Evidence-Based Practice for Rehabilitation Professionals: Concepts and Controversies

Marcel P. Dijkers, PhD, Susan L. Murphy, ScD, OTR/L, Jason Krellman, PhD


This article describes evidence-based practice (EBP) in the health professions and sciences in general and in the rehabilitation disciplines specifically. It discusses the following: what counts as evidence and how that has changed over the last 4 decades, trends in the short history of evidence-based medicine and EBP, the fallacious nature of most criticisms of EBP, (perceived) shortcomings of clinical research and the resulting evidence in rehabilitation, resources available to clinicians who want their practice to be evidence-based, and the barriers these clinicians face in keeping up with the evidence and applying it in practice. Lastly, it describes how the development of a new art and science, knowledge translation, may play a role in truly making EBP feasible in rehabilitation services.

Key Words: Allied health occupations; Evidence-based medicine; Evidence-based practice; Practice guidelines as topic; Professional practice; Rehabilitation; Review literature as topic.

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“The multiplicity of facts and writings has become so great, that everything must soon be reduced to extracts.”

-Voltaire

In just 20 years, evidence-based practice has transformed from a niche phenomenon in medicine to the sine qua non of all of health care, and become the Midas stone of various professional fields.1,2 Limiting their observation to health care, 2 originators of evidence-based medicine (EBM) have written:

The term evidence-based precedes many recommendations, guidelines, and algorithms that are not transparently linked to the underlying evidence base and do not represent the results of a systematic and critical appraisal of that evidence. It sometimes appears as if using the term obviates the need to describe the quality of underlying evidence, the magnitude of effects, or the applicability of any of the results in the context, values, and preferences of the patients.3(p1810)

For rehabilitation clinicians, researchers, and policymakers to properly engage in evidence-based practice (EBP), they need a sophisticated understanding of its background, methods, and limitations. The aims of this article are to (1) describe the background and history of EBM and EBP, (2) discuss some of the major criticisms of EBP, (3) describe types of evidence resources available, (4) identify ways in which rehabilitation systems can engage clinicians in EBP, and (5) address present and future challenges in establishing an EBP culture.

EBM AND EBP: HISTORY AND EPISTEMOLOGY

Clinical Decision Making: From Individual Experience to Systematized Research Evidence

Although there are many characterizations of EBP, all are variations on the definition of EBM originally proposed by Sackett et al: “Evidence based medicine is the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients. The practice of evidence based medicine means integrating individual clinical expertise with the best available external clinical evidence from systematic research.”4(p71) For instance, in rehabilitation, the Vision 2010 Statement of the American Physical Therapy Association (APTA) describes EBP as:

...access to, and application and integration of evidence to guide clinical decision making to provide best practice

List of Abbreviations

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<tr>
<th>Abbreviation</th>
<th>Full Form</th>
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<tr>
<td>AJOT</td>
<td>American Journal of Occupational Therapy</td>
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<td>AOTA</td>
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<td>APTA</td>
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<td>CAT</td>
<td>critically appraised topic</td>
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<td>GRADE</td>
<td>Grading of Recommendations Assessment Development and Evaluation</td>
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<td>NNT</td>
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<td>OT</td>
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<td>PBE</td>
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<td>PEDro</td>
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<td>standardized mean difference</td>
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<td>speech and language pathology</td>
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<td>SR</td>
<td>systematic review</td>
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for the patient/client. Evidence-based practice includes the integration of best available research, clinical expertise, and patient/client values and circumstances related to patient/client management, practice management, and health care policy decision making. Of note is that most definitions of EBP contained in the literature of various rehabilitation disciplines do contain language pertaining to patient values. Such language is absent from the Sackett definition and most early characterizations of EBM. This omission may have contributed to the persistent criticism that EBP values the results of clinical research to the exclusion of other information relevant to clinical decision making.

Of note is that most definitions of EBP contained in the literature of various rehabilitation disciplines do contain language pertaining to patient values. Such language is absent from the Sackett definition and most early characterizations of EBM. This omission may have contributed to the persistent criticism that EBP values the results of clinical research to the exclusion of other information relevant to clinical decision making.

Patient preferences, based on their unique values and wants, have presumably always helped inform EBM. However, significant development of effective aids (eg, means to educate patients so they can make informed choices) to facilitate joint decision making between clinician and patient has really only occurred relatively recently. Figure 1 offers an overview of the many factors that consciously or subconsciously may play a role when clinicians make a decision with respect to the care of an individual patient. The importance given to the clinician’s own experience and expertise, academic learning, and continuing education (CE), as well as cost issues and societal values, has varied over time and still differs across societies and health care systems.

EBP has stressed the use of the results of clinical research, in raw format (research article) or repackaged into what we here will call EBP resources, and possibly enhanced and supplemented in clinical practice guidelines (CPGs). This is the paradigm shift that EBP has brought about—or is trying to bring about, because it cannot be claimed that the move from reliance on authority, clinical experience, and basic science to dependence on clinical research findings has been made completely—not in medicine, and not in nursing and the allied health professions.

Some descriptions of EBP’s or EBM’s history would lead one to believe that before the invention of EBP, clinicians never relied on evidence in making care decisions. That position is, of course, untenable. Even in eras when the craft of healer was learned as an apprentice, there existed evidence: the lore handed down from the master, who likely used as a basis the knowledge handed down by her master, supplemented by her own experience. After all, the term evidence stems from the Latin evidentia (evidence; obviousness; quality of being manifest), which is derived from videre (to see) by way of evidens: clear, distinct, plain, visible, evident. When training moved to universities and other schools, the evidence base was augmented by textbooks, written by experts (authorities) on the basis of their own theories and experience, supplemented here and there by systematic observation, sometimes even experiments (eg, Harvey’s experiments on the circulation of the blood). However, as long as the healing professions were craft-based, and more art than science, practical experience had a major role as the basis of published clinical articles (most commonly case studies and case series), textbooks, and practice decisions. This evidence base had all the potential problems inherent in unsystematic observation: nonrandom samples, poor outcome measurement, primacy and latency effects, and bias of expectations. The history of medicine offers many examples of treatments that were used for hundreds of years, only to be proven ineffective or even harmful by later research (eg, bloodletting). In these years, decisions by clinicians were based largely, if not entirely, on factors to the left of the vertical dividing line in figure 1. Clinical research, as it is defined today, slowly developed in the 1800s, and while randomized controlled trials (RCTs) were referred to earlier, the first of these was not published until the 1900s.

The enormous growth of research, especially clinical research, in the 1970s and later years, offered both a means of creating an evidence base and a barrier to it, thrown up by its sheer abundance: there were so many publications that no clinician could keep up with the literature. At the same time, the spread of computers, especially desktop computers (late 1970s) and above all the invention and increased availability of the Internet (late 1980s) created a means of implementing the 5 canonical EBP steps:

- Ask—a clinical question.
- Acquire—information that may answer the question.
- Appraise—the evidence for its quality and applicability.
- Apply—the evidence in the care of the patient.
- Assess—whether the application resulted in the expected outcomes.

Thus, EBM and EBP emphasized a shift in the issues that are
given priority in decision making, from authority, one’s own training, and prior experience, to the findings of systematic (clinical) research. At the same time, as will be shown, EBM/EBP adherents developed many of the tools needed to make this different approach to clinical decision making feasible.

A Short History of EBM and EBP

While for many years Index Medicus had offered access to the (mostly American) medical journal literature, using this resource required a visit to the medical library. Working oneself through its many volumes ended with nothing but a few citations. A trip to the stacks was required to determine whether a promising title indeed fronted useful information. After 1980–1985, the availability of bibliographic information (including abstracts) from PubMed, Cumulative Index to Nursing and Allied Health Literature, Embase, PsycINFO, and other sources, first on CD-ROM and later over the Internet, made it possible to search for literature from almost anywhere, quickly filter out inapplicable material, and identify some key resources. With just about all journals nowadays (post-2010) available electronically, a trip to the library often is no longer needed either—the user can simply print the article, or scan its abstract on the screen of a desktop or laptop, or even a cell phone, tablet, or personal digital assistant, and start applying the evidence, with or without the step of explicit appraisal.

Computers and the Internet may have provided the infrastructure, and the exponential growth of clinical research publications may have created the need, but the tools of EBP were invented by various groups, in Canada and England primarily, who saw a need to put medicine on a new footing, using the language and methods of clinical epidemiology, health services research methodology, and medical informatics. In England, the medical researcher Cochrane16 noted that while a large amount of research was published, it often was not used, and certainly was not integrated. Much of medical care, whether diagnostic or interventional, Cochrane saw as having no underlying evidence. He proposed a database of studies, specifically RCTs, so that information on effective health care interventions would be easily available. The Cochrane Collaboration, established in 1993, now is an “international network of people helping healthcare providers, policymakers, patients, their advocates and carers, make well-informed decisions about health care by preparing, updating and promoting the accessibility of Cochrane [systematic] reviews.”17 Systematic reviews (SRs) in health care have gone in numbers, size, and methodology well beyond what was first explored in the 1970s in the social sciences.18,19 The success of the Cochrane Collaboration has led to the establishment of the Campbell Collaboration,20 which focuses on “preparing, maintaining and disseminating systematic reviews in education, crime and justice, and social welfare”21; Campbell Collaboration also produces resources of benefit to rehabilitation clinicians, policymakers, and researchers.

A second strand leading to EBP might be called bedside EBM, and was developed by Sackett, Haynes, Guyatt, and other Canadian physicians and clinical epidemiologists. These physicians, centered around the McMaster medical school,22 focused on application of the accumulated evidence to the individual patient, and created the Ask—Acquire—Appraise—Apply—Assess sequence. They taught it to their students, and to other physicians by means of a series of Readers’ Guides published in Canadian Medical Association Journal that focused on critical appraisal of clinical research. This was followed by 25 very influential Users’ Guides to the Medical Literature in the Journal of the American Medical Association, published between 1993 and 2000, and now updated in book format.23 This group was also involved in the invention and creation of many other EBP resources: databases, journals, bibliographic database search algorithms (hedges), and other apps to make the research literature more easily accessible to practicing clinicians, who lack the time and/or the expertise to read and evaluate everything being published in their field, or even to scan and integrate the results of a focused search to answer a well-framed clinical question.

In the 1990s and later years, other areas of health care, such as public health24 and the rehabilitation disciplines,25 followed the lead of medicine. Clinician-scholars (some working as part of the Cochrane Collaboration or other physician-dominated EBP groups), soon followed by the boards of their professional organizations, encouraged their colleagues to start teaching EBP in the training programs, and using EBP in their clinical activities. The fact that EBP resources coming out of the EBM pipeline were not very relevant to nonphysicians led to the creation of alternatives: Physiotherapy Evidence Database (PEDro), speechBITE, and OTSeeker, databases of physical therapy (PT), speech and language pathology (SLP), and occupational therapy (OT) trials, respectively, and of SRs of these trials, assessed for methodologic quality using the PEDro scale. Also fairly recent are Hooked on Evidence, a database of published PT intervention research of all designs, and many websites with critically appraised topics (CATs) and other EBP-relevant information for rehabilitation clinicians. These resources were created by professional organizations, academic training programs, or individual health care providers.

What Is Evidence?

In the 2nd century AD, the Roman physician Galen concluded that the heart subserved human emotional experience and expression.26 This assertion, made by many classical scientists, was based on seemingly compelling evidence of a relationship between the heart and emotions; that is, a rapid heartbeat was associated with intense emotions and slower activity with calmer mood states. Clearly, our current concept of the physiologic basis of emotion departs significantly from that of Galen. Insights from the field of neuroscience that today characterize emotion as a function of complex neural networks that affect the heart and other visceral organs via the autonomic nervous system, are also based on compelling evidence.

Why, then, if the conclusions of Galen and modern neuroscience are each based on compelling evidence, do they differ so much? The difference is both epistemologic and methodologic: how knowledge is obtained and what constitutes evidence of knowing varies greatly between these 2 cultures and time periods. Galen’s conclusions were based on direct observation, a prime route to knowledge before the development of experimental methods. The conclusions of the modern affective neuroscience field were drawn largely using 1 of the most widely accepted paradigms for obtaining scientific knowledge today: basic experimental work conducted in animals, then translated to and corroborated in humans, using the most practical and appropriate means, for example functional neuroimaging studies.

Accepted ways of knowing, and statements of what constitutes “evidence,” vary with the time, place, and culture in which one’s clinical questions are formulated and answers sought. With historical and scientific hindsight, it is easy to look back at the musings of Galen and scoff. However, direct observation can lay the foundation for hypotheses to be tested in an experimental design, a technique unavailable in the second century. Indeed, despite contemporary biases regarding so-called effective research designs (culminating in the crowning in some Cochrane Collaboration groups of the RCT as the
only design that produces evidence), no single design is universally appropriate or effective.27

Therefore, the choice of how to best gain knowledge should probably be guided by the adage, “the right tool for the right job.”27 In the field of rehabilitation science, the right tool should allow researchers to determine what constitutes affirmative evidence of 1 diagnosis over another, what best predicts should allow researchers to determine what constitutes affirm- ment.31

heterogeneous sample of participants to the receipt of either an properties of the simple experiment: random assignment of a heterogeneous sample of participants to the receipt of either an experimental treatment, control treatment, and/or no treatment.31

RCTs produce evidence based on aggregated group data obtained under highly controlled conditions. Therefore, RCTs cannot account for the complex set of extraneous factors present in any given research participant or predict the treatment effect for every individual. Individuals, not groups, are the foci of rehabilitation. The RCT’s inability to produce such detailed information means that its application to rehabilitation research may be limited29,32 and practice-based evidence (PBE) designs are to be preferred, certainly in the initial phases of evidence development.33 Most PBE studies collect information on many more variables than RCTs (allowing a richer description of treatments and subjects) and include more subjects than most RCTs (permitting fruitful subgroup analyses). Single subject designs (SSDs) allow one to examine the individual’s response to treatment, but usually do not produce data that can be generalized to a broad range of individuals.34 Similarly, expert opinion (which could be thought of as based on hundreds of SSDs conducted in the course of clinical practice) is likely to not fully generalize, given the relative uniqueness of each clinician’s experience and patient population, even though the number of patients on which the information is based is far greater than that of an N-of-1 study. Acquiring basic science data is time- and cost-efficient and can address questions that cannot be practically or ethically answered in human research. However, findings from studies using animal models or experimenetal procedures conducted on human tissue in vitro are unsuitable for providing knowledge needed for many questions of clinical rehabilitation because of challenges in generalizing these findings from the bench and animal laboratory to the clinic.35,36

No single research design is superior to all others for addressing most research questions. Consequently, reliance on 1 or even a few mainstay designs to provide rehabilitation research data will not provide the field with complete, generalizable information to guide diagnosis, treatment, and prognosis. In an era with multiple available research designs, each with its own strengths and weaknesses,31 SRs and meta-analyses have gained prominence as a means of evaluating and synthesizing volumes of research findings that were derived using different methods. This process allows clinicians and researchers to become better consumers of available research so they can identify findings that will be of optimum use in their daily practice. Indeed, including a wide range of research designs in SRs and meta-analyses has been recommended to fill in gaps in the field’s understanding of a variety of pertinent issues.37

Shortcomings of Clinical Research Evidence

The evidence used in EBP in principle is results from any research that can inform clinical decision making. There is a preference for clinical rather than basic research, and for findings that resulted from large-sample studies with strong designs leading to robust internal validity and high precision of effect estimates. Systematic reviewers have moved away from crude nose counting as was done in the 1970s—counting the number of studies with positive versus negative outcomes to determine the nature of reality. Now these reviewers emphasize the need to give greater weight to studies that employ better control methodologies (eg, a control group, random assignment, blind- ing of assessors) in evaluating study results. EBP also prefers recent research, which is less likely to incorporate the weak- nesses of older studies, and is more likely to reflect the health care environment in which findings will be applied. Even qualitative research is now counted among the sources of evidence, with publication of methods to assess the quality of individual studies38,39 and to synthesize multiple qualitative studies40-43 or even combine qualitative and quantitative findings44-46.

The peer-reviewed literature is a prime source of that evi- dence, because it is easily located through bibliographic data- bases and accessed through journal subscriptions or interlibrary loan requests, and increasingly through open access jour- nals47-49 as well as unauthorized posting on authors’ and others’ websites.40 However, SR methodologists and authors have emphasized publication bias: the tendency of published studies to have positive findings (ie, providing support for the hypothesis), while investigations with negative findings linger in desk drawers, especially if lacking sufficient power.51 This bias results from a preference of authors, peer reviewers, and editors to publish studies with positive findings, especially intervention studies. The end result is that the published liter- ature contains a high percentage of type I errors: a claim is made (based on sample results) that there is support for the hypothesis, but this claim does not reflect reality.

Another source of bias that recently has been receiving increased attention is a first cousin of nonpublication: selective publication. When studies have multiple subgroups and multi- ple outcomes, and numerous statistical tests are conducted, it is almost always possible to find 1 that resulted in the holy grail: a P value under 0.05. Recent studies comparing plans for research (in grant applications, published protocols, institu- tional review board applications, etc) with the published re- ports have shown that “publication bias in situ” is com- mon.52-55 With large databases and computers with easy to use statistical software widely available, data dredging is of concern in epidemiologic studies, and the requirement of prior registration of analytical protocols is hotly debated.56-58 Even SRs may have deviations from the protocol that was developed before searching for primary studies started,59 the reason for the recent start of a register of SR protocols, PROSPERO.60

To avoid these biasing effects when drawing conclusions, au- thors of SRs should do their best to find studies in the gray literature—dissertations, reports, technical notes, white papers, or other documents produced and published by governmental agen- cies, research institutions, and other groups that are not distributed by commercial publishers and (commonly) not indexed in bibli- ographic databases. They even should try to track down unpublished studies by contacting experts in the area of the review. The creation of trials registries such as ClinicalTrials.gov was occa- sioned exactly by the danger of publication bias—the potential that most studies showing no effect of interventions, or even more harm than benefit, would not be available in making health care decisions. For individual clinicians, attempting to track down gray literature, let alone unpublished studies, is nigh impossible. That is 1 reason that they rely on SRs and other EBP resources to access evidence.61
CRITICISMS OF EBP

From the beginning, EBM and EBP have been criticized from various quarters, based on pragmatic and epistemologic grounds. Some of the criticism resulted from the extravagant claims EBM adherents made or were seen to be making, and from the emphasis in early EBM work on the synthesized evidence, to the exclusion of clinician experience and patient needs and preferences. In spite of later clarifying statements and revised approaches (eg, the Grading of Recommendations Assessment Development and Evaluation [GRADE] methodology), the criticism has never gone away, and probably should not, because it reflects the unavoidable tensions between alternate views on the nature of and bases for clinical decision making. A number of articles discussing EBP and its epistemologic, ethical, clinical, and economical underpinnings and ramifications have been published; the most common criticisms are presented here along with a judgment of the appropriateness of the criticism in light of what state-of-the-art EBP actually does.

EBP Privileges Clinical Research Findings Over Other Forms of Evidence

This is an issue of epistemology: quantitative experimental evidence (especially from RCTs) is seen as crowding out all other forms of evidence and ways of knowing that the healing professions are seen as needing (see fig 1): basic science, pathophysiology, nosology, medical theory, clinical expertise and intelligence, and humanistic understanding. One could argue that, with some exceptions, EBP has never excluded these types of knowledge but has a preference for experimental or at least observational data over expert dogma, and for clinical research findings over the biology the clinician might reference in the absence of clinical research. To quote Sackett et al: “By best available external clinical evidence we mean clinically relevant research, often from the basic sciences of medicine, but especially from patient centred clinical research...”62 Also, with the expansion of EBP from simple pharmacutic treatments into complex interventions (eg, most of rehabilitation), other types of evidence (qualitative research, synthesized, and/or combined with quantitative findings) and theory to guide the proper understanding of the many types of evidence that are relevant, are welcomed.

EBP Disregards Factors That Should Play a Role in Clinical Decision Making

In its initial stages, EBM indeed held research evidence (or specifically RCT-produced evidence) to be the only factor to be considered in making decisions on the care of individual patients. As indicated above, in the EBP canon patient preferences and clinician experience and expertise are now explicitly allowed to also impact clinician decisions; it must be noted that there, as of yet, is no clear pathway on how the 3 should be integrated, or what should be done if they clearly contradict one another.67

EBP Is Blunt Empiricism

The claim has repeatedly been made that EBP uses a black box approach—the numbers rolling out of the relevant RCTs are manipulated statistically, without any desire or ability to put them in the context of theory, or without the statistician considering that there is no such thing as pure and morally neutral observation. In addition, strictly speaking the methodology of EBP can only disconfirm theory, but does not generate new theories, tests, or insights.68 Presumably by now EBP adherents have realized that observations are based on theory, and theory is always the result of attempts to integrate many and sometimes disparate observations. They certainly have found that, in making decisions on what is the best in health care, eliminating bias is impossible, and that the best approach is to be aware of bias, put in place mechanisms to minimize or balance biases, and to make values and value judgments explicit, as in the GRADE approach.65

EBP Only Wants to Deal With the Best Possible Evidence

Having created hierarchies of evidence (see Centre for Evidence-Based Medicine website69 and Edlund et al70), many EBP adherents would rather provide no guidance at all than use the best available evidence, if the latter is less than the theoretically best possible evidence.71 There certainly are many opportunities to observe the opposite, for example in the prescribed methodology of the American Academy of Neurology71 and other CPG producers, but many Cochrane Collaboration groups seem to have no problems with producing what Schlosser and Sigafoos have termed an empty review: an SR without conclusions or recommendations, because none of the evidence was at least of the level of an RCT. This may be true to the spirit of Cochrane’s proposal for a database of intervention trials, but favors 1 type of knowledge, and only the highest grade of experimental design within that category. With contradictory RCTs offered in the literature, and observational studies that come to the same conclusions as good RCTs, just relying on RCTs or meta-analyses of RCTs is a disservice to clinicians.72

In addition, there are many situations in rehabilitation73 and other health care fields,68 where an RCT is not the optimal research design. When an intervention, whether it is life-saving surgery or the provision of a prosthesis, makes a dramatic change in the functioning of patients as observed in the first few cases treated, an RCT is overkill and asking for one is ethically unacceptable. In addition, strong designs like RCTs have their place only in certain phases of the development of new treatments, and for certain purposes such as testing an intervention in a most rigorous way.27 Less controlled designs may be more suitable prior to and after the point where an RCT is needed to demonstrate that a proposed new intervention has an effect, of a worthwhile size, in a certain patient group.

EBP Methods Are Not Applicable to Many Questions That Clinicians Need to Have Answered

EBP methodology is strong in determining the effects of treatments or evaluating the utility of diagnostic and other assessment tools for groups of patients. However, where there are no groups that have been studied (as in orphan diseases, or unusual combinations of disorders, such as a stroke occurring after spinal cord injury), there commonly is no evidence, and certainly no strong group level evidence. Similarly, where there is no easy quantification of outcomes—for instance, for quality of life and other subjective states—EBP abandons the clinician. This issue to a degree has gone away with the more catholic stance of EBP, accepting qualitative research and the synthesis of that research as valid sources of evidence. The issue of a lack of research on patients exactly like the one clinicians need to treat next presumably never will go away (see the next section). The qualitative variation of individual patient circumstances and need requires clinicians to employ clinical reasoning, that is, to draw on their knowledge of basic science and of first principles, on analog reasoning and clinical intuition.
There Is No Such Thing as a Typical Patient

Strictly speaking, EBP deals in averages, and it is an unusual treatment that is successful for all patients studied, or a comparator treatment (even placebo or sham) that fails with all patients. Thus, even with a large effect size and a favorable number needed to treat (NNT), there is no guarantee that a treatment will be successful with the next patient presenting herself.78 Most studies have too few subjects to allow meaningful and preplanned analysis of outcomes for patient subgroups. Add to that the fact that most clinical research that is deemed worthwhile by SR authors is executed using highly selective samples of patients and under unusually controlled circumstances, and one will agree with Rothwell when he states: “Lack of consideration of external validity is the most frequent criticism by clinicians of RCTs, systematic reviews, and guidelines.”79(p82)

The studies that do get published mostly concern treatment situations that are unlike the ones clinicians deal with. Sample restrictions in age, sex, race, and comorbidities;80 extensive use of methods to ensure patients’ adherence to treatment, methods that are unlike anything used in clinical practice; use of surrogate outcomes (eg, biological markers) rather than clinically significant ones; disregard of the preferences patients may have for specific treatment alternatives; and absence of considerations of cost and cost-effectiveness, are the situations most commonly described.81 Even pragmatic studies designed to answer the effectiveness questions (Will it work in practice, and how well? Is it worth it?) may offer the clinician not much more assistance for decisions with respect to an individual patient seen in the clinic than the more common82 explanatory studies designed to answer the efficacy question: Can it work?82

Thus, to determine whether the findings of a particular study, or the findings of an SR, are applicable to the next patient, or even patients in general, the clinician must take a leap of faith based on knowledge of physiology and human behavior as well as experience. A decision needs to be made that what is reported in the literature is applicable to the patient. The only alternative is an N-of-1 study, where the treatment is tried in an SSD with the patient in question as the subject. For most rehabilitation interventions, this is not feasible because their effect cannot be undone. Other versions of SSDs may be useful, however.34

EBP Results in Cookie Cutter Health Care

The dictatorship of the statistical averages is often seen as undermining the autonomy of clinicians, denying their expertise, insight, and judgment as well as undercutting the patient’s right to make choices between alternative interventions and to prioritize outcomes.82 Cookbook medicine was a comment with the clinician’s expertise and the patients’ preferences.84 A decision needs to be made that what is reported in the literature is applicable to the patient. The only alternative is an N-of-1 study, where the treatment is tried in an SSD with the patient in question as the subject. For most rehabilitation interventions, this is not feasible because their effect cannot be undone. Other versions of SSDs may be useful, however.34

EBP Does Not Help With Clinical Decision Making

In its pursuit of the Ask—Acquire—Appraise—Apply—Assess quintet, EBP may have been very successful in developing tools for the first 3, but its canon does not have much to offer with respect to the latter 2. The criticism is made that there is a problem with Apply in that it is often unclear to what degree average results can be applied to individual patients. In addition, standard EBP tools do not assist the clinician with integrating the steps suggested by the best available evidence with the clinician’s expertise and the patients’ preferences.83 A part of this problem is rooted in the tendency to state results of research or evidence reviews without specifying the exact clients, conditions, and contexts (inclusion/exclusion criteria) to which the evidence applies, thus making evidence applicability moot. The various resources offered by EBP may help to shorten the distance between a researcher’s writing desk and a clinician’s examination room, but otherwise there is not much help. Only CPG development teams may grasp this issue sufficiently, and create instruments that bring the implementation of the evidence closer to the clinic, with decision-making tools for use by clinicians or patients, automated reminders in the electronic health record, and similar steps. It would not be unfair to say that EBP has left clinical application orphaned. Or maybe it should be stated that it has clarified the fact that between clinical research and clinical application there always has been a gap. In a later section of this article, the issue of knowledge translation is discussed in more detail.

If implementation (Apply) has gotten short shrift from EBP adherents, then evaluation (Assess) has been positively swept under the carpet. Assess obviously means: see whether the procedure you implemented based on the evidence had the expected outcomes, and if not . . . it is not clear what, in the
case of individual patients, the next step is. If the best has been used and failed, what is the alternative—other than assuming that for the patient in question the evidence is not relevant and leave the straight path. Similarly, evaluating the implementation of new interventions or other procedures for all of one’s patients (the clients of an individual clinician or of an entire clinic or hospital, etc) is not routinized. EBP stresses the published or unpublished evidence of prior research, including consideration of whom the evidence applies to and what outcomes are relevant, but it currently does not offer tools to add local findings, or otherwise obtain evidence that is more appropriate to one’s practice than the averages that can be calculated for the patients that happened to be included in published and unpublished research.

EBP Itself Is Not Evidence-Based

The argument that EBP is in fact not based on evidence is a gotcha accusation that there is no evidence that faithfully implementing EBP will result in a better health status of the population. There also is the allegation that preparing SRs and other EBP resources takes time and money, and that training clinicians in understanding and using EBP devours even more precious resources—all without evidence that it changes the bottom line. However, if EBP means giving more weight to evidence resulting from clinical and other research, and abandoning or at least decreasing reliance on habit, tradition, and authority, it cannot be expected that such a change occurs overnight. The need for knowledge translation and all it involves in convincing clinicians to change their ingrained habits suggests that no quick changes can be expected. Health care establishments and systems are complicated bureaucracies, and the individual clinician cannot count on the whole organization to implement even good CPGs instantaneously. Unless someone finds the funding and the widespread collaboration to do a cluster-RCT of full-bore EBP versus pre-1980 practice approaches, evidence to support EBP will be incremental, partial, and of rather low quality (in terms of EBP-endorsed evidence hierarchies). Smaller, 1 CPG at-a-time RCTs have been done, focusing on changes in clinician behavior or even on patient outcomes. It should be mentioned that to date, more studies have focused on the engagement of clinicians with EBP (barriers, knowledge, attitudes, etc) than on the ultimate result: improved patient outcomes.

PACKAGING THE EVIDENCE: EBP RESOURCES

The evidence to be used in making a particular clinical decision may be available in the thousands of articles, reports, and other documents published each day. However, the lone clinician does not have the time and expertise to review it all, evaluate it critically, and integrate it each day, so as to be conversant with all relevant information published up to 45 minutes prior to the session with a patient, as 1 spool of EBM required. A number of resources (preprocessed evidence-based information) are available to fill the gap, ready to be retrieved from the library or even automatically put on the lone clinician’s desk.

Systematic Reviews

An SR synthesizes all the (high-quality) research evidence of relevance to a particular clinical question. Reviews are required because clinical treatment should be based on a body of evidence, not a single isolated study. To conduct an SR, one follows a protocol to systematically find primary studies, assess them for quality, abstract the relevant information, and synthesize it, qualitatively or quantitatively (meta-analysis). Compared to traditional reviews, SRs reduce bias in the review process and improve the dependability of the answer to the clinical question, through extensive electronic and manual literature searches, critical appraisal of individual studies, and careful abstracting of data, preferably all done in duplicate by independent reviewers. Peer review of the protocol before study start and of the final report contributes to the avoidance of bias and error, issues emphasized in a recent Institute of Medicine report. The benefit of SRs to clinicians is not just that they don’t need to read all primary research reports, but that experts in library science, research methodology, and in the subject area have located and scrutinized these reports and synthesized the findings using prespecified high-quality methods. Unfortunately, many published reviews were not developed following these methods and standards. The National Center for the Dissemination of Disability Research recently published a guideline with a checklist clinicians can use to evaluate the quality and applicability of SRs.

Meta-analyses

A meta-analysis is an SR brought 1 step forward: the synthesis of the findings of the primary studies is done using statistical means, typically resulting in a single effect size. In an SR of intervention research, the effect size reflects the strength of the relationship between an intervention and outcomes; in SRs of diagnostic accuracy studies, it is a quantification of the relationship between a new diagnostic test and a reference standard. Once the various appropriate primary studies have been selected, the meta-analysis authors need to determine whether they can be combined, or that their methods, samples, and outcome measures are so diverse that they should not be amalgamated (apples and oranges). If combination appears reasonable, a forest plot is typically prepared to graphically describe the component studies and their pooled findings. It shows the effect sizes of the individual studies, the 95% confidence interval (CI) for each, as well as the pooled effect size and its CI, all arranged with respect to a line that may correspond to no effect or an effect size of a preselected magnitude.

Metasyntheses

A metasynthesis is an SR of qualitative research—rigorously examining and interpreting the findings of a number of studies performed using qualitative methods. The goal of metasynthesis is to produce a new and integrative interpretation of findings that is more substantive than those resulting from individual investigations. While epistemologic purists in the phenomenologic school of qualitative research may object to combining findings to generalize to practical situations, qualitative researchers working in health care systems have quietly developed methods to combine studies into something that can be used by clinicians.

Health Technology Assessments

The International Network of Agencies for Health Technology Assessment defines health care technology as “prevention and rehabilitation, vaccines, pharmaceuticals and devices, medical and surgical procedures, and the systems within which health is protected and maintained,” and states that technology assessment in health care is a multidisciplinary field of policy analysis which “studies the medical, social, ethical, and economic implications of development, diffusion, and use of health technology.” Health technology assessments often are based on or incorporate SRs, but generally focus on economic and other policy issues of relevance to decision makers in the public sector, rather than clinical ones. The Centre for Reviews
and Dissemination maintains an international database of health technology assessments.

**Clinical Practice Guidelines**

The standard definition of CPGs is that defined by Field and Lohr: “systematically developed statements to assist practitioner and patient decisions about appropriate health care for specific circumstances.”\(^{97}(p38)\) CPGs differ in a number of aspects from SRs: (1) they almost always concern more than just a single focused clinical question, typically offering guidance on diagnosis, treatment, and overall management of patients, basing their recommendations on multiple SRs; (2) where even weak evidence from clinical research is lacking, they generally fill the hole using expert opinion\(^{13}\); and (3) while SRs may be written for researchers, with page after page of methodologic discussion,\(^{98,99}\) CPGs tend to be very practical, aiming to bridge the chasm between evidence and its application in the complicated world of clinical practice. Many CPGs include tools for an individual clinician or a clinical organization to implement the recommendations made—for example, decision-making instruments or outcome assessment tools. Many organizations produce or disseminate CPGs, which like SRs vary widely in quality. The AGREE instrument was developed as a means of critically evaluating the development process and the content of guidelines.\(^{100,107}\)

**Clinical Pathways**

The term clinical pathway may refer to a description of key steps in the process of assessment and treatment, complete with a day from admission timing that service organizations use to keep length of stay to a minimum or optimum to achieve outcomes efficiently. It also may refer to the path through various clinical settings (acute care to inpatient rehabilitation facility to home care) and their coordinated use to optimize outcomes. Some pathways are developed using evidence to select goals, timepoints, or methods, and as such offer another mechanism to bring the evidence base to bear on care.\(^{102}\)

**Databases of Evaluations of Primary Studies**

Several databases have been developed to help clinicians find evidence for specific treatments, culling from the entire (peer-reviewed) research literature. Because clinical investigations differ widely in the quality of their design, execution, and reporting, these databases also report on the methodologic quality of selected studies. PEDro, the first one in the rehabilitation arena, limits itself to controlled trials of PT interventions, providing the abstract (as published by the authors) and bibliographic information, and adding the PEDro scores (10 items and a total score) summarizing methodologic quality. These scores are assigned by volunteer physical therapists all over the world. PEDro also contains SRs and CPGs in PT, which are not rated for quality. The OTSeeker and speechBITE databases focus on OT and SLP treatments, respectively, but also use the PEDro scale, supplemented in the case of speechBITE by an instrument for evaluating SSDs. A therapist looking for an evidence-supported treatment for a patient’s problem may use these databases to find 1 or more studies, and based on the PEDro score make a decision whether it would be worthwhile to read the article(s) describing the research. There are no equivalent databases of other types of clinical research (eg, diagnostic accuracy or prognostic studies) in rehabilitation.

**Databases of Extractions From Primary Studies**

Databases with extractions take a different path. The APTA Hooked on Evidence website\(^{103}\) contains “current research evidence on the effectiveness of physical therapy interventions” in the form of information on treatment research (not just controlled trials, but of any design) abstracted from the published report using a standard template that calls for information on the treatment studied as well as the outcomes and sample. Copied from the original article or calculated by the extractors (volunteer APTA members) are key effect size indicators: absolute mean difference and standardized mean difference (SMD) for continuous outcome measures, and odds ratio, risk ratio, and NNT for dichotomous outcomes. In the case of Hooked on Evidence, the extraction also contains much information that addresses study quality, for example, blinding of provider, patient, and assessor and use of intent-to-treat analysis. The potential uses of such extractions databases are similar to those of data SR of valued studies: to allow a clinician to quickly find a treatment, and assess the quality of the evidence supporting it. The extra here is the information on the strength of the intervention as expressed in an effect size.

**CATs and Critically Appraised Articles**

A CAT is a poor man’s SR—a short (often only 1–2 pages) summary of a search and critical appraisal of readily available studies related to a clinical question and focused on the clinical bottom line: what the clinician needs to do. CATs often are developed in a particular clinical setting (eg, a rehabilitation clinic) and kept on file for use by all clinicians practicing there. They sometimes are shared beyond the local setting. The Centre for Evidence-Based Medicine\(^{97}\) distributes CATmaker, a small program to assist clinicians to make CATs of therapy, diagnosis, prognosis, and etiology/harm. CATmaker assists in creating the clinical bottom line in the form of SMD, NNT, and other effect sizes, as appropriate. Some authors describe CATs as just concerning 1 study rather than all the evidence related to the clinical question; in that circumstance, a CAT is closer to an extraction than to an SR. The term critically appraised article is sometimes used for a freestanding evaluated study, extraction, or even a single-article CAT.\(^{104}\)

**EBP Journals**

EBP journals publish extractions from newly published research. They tend to offer an abstract (rewritten from the original article to focus on those elements most relevant to a clinician) that includes effect size indicators, and in addition may have an explicit research quality rating, a grading of the evidence on a I–IV or similar scale, and a commentary that places the evidence in the light of earlier studies or clarifies the role of the evidence in treatment, diagnosis, and prognosis. Most of these journals also have short articles that offer CE in EBP/EBM, with information on understanding terminology or on performing effect size and other calculations. There are over 30 journals in various areas of medicine and allied health, but none could be found in medical rehabilitation.

**Targeted Evidence Dissemination**

While EBP journals focus on describing concisely and disseminating the higher quality research that is most relevant to practice in a particular discipline or domain of health care, that still leaves the subscriber with 20 to 40 two-page summaries to work through each month. Staff of McMaster’s Premium Literature Service (PLUS) program scans hundreds of journals for evidence, selects the research that is of high methodologic quality, then has those articles evaluated by at least 4 reviewers (selected from a group of hundreds of volunteer clinicians) for relevance and newsworthiness. Only articles that exceed a threshold value for relevance to the health care specialty of the
raters and of newsworthiness to the target group of clinicians are considered worth disseminating to subscribers, but the latter have the option to customize what is emailed to them by setting the bar even higher. (Newsworthiness is described as the likelihood that the information is news to the target audience.) The PLUS program most recently started a service, Rehab+, directed at physical and occupational therapists. They receive email messages with the abstracts written by the study’s authors, the relevance and newsworthiness ratings as assigned for rehabilitation subspecialties (eg, client/patient education and neurolologic), as well as whatever short comments the raters added to their ratings.

ENGAGING REHABILITATION CLINICIANS IN EBP

In recent years, implementing EBP has become a priority for the rehabilitation professions. Given the contemporary rise in more streamlined care, in which patients have shorter hospital stays and fewer visits with clinicians, professionals have an increased accountability for the services they provide. Furthermore, the inability to cite research evidence supporting practice could ultimately negatively affect reimbursement. Despite the importance of EBP, there are several barriers to its use. Clinicians have cited lack of time, limited access to research, and a lack of expertise in evaluating the evidence. Whereas it is important for clinicians to be proactive and attempt to overcome such barriers, support from their professional organizations and their practice settings appears necessary in order to change practice habits.

Professional organizations provide learning opportunities that can increase skill in appraising research; they present flexibility to clinicians by offering many mechanisms such as in-person courses and online learning. By taking courses that have CE units, clinicians can learn about the fundamentals of EBP and have it count toward their requirements for continuing accreditation and licensure. However, knowledge of the principles and procedures of EBP alone may not be enough to actually use research evidence in practice. McCluskey and Lovarini tested the effectiveness of a 2-day interactive workshop in changing knowledge of and attitudes toward EBP, and tracked patterns of implementing EBP (eg, searching literature, appraising research, and using it in practice) for 8 months after the workshop. Although knowledge and attitudes significantly improved over time, there was very little implementation.

One way to assist with implementation of EBP is to expand the mechanisms through which relevant research evidence is readily available to clinicians. A number of these have been described already, but additional resources exist. For instance, American Occupational Therapy Association (AOTA) has an EBP project that provides several tools for OT clinicians to access and use research evidence. As part of the project, SRs have been undertaken in several practice areas and are being published in the American Journal of Occupational Therapy (AJOT). In addition, AOTA has developed a series of CATs and critically appraised articles that provide a synopsis of a group of articles in a specific practice area or a summary of individual articles and SRs, respectively. AOTA also provides evidence briefs, which are easy-to-read summaries of studies of OT intervention effectiveness. EBP articles published in AJOT, the OT Practice Magazine, and special interest section newsletters are also highlighted on the AOTA website for quick access by clinicians. These initiatives provide readily available resources for clinicians who have limited time.

On a systems level, it is important to have a culture in rehabilitation settings that is supportive of research. In rehabilitation provider organizations (hospitals, clinics, etc) there needs to be support for the use of EBP and allowance of time for research activities and access to resources. For example, clinicians should have Internet access and be trained in use of the databases they have access to. Especially in settings that are linked with academic institutions, clinicians may have access to many searchable databases such as Medline and PsycINFO. Librarians in these institutions usually offer assistance with searching the literature as part of their services. There are also many free online resources to use evidence and to practice EBP, and knowledge of these resources should be shared. In services could be planned that help clinicians access and use these tools in their practices. In addition, having people on staff with some training in EBP who can serve as knowledge-translators may facilitate implementation of EBP. Encouraging clinicians to use validated outcome measures and track the outcomes of their services can also help them make informed decisions about effectiveness using a systematic approach. Forming journal clubs and working on SRs with colleagues can also help foster a research-friendly environment.

A criticism of EBP mentioned previously is that the research unearthed by searches may have limited relevance to a clinician’s particular problem. In rehabilitation, where there is still a great need to build the evidence base, this can certainly be an issue. One way to build evidence is to form partnerships between researchers and clinicians to address timely and clinically relevant research questions. A model for this is the Practice Oriented Research Training program at the University of Michigan in which clinicians receive hands-on training and mentorship to write a short grant proposal and if funded, conduct a small research project within their practice setting to produce evidence. Although this requires time and effort of clinicians outside of their work responsibilities, the practice setting is supportive, allowing grant recipients protected time in their schedule to conduct the projects.

Partnerships between clinicians and researchers support the idea of knowledge translation. EBP often implies a 1-way information transfer in which research is accessed and then used by clinicians, whereas knowledge translation takes into account a clinician’s practice knowledge. This 2-way transfer of information between researcher and clinician, emphasized in the knowledge translation model of the Canadian Institutes of Health Research, will provide the practice knowledge needed to formulate these research questions most applicable to practice.

CONCLUDING REMARKS

Few in rehabilitation would argue with the basic premises of EBP: (1) professional action needs to be informed by available evidence; (2) when choices exist, clinicians should select the intervention (or the measurement instrument, etc) for which evidence suggests the most favorable cost-benefit ratio; and (3) the selected evidence-based approaches should maximally fit the needs and preferences of the patient. However, a great deal of change must occur before these ideals will permeate common practice in the rehabilitation arts. Indeed, in the coming years, rehabilitation professionals will have to oversee and facilitate the next major paradigm shift in the rehabilitation sciences: the redefinition of evidence from an inconsistent combination of basic science research findings and the experimentally derived opinions of individual professionals, to findings derived from clinical research conducted using designs appropriate to answer the question(s) at hand. Only then will rehabilitation researchers and clinicians truly be engaging in EBP.
There Is No Comprehensive Rehabilitation Evidence Base

While the health issues that detract most from quality-adjusted life years have shifted over the last 150 years from survival of injuries and infectious diseases to adjustment to chronic diseases and functioning in spite of the long-term effects of injury and disease, the emphasis in the research supported by society has not necessarily kept the pace. Add to that the fact that limited commercial profit can be made off drugs and equipment used as part of the rehabilitation process, let alone off the hours of 1-on-1 interaction between therapists and their patients, and it is not surprising that not much rehabilitation research exists. A clinician with a clinical question who does a diligent search for evidence will frequently come up with nothing, not even weak research, and may have to be satisfied with findings for a different patient population and reasoning by analogy (indirect evidence as it has come to be termed). It is unknown to what degree this problem is quantitatively or qualitatively different from that in other areas of health care—for example, behavioral medicine or surgery.

All Rehabilitation Research Produces Low-Level Evidence Only

This is true only to a limited degree. It is correct that given its nature (small numbers of subjects available, difficulty of binding clinicians and patients, complexity of the interventions of interest, inability to undo treatment outcomes) the research design that produces the strongest evidence (eg, the double-blinded cross-over RCT) often is not available to rehabilitation researchers. But rather than buying into the methodologic purity of those Cochrane Collaboration review groups that will not consider anything less than an RCT in their SRs, we should be satisfied with creating and using the best research that is possible given the circumstances. The evidence hierarchy developed by Sackett in 1989 and refined since then has a number of shortcomings, including an exclusive focus on internal validity of studies. Different methods of grading evidence should be considered by rehabilitation researchers and clinicians, as is argued in 1 article in this supplement.

In addition, rehabilitation researchers increasingly are realizing that in the development of treatments as well as diagnostic and other instruments, research needs to go through a series of phases, and the optimal research design for 1 phase may be inadequate for the next. Thus, if we were to have separate evidence hierarchies for different phases, it might become clear that the quality of rehabilitation research is not so deficient as many complain. That is not to say that no improvements in the quality of our research are needed; 1 impetus behind the current supplement is the concern that better research is needed to give rehabilitation clinicians the tools and information they need to serve their patients and clients better.

Clinicians Need Better Training to Understand and Fruitfully Use Evidence

Timid as well as more encompassing attempts to introduce the concepts of EBP now have been part of professional training programs for close to 2 decades. However, in surveys therapists continue to report limited knowledge of or use of EBP, although knowledge and use may be greater for better-educated and more recent graduates. A barrier to EBP that is reported time and again is the limited stock of that knowledge that is required for building practice on a foundation of research-supplied evidence, although the majority of therapists surveyed are convinced of the value of EBP for their patients and their field. It was suggested above that additional training may be delivered as inservice education; it might even be supposed that local or distance learning may be of greater benefit if it can be driven by clinical needs and applied in clinical practice. Training and retraining may be considered an ongoing need, because the field of EBP is still developing quickly.

Rehabilitation Settings Need to Do a Better Job of Delivering the Evidence When and Where Therapists, Physicians, and Nurses Need It

No one should assume that the deluge of research publications will abate in the near future; if anything, even the supply of secondary publications (SRs of research rather than primary research) will grow to a level where reading it all becomes an impossibility. Better access for clinicians to bibliographic databases and to the journals themselves will be insufficient per se, and hospitals and clinics will need to consider various forms of point-of-care access, such as reminders, checklists, and assessment tools derived from SRs and CPGs built into the electronic health record. Maybe one should envision a third phase of the EBP paradigm shift: in the first phase the potential value of clinical research evidence was stressed (and sometimes overstated); in the second phase, a phase still ongoing, methods of assessing and summarizing the available evidence were fine-tuned; the third phase will focus on ever more extensive, sophisticated, and powerful methods to see that evidence truly used. The shift to knowledge translation now seems to have taken a foothold, and in the near future we will see more of the following:

- Research funding agencies emphasizing knowledge translation as the final stage of clinical research projects, and paying for implementation research.
- Rehabilitation clinical programs appointing individuals with clinical and EBP training to assume the role of knowledge broker.
- Journals dedicated to the art and science of translation from the research laboratory to the clinic. For instance, Implementation Science “aims to publish research relevant to the scientific study of methods to promote the uptake of research findings into routine healthcare in both clinical and policy contexts.”

EBP is a young field, not just in rehabilitation. There are still new concepts, many controversies, and especially new developments that the field as a whole and individual clinicians and researchers will need to work hard to keep up with.

References


