebm.bmjournals.com
Bandolier Evidence-Based Health Care	http://www.jr2.ox.ac.uk/bandolier/extra.html
Centre for Evidence-Based Medicine	http://www.cebm.net/index.asp
BestBETs	http://www.bestbets.org/

contained information based on published guidelines.⁷ Within the sports medicine field, new Internet services that use a standardized reporting and summary format are available, such as SportsMed Update.

How to Practice Evidence-Based Medicine

Sackett et al^{1,2} proposed 5 steps for incorporating EBM into clinical practice.

1. Defining Clinically Relevant Questions. Situations arise in the athletic training setting daily in which there is a question about the best course of action. In addition, an athlete may present with an unusual case not seen before and so the athletic trainer may be uncertain as to the appropriate care. Therefore, every time a clinician sees a patient, some need for information regarding the diagnosis, prognosis, or management is generated. Sometimes the information is easy to find, such as rehabilitation protocols for anterior cruciate ligament reconstructions. Much of the time, however, the needed information is not easily accessible, and this is the point in the clinical decision-making process when answerable questions are formulated and the opportunity to initiate the EBM learning process is offered.

Clinical questions must be formulated in such a way that the search for the answers will yield relevant and helpful results. Poorly worded questions are more likely to result in either an unmanageable amount of information to review or none at all. To pose a clear question, the clinician must identify 4 components: (1) the patient population, (2) the intervention/treatment, (3) a comparison group, and (4) the outcome of

interest.⁸ Table 3 lists examples of clinical questions relevant to each domain⁹ of athletic training.

2. Searching for the Best Evidence. With an answerable, focused, and clinically relevant question in hand, the clinician now turns to finding the answer. A few years ago, this search for answers was a very daunting project. It involved long hours hunting through back issues of medical journals in the library. Now this process is made infinitely easier with computers and access to medical bibliographic databases via the Internet.

The user types in the relevant terms to be searched for, and the database retrieves all the articles containing those terms. In most bibliographic databases, only the complete article citation and select abstracts are available (rather than the entire article). The number of citations retrieved depends on the topic searched and the skills of the user. Becoming effective at searching the literature can take time. One group¹⁰ showed that more than 50% of the relevant studies can be missed using MEDLINE. However, several existing resources are available to assist clinicians with effective search strategies.¹⁰⁻¹³

The task of narrowing the search results to a manageable and most relevant few requires the largest time investment of the 5 steps. Establishing a set of criteria for article selection will aid the process. For example, to answer clinical questions pertaining to case management, criteria may include the following: (1) English-language studies, (2) published in the past 5 years, and (3) randomized, controlled study design. Using information in the complete citation and accompanying abstract, articles meeting these criteria are then selected for com-

Table 2. Select Cochrane Reviews on Topics Relevant to Certified Athletic Trainers*

Abstract Number	Topic
003528	Deep transverse friction massage for treating tendinitis
003686	Nonsteroidal anti-inflammatory drugs (NSAIDs) for treating lateral elbow pain in adults
003375	Therapeutic ultrasound for treating patellofemoral pain syndrome
002938	Different functional treatment strategies for acute lateral ankle ligament injuries in adults
000450	Interventions for preventing and treating stress fractures and stress reactions of bone of the lower limbs in young adults
001256	Interventions for preventing lower limb soft tissue injuries in runners
000018	Interventions for preventing ankle ligament injuries
000232	Interventions for treating acute and chronic Achilles tendinitis
002267	Orthotic devices for treating patellofemoral pain syndrome

*Cochrane Reviews are available at www.cochrane.org.

Table 3. Examples of Clinical Questions for Evidence-Based Approaches for the Domains of Athletic Training

Domain	Clinical Question
Injury prevention	Does a preseason functional conditioning program prevent anterior cruciate ligament injuries among women soccer and basketball players?
Assessment/evaluation	What is the most sensitive clinical test to detect meniscal lesions of the knee?
First aid/treatment	Do long-leg pneumatic braces reduce the recovery time for tibial stress fractures?
Rehabilitation	Is high-load eccentric exercise training effective for Achilles tendinosis?
Organization/administration	Does using a handheld computer improve the quality of record keeping in the athletic training room?
Counseling/guidance	Is group or individual nutrition counseling more effective for athletes with eating disorders?
Education	Do computer-based injury simulation programs improve the clinical decision-making skills of athletic training students?

prehensive review. The complete articles may be obtained either by photocopying them from the journal, having the local library acquire a copy, or, in some fortunate cases, through free, Web-based links to the journal. Many subscription bibliographic databases also allow direct access to full articles.

The most common search engine used in the United States to search the medical literature is MEDLINE, which can be accessed via PubMed (see Table 1), a free service of the National Library of Medicine. SPORT Discus requires a subscription for access and works in the same fashion as MEDLINE but indexes more sports medicine publications relevant to athletic training. Some subscription databases cater to busy health care professionals searching for summaries of scientific evidence on a particular topic. These databases make the search and acquisition easier by taking a topic of interest, finding the relevant articles, appraising the quality of studies, and collating the results into a systematic review. Clinicians may be fortunate to find that their specific clinical question has already been asked, and the results are readily available for their review. Examples of databases offering these services are the Cochrane Library, Best Evidence, UpToDate, PEDro, and Hooked on Evidence (see Table 1).

3. Critically Appraising the Evidence. Once the relevant information has been retrieved, the next step is to determine its validity and usefulness. This is likely the most difficult task in practicing EBM because the skills in evaluating research and research methods may be unfamiliar to most athletic trainers. Additionally, this is the step in which the most judgment is required. Two issues arise with regard to appraising the evidence: rating the quality of studies and applying statistical results to clinical practice.

Formal evaluation of study quality, through rating scales and analytic methods, is used to quantitatively rank or rate each study against some set of standard criteria for the purpose of publishing systematic reviews of the literature. A detailed description of available quantitative rating scales is out of the

scope of this article, but information is available for those who are interested.^{5,14,15}

When examining a study, most athletic trainers are familiar with the idea of a statistically significant difference between comparison groups. However, this difference may not translate into a clinically significant difference. Evidence-based medicine introduces concepts such as numbers needed to treat, absolute risk increase, likelihood ratios, and confidence intervals¹⁶ as well as many others, which more closely relate the differences in clinically relevant ways rather than presenting traditional *P* values to signify statistical differences between groups. Applying these concepts from EBM when appraising the literature will dramatically increase the clinician's understanding of the study's results and, thus, may be helpful in shaping the clinical decision. Because of space limitations in this article, future submissions to the *Journal of Athletic Training* are planned to further elaborate on and illustrate the applicability of these concepts to the athletic training audience.

4. Applying the Evidence. Now that the clinician has found the needed information and determined it to be valid and important, the next step is to integrate it into the particular clinical situation involving a patient. It is important to point out here that EBM does not force an athletic trainer to act in a certain way. Even though the evidence may point to the "best way" to handle a clinical situation, it may not be the right decision in an individual case. Drawing on past clinical training and experience, the ultimate decision is still the clinician's. It is also essential to factor in patient preferences, cost, and convenience.

5. Evaluating the Performance of EBM. One of the hallmarks of EBM is critical thinking. Critical thinking is applied to evaluate the usefulness of the research and again when the clinician determines which course of action is best. In the final step, clinicians must again engage critical-thinking skills to evaluate how well the whole process worked. Was the intended outcome achieved? Did the evaluation or treatment method help this athlete? How much time did the process take? Each step in the EBM process, from posing a good clinical question to finding the helpful evidence to appraising and applying that evidence, needs to be examined and thought given as to how to make it more effective. Most clinicians will not take the time to become proficient at EBM if it requires too much time and their efforts are not fruitful. As with all other skills, practice is required to make it work. Outcome assessment and re-evaluation of the process are integral parts of the EBM concept.

What Is the Next Step With Evidence-Based Medicine?

The time has come to implement EBM into clinical athletic training practice. Here are recommendations on how to take the next step:

- Develop EBM skills in certified athletic trainers through interactive workshops and seminars.
- Teach in athletic training undergraduate and graduate curricula the clinical research skills and methods of practicing EBM.
- Urge athletic training researchers to publish more systematic reviews of athletic training-specific methods and procedures.
- Call for more clinical athletic training research to determine the effectiveness of current practices.
- Develop in sports medicine and athletic training journals a

regularly occurring section that provides brief reviews of already published studies relevant to clinical athletic training using the appraisal guidelines set forth in the practice of EBM.

CONCLUSIONS

The time has come to implement EBM into athletic training. Practicing EBM will enable athletic trainers to contend with the exponential growth in medical literature and provide a scientific foundation for clinical practice.

Evidence-based medicine places a greater emphasis on examining clinical athletic training. It asks that the care of athletes be rooted in methods shown to be effective through scientific research and calls for more clinical research to demonstrate that tried and true methods are effective. Evidence-based medicine is not an effort to replace clinical judgment but instead helps the clinician incorporate the scientific evidence into practice to improve the care delivered to athletes.

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