FIFTH EDITION

Guide to Evidence-Based Physical Therapist Practice

Dianne V. Jewell

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To every physical therapy student and colleague brave enough to consider new, credible information that challenges your assumptions and yet not lose site of the individual who sought out your talents—you are the reason I have committed to the writing and rewriting of each successive edition.

Brief Contents

Contents

Preface

Guide to Evidence-Based Physical Therapist Practice, Fifth Edition provides foundational groundwork in research methods and teaches physical therapy students and clinicians alike how to integrate evidence in clinical practice. Its goal is to make the evidence-based physical therapist (EBPT) practice process accessible and relevant to nonresearchers who need to *apply* research as well as participate in its creation.

Consistent with prior versions, the patient and client management model described in the American Physical Therapy Association's *Guide to Physical Therapist Practice 3.0* remains the framework for discussion. The definitions and labels used to describe the evidence-based practice approach to physical therapist services delivery are consistent with the World Health Organization's *International Classification of Functioning, Disability and Health*. Updated citations provide current examples throughout the book of the various forms of evidence available to students and practitioners.

Organization of the *Fifth Edition*

The organization and goals of the sections are described here. Every effort has been made to have a structure that promotes ease of use for the physical therapy student and practicing clinician.

Part 1: Principles of Evidence-Based Physical Therapist Practice

Part I is made up of three chapters that set the stage for the use of evidence in patient and client management. Tools and resources from organizations and individual authors recognized as leaders in the evidence-based practice movement are adapted or referenced in the context of physical therapist practice.

Part 2: Elements of Evidence

The eight chapters of Part II describe the different components of a research article with an emphasis on the features that enhance or diminish a study's quality. The goal of these chapters is unchanged. They are intended to increase readers' understanding of and confidence with the evidence they review, not to train new researchers. The remaining chapters review statistical methods relevant to physical therapist practice and their application in different research designs.

Part 3: Appraising the Evidence

The underlying principle remains; EBPT practice requires students and clinicians to work with the best available evidence that oftentimes is weakly designed. The chapters in this section assist readers in determining for themselves whether the evidence they locate is useful *despite* its limitations.

Part 4: Evidence in Practice

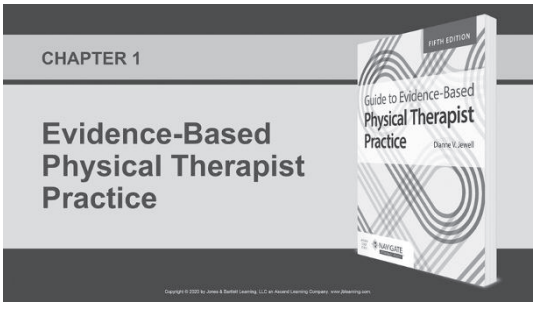
Part IV continues its focus on the application of evidence in the context of patient and client management. A fundamental tenet of this book is that evidence must be considered with respect to the preferences and values of the individual patient or client.

Updates to the *Fifth Edition*

Key updates to select chapters in response to reviewer feedback are listed below. My hope is that these updates serve readers in their quest to engage effectively in EBPT practice.

- *Chapter 1 Evidence-Based Physical Therapist Practice.* Content has been added that briefly reminds readers of the clinical decision-making processes physical therapists use and their relationship to evidence-based practice.
- *Chapter 2 What Is Evidence?* An overview of qualitative research designs has been added along with content to clarify use of the hierarchy related to pre-appraised evidence.
- *Chapter 3 The Quest for Evidence: Getting Started.* Readers of prior editions will notice a significant reduction in content of this chapter as most screenshots have been eliminated. This change reflects the reality that format and functionality of electronic search engines are updated more often than textbooks are published! Real-time instruction from a qualified librarian is the most efficient and timely way to introduce students to the variety of resources and features available.
- *Chapter 5 Research Design.* A section on mixed-methods research has been added.
- *Chapter 7 Variables and Their Measurement.* This chapter originally contained content pertaining to types of variables, levels of measurement, and terms and concepts related to measurement reliability and validity. In this edition, the chapter has been split into two so that measurement reliability and validity (new Chapter 8) can be considered separately. Subsequent chapters have been renumbered accordingly.
- *Chapter 11 Unraveling Statistical Mysteries: Inference.* Formerly Chapter 10, the content has been reorganized to consolidate information related to parametric and non-parametric statistics followed by tests of relationships and tests of differences. Readers should find it easier to understand the highly technical nature of the terms and concepts with this new organization.
- *Chapters 12 to 22* have updated examples from the current literature.
- *Glossary.* Important terms and their definitions have been moved from the beginning of each chapter into a glossary to reduce redundancy and length of the overall text. Terms in the glossary are presented in bold font.

Instructor Resources



In addition to the updates described, *Guide to Evidence-Based Physical Therapist Practice, Fifth Edition* includes a comprehensive suite of instructor resources. These resources are provided so instructors can effectively map and incorporate the book into their course.

- Appraisal Forms (*New to this edition*!)
- Lecture Outlines (*New to this edition*!)
- Instructor Manual
- Test Bank, including in LMS-compatible formats
- Slides in PowerPoint format
- Answers to In-Text Questions
- Answers to Practice Quizzes
- Sample Syllabus
- Image Bank

Student Resources

In the hopes of supplying students with all the tools they need to practice and apply the material in the book, each new copy of the Fifth Edition comes with access to the Navigate Advantage Access. Resources in Navigate include:

- eBook, with interactive glossary and assessments (*New to this edition*!)
- Appraisal Forms (*New to this edition*!)
- Open Educational Resources
- Practice Quizzes
- Slides in PowerPoint format
- Learning Objectives
- Flashcards

Acknowledgments

Reviewers who use this text in classrooms around the country have always propelled the improvements to each edition, including this one. They keep me from writing in an echo chamber where only my thoughts and ideas live, and for that I thank them. Special thanks for this *Fifth Edition* also go to Jones & Bartlett Learning team members Whitney Fekete and Carol Guerrero.

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PART 1

Principles of Evidence-Based Physical Therapist Practice

CHAPTER 1

Evidence-Based Physical Therapist Practice

OBJECTIVES

Upon completion of this chapter the student/practitioner will be able to do the following:

1. Discuss the circumstances that have resulted in an emphasis on the use of evidence in practice.
2. Distinguish among definitions of evidence-based medicine, evidence-based practice, and evidence-based physical therapist (EBPT) practice.
3. Discuss the use of evidence in physical therapist decision-making in the context of the American Physical Therapy Association's *Guide to Physical Therapist Practice 3.0*.[1]
4. Describe focus areas of EBPT practice.
5. Describe the general steps involved in EBPT practice.
6. Discuss the barriers to EBPT practice and possible strategies for reducing them.

Introduction

Physical therapists engage in high-stakes clinical decision-making to address diseases and disorders that interfere with a person's ability to move. Our initial professional education provides a framework that supports systematic and iterative collection and analysis of information about these problems, interspersed with judgment about what that information means and what we can do about it. As experience is gained through practice, this clinical decision-making framework is revised and refined, an indication of our growing expertise. Jensen and colleagues proposed that this higher-level clinical reasoning results from collaborative processes informed by a physical therapist's reflection about the impact of their actions (**Figure 1.1**).[2] Sources of information that feed these processes include (1) patient or client perspectives, experiences, and **values**; (2) objective data from the physical **examination**; and (3) available scientific **evidence**.

Use of systematically developed evidence in clinical decision-making is promoted extensively across health care professions and practice settings. Gordon Guyatt, MD, David L. Sackett, MD, and their respective colleagues published the original, definitive works that instruct physicians in the use of clinical research evidence in medical practice.[3,4] In addition, federal agencies, including the Agency for Healthcare Research and Quality and the Centers for Medicare and Medicaid Services, evaluate the strength of published evidence during the development of clinical guidelines and health care policies.[5,6] Professional associations

CLINICAL SCENARIO

Meet Your Patient

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Anne is a 41-year-old right-handed high school chemistry teacher and married mother of two boys ages 9 and 11 (preferred pronouns are she/her/hers). She presents to your outpatient physical therapy clinic with a 4-week complaint of progressively increasing pain that extends from her right elbow to midway down her lateral forearm. She denies previous injury to this upper extremity but notes that she spent several hours shoveling heavy wet snow from her front walk prior to the onset of her symptoms. Her pain makes it difficult for her to use a keyboard and mouse, grasp and manipulate pens and utensils, and maintain a grip on a full coffee mug or glass beaker. She also has discontinued her upper extremity strength training regimen and switched from an elliptical aerobic device to a recumbent cycle ergometer.

She states that ice packs temporarily relieve her pain. She sought out physical therapy because her primary care physician recommended anti-inflammatory medication and an orthopedic surgeon recommended a corticosteroid injection. She does not want to take medication in any form. She is anxious to resolve this problem as it interferes with her work and daily exercise program. Anne also has lots of questions about her options and any research available to prove or disprove their usefulness in her case.

How will you describe the role of evidence in your clinical decision-making?

such as the American Medical Association, the American Heart Association, and the American Occupational Therapy Association also have developed resources to help their members and consumers access evidence regarding a wide variety of diseases, treatments, and **outcomes**.[7–9]

The physical therapy profession also has expressed a commitment to the development

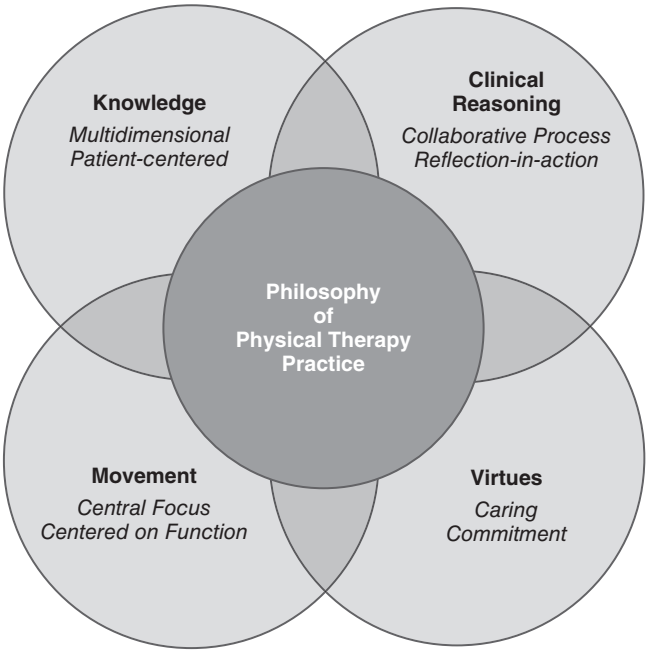

Figure 1.1 Philosophy of physical therapy practice.

Reproduced from Jensen, G. M., Gwyer, J., Shepard, K. F., & Hack, L. M. (2000). Expert practice in physical therapy. *Physical Therapy, 80*(1), 28–43.

and use of published evidence. The American Physical Therapy Association envisioned that by 2020 physical therapists would be autonomous practitioners who, among other things, used evidence in practice. Numerous articles regarding the methods for, benefits of, and barriers to evidence-based practice have been published in the journal *Physical Therapy*.[10–13] For several years the journal also included a recurring feature, "Evidence in Practice," in which a patient case was described and the subsequent search for, evaluation of, and application of evidence were illustrated.[14] The journal also added features such as "The Bottom Line" and podcasts in 2006 and 2008, respectively, to facilitate the translation of evidence into practice. Finally, the American Physical Therapy Association has curated a variety of resources to meet the different needs that practicing physical therapists have for evidence.[15]

The historical groundswell of interest in the use of evidence in health care resulted from the convergence of multiple issues, including (1) extensive documentation of apparently unexplained practice variation in the management of a variety of conditions, (2) the continued increase in health care costs disproportionate to inflation, (3) publicity surrounding medical errors, (4) identification of potential or actual harm resulting from previously approved medications, and (5) trends in technology assessment and outcomes research.[16–19] In addition, the rapid evolution of Internet technology increased both the dissemination of and access to health care research.

Related issues stimulated the drive for evidence-based physical therapist (EBPT) practice, the most dramatic of which was the use of evidence by commercial and government payers as a basis for their coverage decisions. For example, the Centers for Medicare and Medicaid Services ruled that insufficient scientific evidence existed to support the use of transcutaneous electrical stimulation for chronic low back pain and stated that patients must be enrolled in a clinical trial as a condition of coverage for this modality under the Part B benefit.[20] In light of these important developments, physical therapists needed an understanding of what evidence-based practice is, how it works, and how it may improve their clinical decision-making.

Evidence-Based What?

The use of evidence in health care is referred to by a variety of labels with essentially similar meanings. Evidence-based medicine, a term relevant to physicians, is defined as "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 clinical evidence from systematic research."[21(p.71)]

"Evidence-based practice" and "evidence-based health care" are labels that have been created to link the behavior described by evidence-based medicine to other health care professionals. Hicks provided this expanded definition: "care that 'takes place when decisions that affect the care of patients are taken with due weight accorded to all valid, relevant information.'"[22(p.8)] In all cases, evidence does not replace clinical expertise; rather, evidence is used to inform more fully a clinical decision-making process in which expertise provides one perspective to the clinical problem.

Regardless of the label, the implicit message is that the use of evidence in clinical decision-making is a movement away from unquestioning reliance on knowledge gained from authority or tradition. Authority may be attributed to established experts in the field as well as to revered teachers in professional training programs. Tradition may be thought of as practice habits expressed by the phrase "this is what I have always done for patients like this one." Habits may be instilled by eminent authority figures, but they also may be based on local or regional practice norms that are reinforced by their use in payment formulas ("usual and customary") and in legal proceedings ("local standard of care"). Practice habits also may be reinforced by errors in clinical reasoning related to various biases and the inadequacies of experience-based problem solving, such as those described in **Table 1.1**.[23]

Knowledge derived from authority and tradition often reflects an initial understanding of clinical phenomena from which diagnostic and treatment approaches are developed based on **biologic plausibility** and anecdotal experience. As such, this form of knowledge will continue to have a role as

Table 1.1 Examples of Biases and Heuristic Failures in Clinical Reasoning

Type of Reasoning Error	Nature of the Problem	Clinical Management Consequences
Ascertainment Bias	Occurs when a clinician draws a conclusion based on previously held expectations of a particular outcome (e.g., a physical therapist determines that a patient is catastrophizing their back pain experience because they have expressed job dissatisfaction).	The physical therapist forgoes clinical examination procedures that would have identified joint restrictions in the woman's lumbar spine.
Confirmation Bias	Occurs when a clinician selectively focuses on information that confirms a hypothesis (e.g., a physical therapist remembers only those people with adhesive capsulitis of the shoulder who improved following application of ultrasound and forgets those people who did not improve with the same technique).	The physical therapist applies ultrasound to all people with adhesive capsulitis of the shoulder regardless of their response to the modality.
Recency Effect	Occurs when a clinician believes that a particular patient presentation or response is a common phenomenon because it is easily remembered (e.g., a physical therapist believes that fibromyalgia is more common in men than in women because the last two patients with this diagnostic label were male). OR Occurs when a clinician believes that a particular patient presentation or response is an uncommon phenomenon because it is not easily remembered (e.g., a new graduate physical therapist does not remember how to differentiate among various sources of painful conditions that express themselves in dermatomal patterns).	The physical therapist classifies all men with generalized pain in the upper back as having fibromyalgia. The physical therapist mistakes pain due to herpes zoster for radicular pain due to vertebral joint restriction in a person with an idiopathic acute onset of symptoms.
Representativeness Exclusivity	Occurs when a clinician draws conclusions about a patient presentation or response based only upon those people who return for scheduled treatment sessions (e.g., a physical therapist believes all people with Parkinson's disease benefit from a particular balance program based on their experience with people who have completed an episode of treatment versus those who have not).	The physical therapist applies the balance program exactly the same way for all people with Parkinson's disease who are referred for management.
Value Bias	Occurs when the importance of an outcome in the eyes of the clinician distorts the likelihood of the outcome occurring (e.g., a physical therapist's concern about undiagnosed fractures in acute painful conditions outweighs the data about prevalence of fractures under specific situations).	The physical therapist forgoes application of validated clinical prediction rules and refers all people with acute painful conditions for radiographic testing.

Modified with permission from John Wiley and Sons. Croskerry P. Achieving quality in clinical decision making: cognitive strategies and detection of bias. *Acad Emerg Med.* 2002;9(11):1184–1204.

new clinical problems are encountered that require new solutions. The fundamental weakness in a clinician's dependence on this type of knowledge, however, is the potential for selection of ineffective or even harmful tests, measures, or **interventions** as a result of the lack of inquiry into their "true" effects. These cognitive and heuristic failures can lead to incomplete or incorrect conclusions about what is wrong with an individual patient or client and what is the most effective means for treating the problem.

Straus and colleagues offer as an example the use of hormone replacement therapy in women without a uterus or those who are postmenopausal.[24] Women in these situations were observed to have an increased risk of heart disease that, from a biologic perspective, appeared connected to the loss of estrogen and progestin. Replacing the lost hormones in an effort to reduce the risk of heart disease in these women made sense. The success of this treatment was confirmed further by observational studies and small randomized controlled trials.[25] However, the early termination in 2002 of a large hormone replacement therapy trial sponsored by the National Institutes of Health challenged the concept of protective effects from this intervention. The study's initial results indicated, among other things, that estrogen replacement did not protect postmenopausal women against cardiovascular disease as had been hypothesized. Moreover, long-term estrogen plus progestin therapy increased a woman's risk for the development of heart attacks, strokes, blood clots, and breast cancer.[18] In effect, years of clinical behavior based on a biologically plausible theory supported by lower-quality evidence were invalidated by a well-designed piece of evidence. This example is extreme, but it makes the point that clinicians should willingly and knowingly reevaluate the assumptions that underlie a practice that is based on authority and tradition supported by limited evidence.

Evidence-Based Physical Therapist Practice

With that background in mind, this text has adopted the term evidence-based physical therapist (EBPT) practice to narrow the professional and clinical frame of reference. The definition of EBPT practice should be consistent with previously established concepts regarding the use of evidence, but it also should reflect the specific nature of physical therapist practice.

The American Physical Therapy Association's *Guide to Physical Therapist Practice 3.0* describes physical therapy as a profession informed by the World Health Organization's International Classification of Functioning, Disability and Health (ICF).[1,26] This framework is an expansion of the biopsychosocial model of health that provides "a means not only to describe the states of illness and disability, but also to classify the components and magnitude of the level of health."[1] The model illustrated in **Figure 1.2** depicts the clinical aspects

Structure of the International Classification of Functioning, Disability and Health (ICF) model of functioning and disability.[5]

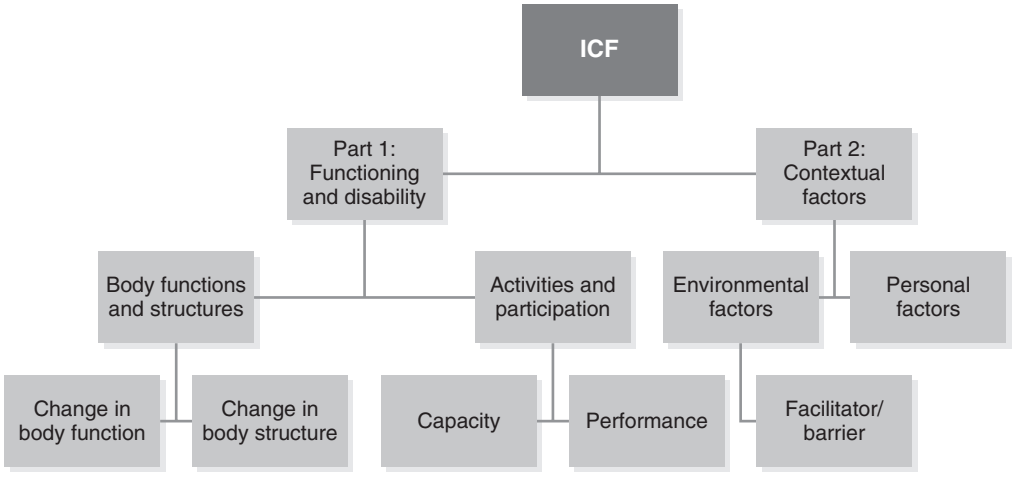

Figure 1.2 Structure of the ICF model of functioning and disability.

of a patient's or client's situation as well as the social context that shapes perceptions of health, wellness, illness, and disability for each individual. Within this framework physical therapists examine, evaluate, diagnose, prognosticate, and intervene with individuals with identified **impairments**, **activity limitations**, and **participation restrictions** as well as with persons with health, **prevention**, and wellness needs. These professional behaviors are summarized in the term *patient and client management*. Finally, the management process incorporates the individual patient or client as a participant whose knowledge, understanding, goals, preferences, and appraisal of their situation are integral to the development and implementation of a physical therapist's plan of care.

A definition of EBPT practice that reflects the intent of evidence-based medicine as well as the nature of physical therapist practice is offered here:[1,27]

> Evidence-based physical therapist practice is "open and thoughtful clinical decision making" about physical therapist management of a patient or client that integrates the "best available evidence with clinical judgment" and the patient's or client's preferences and values, and that further considers the larger social context in which physical therapist services are provided, to optimize patient or client outcomes and quality of life.

The term *open* implies a process in which physical therapists are able to articulate in understandable terms the details of their recommendations, including (1) the steps taken to arrive at this conclusion, (2) the underlying rationale, and (3) the potential impact of taking or refusing action. *Thoughtful clinical decision making* refers to the physical therapist's appraisal of the risks and benefits of various options within a professional context that includes ethics, standards of care, and legal or regulatory considerations.[28] This is where the systematic, iterative and reflective behaviors inherent in expert practice come into play. *Best available evidence* refers to timely, well-designed research studies relevant to the question a physical therapist has about a patient's or client's management. *Preferences and values* are the patient's or client's "unique preferences, concerns, and expectations"[4] against which each option should be weighed and that ultimately must be reflected in a collaborative decision-making process between the therapist and the patient or client. This point is consistent with the emphasis on **person-centered care** as articulated by the World Health Organization.[29] Finally, "larger social context" refers to the social, cultural, economic, and political influences that shape health policy, including rules governing the delivery of and payment for health care services.[30] **Figure 1.3** provides an illustration of EBPT practice.

Evidence-Based Physical Therapist Practice Focus Areas

A clinician interested in EBPT practice rightly might ask, "Evidence for what?" The process of patient and client management provides the answer to this question when you consider its individual elements (**Figure 1.4**).[1] To conduct an examination and **evaluation**, physical therapists must choose, apply, and interpret findings from a wide variety of tests and measures, such as ligament stress techniques and quantifications of strength and range of motion. Similarly, accurate **diagnosis** of conditions resulting in pain depends on a properly constructed and tested classification scheme. Well-designed research may assist the physical therapist in selecting the best techniques to correctly identify, quantify, and classify an individual's problem, a result that will enhance the efficiency and effectiveness of service delivery.

Prognosis refers to a prediction of the future status of the patient or client that may reflect the natural course of a condition or result following physical therapy treatments or prevention activities. Predictive ability depends on the physical therapist's understanding of the phenomenon in question (i.e., accurate diagnosis) as well as the identification of indicators that signal a particular direction. In all cases, the therapist must determine which of the numerous characteristics about the individual's physical, psychological,

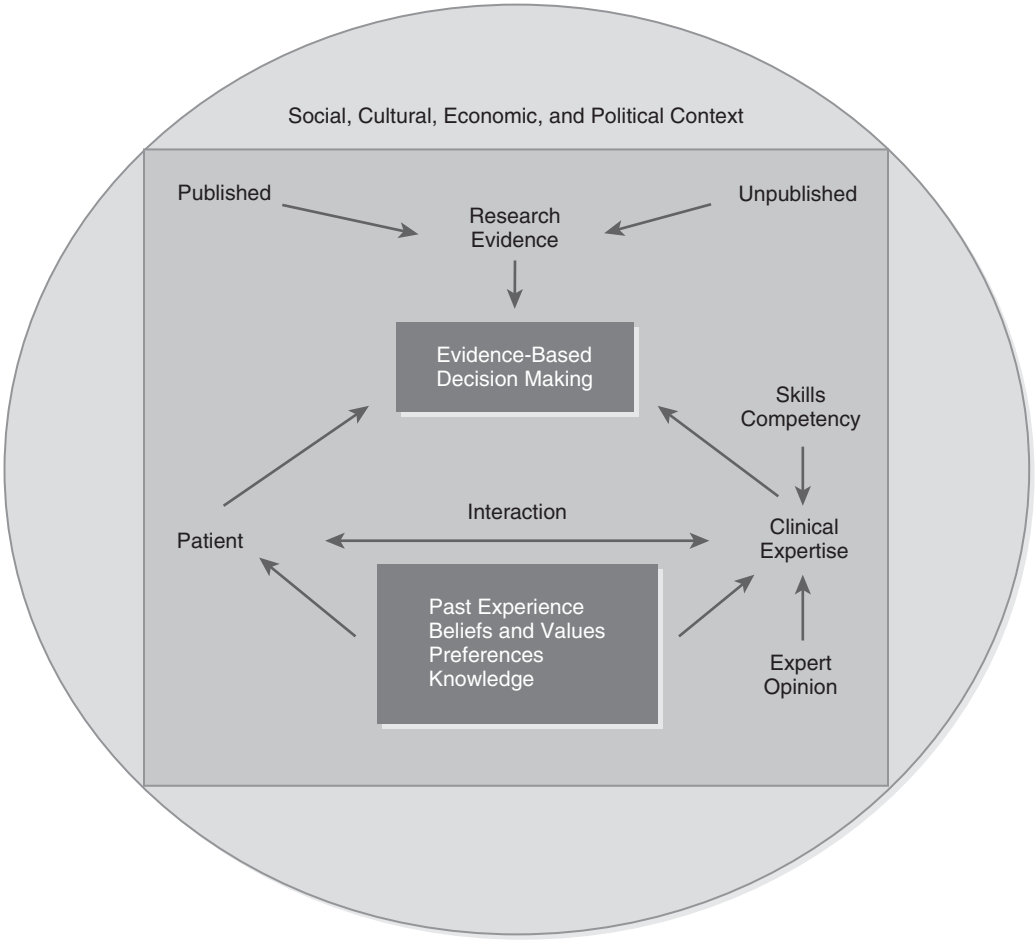

Figure 1.3 Evidence-based physical therapist practice in a societal context.

behavioral, and environmental situation will be most predictive of the outcome of interest. Evidence may identify the most relevant factors that will produce the most accurate prediction.

The choice of interventions is the step in the patient and client management process that carries particular weight because of the dual responsibilities of the provider to "do good" (**beneficence**) and to "do no harm" (**nonmaleficence**). The stakes in this balancing act increase when the intervention in question has a risk of serious consequences, such as permanent disability or mortality. Most treatment options physical therapists implement are not "high risk" in this sense; however, the application of low-risk interventions that produce no positive effect does not meet the test of beneficence. A common clinical scenario is one in which a patient presents with a painful condition and the therapist must decide which manual techniques, exercise, or some combination of both will be most effective for this individual. Relevant studies may assist the therapist and the patient in a risk-benefit analysis by providing information about effectiveness and harm.

The end products of the patient and client management process are referred to as the outcomes, which should be distinguished from treatment effects.[30] The former focus on results that

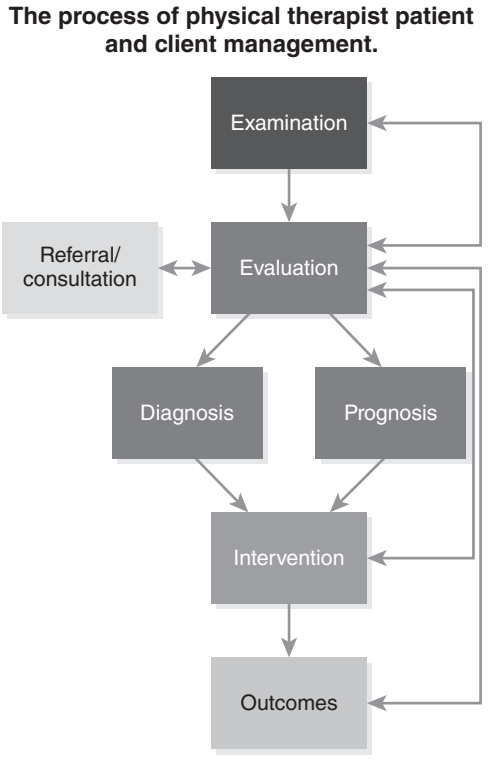

Figure 1.4 The process of physical therapist patient and client management.

occurred at the conclusion of the episode of care from the individual's point of view. For example, return-to-work represents a common outcome following outpatient orthopedic physical therapist management. In contrast, treatment effects represent the change, if any, in the underlying problems that prevented the individual from working.

Outcomes usually are stated in functional terms such as "The patient will work 6 hours without pain." Such statements reflect the individual's goals for the physical therapy episode of care. Use of standardized outcomes measures, however, permits an analysis of progress over the course of an episode for a single individual as well as a comparison across patients or clients with similar issues. As with the selection of tests and measures used to quantify impairments and aid in diagnosis, a physical therapist must decide which standardized outcomes instrument will provide the most discriminating information with respect to changes in impairment of body functions and structures, activity limitations, participation restrictions, or health-related quality of life. A review of available evidence may assist the therapist to determine what outcomes are possible and which measurement tool is able to detect change in a consistent and meaningful fashion.

Evidence also may inform a physical therapist's understanding of patients' or clients' perspectives, beliefs, attitudes, and opinions as they experience health, disease, and/or disability and navigate health care services. The impact of these experiences on their relationships with others, their ability to engage in their environment, and their sense of self and relatedness to a larger community also may be relevant to physical therapists' clinical decision-making and anticipated outcomes. A review of studies that capture these experiences through the individual's own words may facilitate the therapist's effort to deliver person-centered care.

The Process of Evidence-Based Physical Therapist Practice

Evidence-based physical therapist (EBPT) practice as a process starts with a question in response to a patient's or client's problem or concern. A search for relevant studies to answer the question is then followed by a critical appraisal of their merits and conclusions as well as a determination of their applicability to the individual. At the conclusion of the appraisal, the therapist will consider the evidence in the context of their clinical expertise, professional ethical principles, and current professional standards. The individual's values and preferences with respect to that evidence also must be discerned through explicit conversation and integrated into this phase of the clinical decision-making process.[31] Finally, the therapist and that individual will collaborate to identify and implement the next steps in the management process.

Successful EBPT practice depends on a variety of factors. First, physical therapists require sufficient knowledge about their patient's or client's condition to recognize what is unknown. In other

words, physical therapists must be willing to suspend the assumption that they have complete information about an individual's situation. In addition, they must have or have access to knowledge of the evidence appraisal process—that is, which features characterize stronger versus weaker study designs. Second, physical therapists need access to the evidence, a situation that has improved considerably with the advent of online databases and electronic publication of journals. Availability of these resources, however, does not ensure their efficient use, particularly when it comes to developing effective search strategies. Third, physical therapists need the time to search for, appraise, and integrate the evidence into their practice. In busy clinical settings, time is a limited commodity that usually is dedicated to administrative tasks, such as documentation of services and discussions with referral sources or payers. Unless the entire clinic or department adopts the EBPT practice philosophy, it may be difficult for a single physical therapist to incorporate the behavior into the patient and client management routine.

Results from a survey conducted by Jette et al. in 2003 suggested that some of the requirements of EBPT practice are obstacles to its implementation.[12] Although most respondents (n = 488) believed evidence was necessary for practice and improved quality of care, 67% of the subjects listed "lack of time" as one of the top three barriers to implementation of EBPT practice. Nearly all respondents (96%) indicated they had access to evidence; however, 65% reported performing searches for clinical studies less than twice in a typical month. In addition, notable proportions of the sample indicated lower confidence levels in their abilities to search effectively (34%), appraise the study designs (44%), and interpret results using terms such as "odds ratio" (47%) and "confidence interval" (37%). Finally, older therapists with more years since licensure were less likely to have the necessary training in, familiarity with, and confidence in the skills necessary for effective EBPT practice.

Subsequent studies have suggested an overall improvement in physical therapists' knowledge of and self-efficacy with evidence-based practice skills. However, changes in clinical decision-making in response to available evidence continue to lag.[32–34] This disparity between EBPT practice knowledge and actual practice fuels the current interest in knowledge translation methods.[35–39] Jones et al. published a systematic review of the evidence regarding knowledge translation interventions in rehabilitation.[35] Thirteen of the articles included in the review were specific to physical therapist practice. All of these studies included some form of professional education regarding EBPT practice. Only two included audit and feedback mechanisms to remind study participants to use the techniques they learned. Results were mixed, a finding Jones and colleagues attributed to the low methodological quality of most of the studies. Clearly, more work is needed to close the gap between the EBPT practice knowledge and skills acquired in professional physical therapist education and their application in clinical practice.

So what can be done to reduce the barriers to effective EBPT practice? Perhaps most importantly, a philosophical shift is required to develop consistent behavior during a busy day of patient or client management. Physical therapists must value the contribution trustworthy evidence can make to their clinical decision-making processes. Management support also is necessary in terms of EBPT practice education, access to evidence, time allotted in a therapist's schedule, and ongoing feedback about the impact evidence has on patient or client outcomes. Use of services that locate, summarize, and appraise the evidence for easy review by practitioners may also help the time issue. However, physical therapists must determine whether the methodology used by these services is sufficiently stringent to provide an appropriate assessment of evidence quality. Databases dedicated to physical therapy evidence also may enhance the efficiency of the search process.

Ultimately, the ability to engage in EBPT practice consistently requires practice, just like any other skill. The process starts with the individual patient or client and the questions generated from the initial encounter, such as the following:

- Which tests will provide accurate classification of this person's problem?
- What activity limitations can be anticipated if this problem is not addressed?

- What is the most effective intervention that can be offered for documented impairments in body functions and structure?
- How will we know if we have been successful?
- How can changes in this person's quality of life that result from this episode of care be captured?
- Can the perspectives of other people who have similar issues or concerns inform my decision-making for this individual?

A physical therapist's willingness to consider these questions *consciously* is the first step in EBPT practice. The word *consciously* is emphasized because it takes practice to develop the habit of openly challenging one's assumptions and current state of knowledge. Until this behavior becomes a routine part of your clinical decision-making, EBPT practice will be difficult to implement in a consistent and time-efficient manner.

WRAP-UP

Summary

The use of systematically developed evidence in clinical decision-making is promoted among many health professions in response to documented practice variation and increasing health care costs as well as in response to a desire for improved quality of care. Evidence-based practice in any profession promotes less dependence on knowledge derived from authority or tradition through the use of evidence to evaluate previously unquestioned information. EBPT practice is open, thoughtful clinical decision-making that integrates the best available evidence, clinical expertise, and the patient's or client's preferences and values within the larger social context of the individual and the therapist. Well-designed research studies may inform decision-making regarding measurement, diagnosis, prognosis, interventions, and outcomes as well as the perspectives and experiences of individuals seeking physical therapist services. Requirements for EBPT practice include a willingness to challenge your assumptions, the ability to develop relevant clinical questions about a patient or client, access to evidence, knowledge regarding evidence appraisal, and the time to make it all happen as well as a willingness to acquire, practice, and evaluate the impact of the necessary skills described in this text.

Exercises

1. Describe two factors that have prompted the emphasis on evidence-based practice in health care. How might evidence address these issues or concerns?
2. Discuss the strengths and weaknesses of clinical knowledge derived from:
   a. Authority
   b. Evidence
   c. Tradition
3. Describe a specific example in current physical therapist practice of each type of knowledge listed in question 2.
4. Use Anne's case history and provide examples for each of the potential errors in clinical reasoning described in Table 1.1.
5. Discuss the potential contribution of evidence to each step of the patient and client management process. Provide clinical examples relevant to physical therapist practice to support your points.
6. Discuss the role of the patient or client in EBPT practice. Provide a clinical example relevant to physical therapist practice to support your points.
7. Think about your experiences in the clinical setting and complete the survey in **Figure 1.5** modified from Jette et al.[12] What do your answers tell you about your willingness and readiness to participate in EBPT practice?

8. Based on your results from question 7, identify two changes you would need to make to enhance your ability to participate in EBPT practice. For each change, identify one strategy you could implement to move you in the right direction.

Appendix.
Evidence-Based Practice (EBP) Questionnaire

This section of the questionnaire inquires about personal attitudes toward, use of, and perceived benefits and limitations of EBP.
For the following items, place a mark [X] in the appropriate box that indicates your response.

1. Application of EBP is necessary in the practice of physical therapy.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
2. Literature and research findings are useful in my day-to-day practice.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
3. I need to increase the use of evidence in my daily practice.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
4. The adoption of EBP places an unreasonable demand on physical therapists.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
5. I am interested in learning or improving the skills necessary to incorporate EBP into my practice.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
6. EBP improves the quality of patient care.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
7. EBP does not take into account the limitations of my clinical practice setting.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
8. My reimbursement rate will increase if I incorporate EBP into my practice.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
9. Strong evidence is lacking to support most of the interventions I use with my patients.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
10. EBP helps me make decisions about patient care.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
11. EBP does not take into account patient preferences.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

For the following items, place a mark [X] in the appropriate box that indicates your response for a typical month.

12. Read/review research/literature related to my clinical practice.
☐ ≤ 1 article ☐ 2-5 articles ☐ 6-10 articles ☐ 11-15 articles ☐ 16+ articles
13. Use professional literature and research findings in the process of clinical decision making.
☐ ≤ 1 time ☐ 2-5 times ☐ 6-10 times ☐ 11-15 times ☐ 16+ times
14. Use MEDLINE or other databases to search for practice-relevant literature/research.
☐ ≤ 1 time ☐ 2-5 times ☐ 6-10 times ☐ 11-15 times ☐ 16+ times

The following section inquires about personal use and understanding of clinical practice guidelines. Practice guidelines provide a description of standard specifications for care of patients with specific diseases and are developed through a formal, consensus-building process that incorporates the best scientific evidence of effectiveness and expert opinion available.
For the following items, place a mark [X] in the appropriate box that indicates your response.

15. Practice guidelines are available for topics related to my practice.
☐ Yes ☐ No ☐ Do Not Know
16. I actively seek practice guidelines pertaining to areas of my practice.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
17. I use practice guidelines in my practice.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree
18. I am aware that practice guidelines are available online.
☐ Yes ☐ No
19. I am able to access practice guidelines online.
☐ Yes ☐ No
20. I am able to incorporate patient preferences with practice guidelines.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

The following section inquires about availability of resources to access information and personal skills in using those resources.
For the following items, place a mark [X] in the appropriate box that indicates your response. In items referring to your "facility," consider the practice setting in which you do the majority of your clinical care.

21. I have access to current research through professional journals in their paper form.
☐ Yes ☐ No
22. I have the ability to access relevant databases and the Internet at my facility.
☐ Yes ☐ No ☐ Do Not Know

(continues)

Figure 1.5 Survey of beliefs and attitudes regarding evidence-based physical therapist practice.

23. I have the ability to access relevant databases and the Internet at home or locations other than my facility.
☐ Yes ☐ No ☐ Do Not Know ☐ Agree ☐ Strongly Agree

24. My facility supports the use of current research in practice.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

25. I learned the foundations for EBP as part of my academic preparation.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

26. I have received formal training in search strategies for finding research relevant to my practice.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

27. I am familiar with the medical search engines (e.g., MEDLINE, CINAHL).
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

28. I received formal training in critical appraisal of research literature as part of my academic preparation.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

29. I am confident in my ability to critically review professional literature.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

30. I am confident in my ability to find relevant research to answer my clinical questions.
☐ Strongly disagree ☐ Disagree ☐ Neutral ☐ Agree ☐ Strongly Agree

For the following item, place a mark [x] in one box in the row for each term.

31. My understanding of the following terms is:

Term	Understand Completely	Understand Somewhat	Do Not Understand
a) Relative risk	☐	☐	☐
b) Absolute risk	☐	☐	☐
c) Systematic review	☐	☐	☐
d) Odds ratio	☐	☐	☐
e) Meta-analysis	☐	☐	☐
f) Confidence interval	☐	☐	☐
g) Heterogeneity	☐	☐	☐
h) Publication bias	☐	☐	☐

For the following items, rank your top 3 choices by placing number in the appropriate boxes (1 = most important).

32. Rank your 3 greatest barriers to the use of EBP in your clinical practice.
☐ Insufficient time
☐ Lack of information resources
☐ Lack of research skills
☐ Poor ability to critically appraise the literature
☐ Lack of generalizability of the literature findings to my patient population
☐ Inability to apply research findings to individual patients with unique characteristics
☐ Lack of understanding of statistical analysis
☐ Lack of collective support among my colleagues in my facility
☐ Lack of interest

Figure 1.5 *(continued)*

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CHAPTER 2

What Is Evidence?

OBJECTIVES

Upon completion of this chapter the student/practitioner will be able to do the following:

1. Discuss the concept of "best available clinical evidence."
2. Describe the general content and procedural characteristics of desirable evidence and their implications for the selection of studies to evaluate.
3. Describe different forms of evidence and their uses for answering clinical questions in physical therapist practice.
4. Discuss and apply the principles and purposes of evidence hierarchies for each type of clinical question.
5. Discuss the limitations of evidence hierarchies and their implications for the use of evidence in practice.

Introduction

The case has been made that physical therapists should use **evidence** to inform their clinical decision-making during the patient and client management process. This claim raises the question, "What qualifies as evidence?" In their original work, Guyatt and Rennie stated that "any empirical observation about the apparent relation between events constitutes potential evidence."[1] This observation acknowledged that a variety of information types exist that may be integrated with clinical decisions. Options include but are not limited to published research articles, **clinical practice guidelines**, patient or client records, and recall of prior patient or client cases. As these authors acknowledged, however, clinical research is the preferred source of information. Sackett and colleagues put a finer point on it with their use of the modifier "best available" clinical evidence. They proposed that a method of prioritizing the evidence according to its merits is required to guide the clinician's selection of relevant information.[2] This chapter discusses the forms and general characteristics of evidence available as well as the hierarchies that have been developed to rank them.

General Characteristics of Desirable Evidence

In light of the variety of evidence potentially available to physical therapists, it is helpful to have some general characteristics to consider during the initial search. Desirable attributes relate both

CLINICAL SCENARIO

Relevant Patient Characteristics

Anne's case history contains information about her that may influence your search for evidence and your judgment about its relevance. Examples include age and fitness level.

What other characteristics can you identify that may influence your search for and application of evidence in Anne's situation?

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to content and to procedural considerations that serve as preliminary indicators of quality.

Study Contents

The first content criterion pertains to the type of question a physical therapist wants to answer. The patient and client management elements of **examination, diagnosis, prognosis, intervention** (including preventive measures), and **outcomes** provide potential focus areas for evidence development and application. Ideally, the evidence located will address specifically the test, measure, classification system, prognostic factor, treatment technique, **clinical prediction rule**, or outcome that the physical therapist is considering relative to an individual patient or client. Evidence also may be used to inform a therapist's understanding about an individual's **values** and beliefs with respect to their health care needs.

The second content criterion pertains to the individuals studied. Desirable evidence includes subjects whose personal and/or clinical characteristics are similar to the patient or client in order to increase the therapist's ability to apply the research findings to this individual. Common attributes of interest include but are not limited to the subjects' age, gender, race/ethnicity, education level, occupation, diagnosis(es), stage of illness, duration of the problem(s), functional status, level of disability, and clinical setting in which patient or client management is occurring. Subjects in a research study with personal and/or clinical characteristics that differ markedly from those of an actual patient or client may respond differently than the individual with whom the physical therapist wishes to use the evidence they have located.

Study Procedures

Two basic procedural characteristics have relevance in the evidence selection process as well. The period during which the evidence was developed is often of interest given the rapid evolution of medical technology and pharmaceutical agents. This is particularly relevant for research publications given that articles often appear in journals a year or more after the completion of the project.[1] Early release on the Internet ahead of the printed version undoubtedly has reduced this timeline in many cases. Nevertheless, older evidence may not reflect current patient or client management. A hypothetical example might be a 15-year-old study evaluating the **effectiveness** of an aerobic training program for individuals with multiple sclerosis that has limited relevance now that a variety of disease-modifying drugs are available.[3] However, evidence should not be rejected only because of its age if the techniques in question and the context in which they were evaluated have remained relatively unchanged since the data were collected.

A procedural characteristic specific to scientific journals is the application of **peer review**.

Peer review is the process by which manuscripts are evaluated by identified content experts to determine their merit for publication. Evaluation criteria usually include the credibility of a research study in terms of its design and execution, relevance of the findings for the field and/or the specific journal, contribution to the body of knowledge about the topic, and, to a lesser degree, writing style.[4] Peer review acts as an initial screening process to weed out lower-quality efforts.

Table 2.1 summarizes the four general characteristics of evidence that are preferable. Note that these attributes are labeled "desirable," not "mandatory." This word choice is intentional because there is much work to be done to expand the depth and breadth of evidence related to physical therapist practice. Many of the clinical questions physical therapists have about their patients or clients have not been explored or have been addressed in a limited fashion. A search for the "best available clinical evidence" may result in the identification of studies that were not peer reviewed or did not include subjects that look like a therapist's individual patient or client. Similarly, studies may not exist that include a test or technique of interest in the clinical setting. The evidence-based physical therapist (EBPT) practice challenge is to decide whether and how to use evidence that is limited in these ways when it is the only evidence available.

Table 2.1 Four Desirable Characteristics of Research Identified During a Search for Evidence

1. The evidence addresses the specific clinical question the physical therapist is trying to answer.
2. The subjects studied have characteristics that are similar to the patient or client about whom the physical therapist has a clinical question.
3. The context of the evidence and/or the technique of interest are consistent with contemporary health care.
4. The evidence was published in a peer-reviewed medium (paper, electronic).

Forms of Evidence

As noted previously, forms of evidence may include anything from patient records and clinical recall to published research. Evidence-based practice in health care emphasizes the use of research to inform clinical decisions because of the systematic way in which data are gathered and because of its potential to provide objective results that minimize **bias**. A variety of research design options exist. A key point is that different research designs are suited to answering different types of clinical questions physical therapists may have about their patients or clients. The usefulness of a diagnostic test must be evaluated with methods that are different from those used to determine whether an intervention works. As a result, therapists should anticipate looking for evidence with different research designs depending on what they want to know. The remainder of this chapter provides highlights of these different designs and their relative merits.

Quantitative Research Designs: Overview

Forms of evidence fall along a continuum that is dictated by the presence and strength of a quantitative research design that was established *prior to* data collection (**Figure 2.1**). At one end of the continuum is research that attempts to impose maximum control within the design in order to reduce the chance that bias will influence the study's results. Bias is a systematic deviation from the truth that occurs as a result of uncontrolled (and unwanted) influences during the study.[4] Various authors refer to research designs with the best features to minimize bias as **randomized clinical trials**, **randomized controlled trials**, or **randomized controlled clinical trials**.[4-7] The acronym used for all three is "RCT." These studies also are categorized as **experimental designs**. Irrespective of the label, the researchers' intention is the same: to reduce unwanted influences in the study through random assignment of study participants to two or more groups *and*

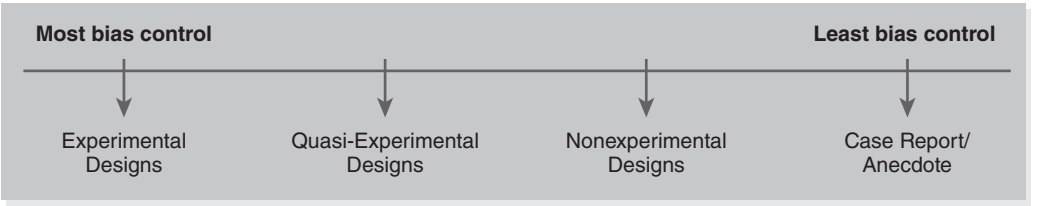

Figure 2.1 Continuum of bias control in quantitative research designs.

through controlled manipulation of the experimental intervention. A variant of this approach is the **single-system design** in which only one person is studied who receives, on an alternating basis, both the experimental and control (or comparison) conditions.[6]

An RCT or single-system design is best suited to answer questions about whether an experimental intervention has an effect and whether that effect is beneficial or harmful to the subjects. When conducted under ideal conditions—that is, when a high degree of control is achieved—these studies are focused on treatment **efficacy**. An example might be a study in which some individuals with traumatic brain injuries are randomized to an experimental balance-training program that is performed in a quiet research laboratory. Such an environment is free of distractions that may interfere with the subjects' ability to pay attention to directions and focus on the required activities. Alternatively, if the same subjects perform the experimental balance-training program during their regular physical therapy appointment in the outpatient rehabilitation center, then the RCT is focused on treatment effectiveness.[8] Investigators in this version of the study want to know if the balance program works in a natural clinical environment full of noise and activity.

Randomized clinical trials and single-system designs are approaches used to conduct an original research project focusing on one or more persons. These individual studies themselves may serve as the focus of another type of controlled research design referred to as a **systematic review**. Systematic reviews, or "syntheses," consist of original evidence that has been selected and critically appraised according to preestablished criteria.[5] The goal of this research design is to draw conclusions from the cumulative weight of studies that, individually, may not be sufficient to provide a definitive answer. The preestablished criteria are used to minimize bias that may be introduced when investigators make decisions about which prior studies to include and when judgments are made about their quality. Systematic reviews may address any type of clinical question; however, most commonly they focus on well-controlled studies of interventions—in other words, on RCTs.

At the other end of the quantitative research continuum is the unsystematic collection of patient or client data that occurs in daily physical therapist practice. The term "unsystematic" is not meant to imply substandard care; rather, it is an indication that clinical practice is focused on the individual patient or client rather than on groups of subjects on whom behavioral and data collection controls are imposed to ensure research integrity. This type of evidence often is labeled "anecdotal"[9] and frequently is used when therapists recall from memory prior experiences with patients or clients similar to the person with whom they are currently dealing. In response to regulatory and payment pressures, many clinical settings are creating a degree of consistency in data collection with their implementation of standardized assessment and outcomes instruments, electronic health records, and databases to capture patient or client outcomes. As a result, physical therapists working in these settings may find some practice-generated evidence that is useful to inform their clinical decision-making.

In between the two ends of the quantitative research continuum are study designs that lack one or more of the following characteristics:

1. Randomization techniques to distribute subjects into groups.
2. The use of more than one group in order to make a comparison.
3. Controlled experimental manipulation of the subjects.
4. Measures at the patient or client level (e.g., impairment in body functions and structure, activity limitations, participation restrictions).
5. A systematic method for collecting and analyzing information.

These designs have fewer features with which to minimize bias and/or shift their focus away from patient or client-centered outcomes. For example, **quasi-experimental designs** maintain the purposeful manipulation of the experimental technique, but they may not randomize subjects to groups or may have only one subject group to evaluate.[9] **Nonexperimental (or observational) designs** have even less control than quasi-experimental studies because they have the same limitations with respect to their group(s) and they do not include experimental manipulation of subjects.[6] In spite of their less rigorous designs, both quasi-experimental and nonexperimental studies are used to evaluate the effectiveness of interventions, often due to ethical or pragmatic reasons related to the use of human subjects in research. In addition, observational designs are used to answer questions about diagnostic tests, clinical measures, prognostic indicators, clinical prediction rules, and patient or client outcomes.

Below quasi-experimental and nonexperimental designs on the continuum are research efforts that focus only on cellular, anatomic, or physiologic systems. These studies often have a high degree of control because they are grounded in the scientific method that is the hallmark of good bench research. They are lower on the continuum not because of their potential for bias but because they do not focus on person-level function. For this reason, they are referred to as **physiologic studies**.[1]

Even lower on the continuum are **case reports** and **narrative reviews**. These study approaches have different purposes. Case reports simply describe what occurred with a patient or client (or a series of these individuals), whereas narrative reviews summarize previously conducted studies without analysis of their quality.[10-12] In spite of these differences, these designs have one common element that puts them both at the bottom of the continuum: They lack the kind of systematic approach necessary to reduce bias. It is important to note, however, that the content of a case report or narrative review may provide a stimulus to conduct a more rigorous research project.

Qualitative Research Designs: Overview

Qualitative research designs propose that knowledge and understanding about experiences, opinions, values, and beliefs are derived from each individual within their societal context.[6] Investigators use an iterative analytic process to identify thematic patterns in the words that subjects use when observed and/or interviewed. These designs do not introduce experimental interventions or controls that limit knowledge or behavior in an artificial context (i.e., a clinic or laboratory). Rather, researchers attempt to capture how subjects construct meaning about naturally occurring phenomena and interactions within their environment.

Table 2.2 provides a summary of research design characteristics as well as a list of citations from physical therapy literature that represent each type of study design described here.

Research Designs: Timing

Research designs also may be categorized according to the timeline used in the study. For example, physical therapist researchers may want to know the relationship between the number of visits to an outpatient orthopedic clinic and the workers' compensation insurance status of patients treated over a 3-year period. Such a question may be answered through an analysis of 3 years of historical patient records from the clinic. This **retrospective**

Table 2.2 Citations from Physical Therapy Research Illustrating Different Study Designs

Study Design	Fundamental Characteristics	Citation
Systematic Review	■ Seeks to draw conclusions based on the cumulative information from multiple individual studies. ■ Uses systematic methods to minimize bias in the selection and analysis of included studies.	Sanchez-Infante J, et al. Is dry needling applied by physical therapists effective for pain in musculoskeletal conditions? A systematic review and meta-analysis. *Phys Ther.* 2021;101(3).
Randomized Clinical Trial	■ Seeks to evaluate the efficacy or effectiveness of an intervention through purposeful manipulation of some of the subjects. ■ Uses comparisons among individuals randomly assigned to different groups. ■ Implements the most rigorous controls to minimize bias.	Inoue M, et al. Effect of exercise involving standing weight shifting to the nonparetic side on an inclined surface in the early phase after a stroke: a randomized controlled trial. *Phys Ther.* 2021;101(8).
Single-System Design	■ Seeks to evaluate the efficacy or effectiveness of an intervention through purposeful manipulation of a single subject. ■ Makes comparisons by alternating the conditions to which the subject is exposed. ■ Implements the most rigorous controls to minimize bias.	Chen YP, et al. Use of virtual reality to improve upper-extremity control in children with cerebral palsy: a single subject design. *Phys Ther.* 2007;87(11):1441–1457.
Quasi-Experimental Study	■ Seeks to evaluate the efficacy or effectiveness of an intervention through purposeful manipulation of some of the subjects. ■ A comparison between 2 or more groups is an option, but not required. ■ Contains fewer controls to minimize bias.	Yardımcı-Lokmanoğlu BN, et al. The effects of different exteroceptive experiences on the early motor repertoire in infants with Down syndrome. *Phys Ther.* 2021;101(9).
Observational Study	■ Seeks to evaluate the usefulness of a diagnostic test, clinical measure, prognostic indicator, clinical prediction rule, or outcome. ■ A comparison between two or more groups is an option, but not required. ■ Contains fewer controls to minimize bias.	Gandotra S, et al. Activity levels in survivors of the intensive care unit. *Phys Ther.* 2021;101(9).
Physiologic Study	■ Seeks to understand anatomic and/or physiologic behavior at the cellular level. ■ Highly controlled bench research that adheres to traditional scientific methods.	Li S, et al. Acceleration of bone-tendon interface healing by low-intensity pulsed ultrasound is mediated by macrophages. *Phys Ther.* 2021;101(7).
Case Report	■ Describes the management of an individual patient or client (or a series of them) as it occurred in the clinical environment. ■ Does not include controls to minimize bias in the research sense.	Çinar GN, et al. Complex decongestive therapy in the physical therapist management of rosacea-related edema (Morbus Morbihan Syndrome): A case report with a new approach. *Phys Ther.* 2021;101(9).

Table 2.2 Citations from Physical Therapy Research Illustrating Different Study Designs *(continued)*

Study Design	Fundamental Characteristics	Citation
Summary	■ Summarizes the content and findings of a collection of previously conducted studies. ■ Does not use systematic methods to minimize bias in the selection or analysis of the included studies.	Yamamoto TP, et al. Virtual reality for stroke rehabilitation. *Phys Ther.* 2016;96(10):1508–1513.
Qualitative Inquiry	■ Investigates subjects' thoughts, perceptions, opinions, beliefs, attitudes and/or experiences. ■ Seeks to identify thematic patterns in words using an iterative analytic process that does not impose controls to influence subject behavior or participation.	Palacios-Ceña D, et al. Working on the frontlines of the COVID-19 pandemic: a qualitative study of physical therapists' experience in Spain. *Phys Ther.* 2021;101(4).

design has as an opposite form—a **prospective design**—in which the investigators collect information from new patients who are admitted to the clinic. As **Figure 2.2** illustrates, a retrospective approach takes advantage of data that already exist, whereas a prospective approach requires that new data be collected in real time.

In a similar fashion, researchers may be interested in a single point in time or a limited time interval (i.e., **cross-sectional study**), or they may wish to study a phenomenon over an extended period of time (i.e., **longitudinal study**). In the cross-sectional approach, investigators may have an interest in the functional outcome at discharge (a single point in time) from the hospital of patients receiving physical therapist services following total hip replacement. In contrast, a longitudinal approach would include follow-up of these patients to assess outcomes at discharge and at a specified point or points in time in the future (e.g., 3 months, 6 months, 1 year). **Figure 2.3** illustrates these design options.

The sequence of events across time in a study is important, particularly when an investigator is trying to determine whether a change in the patient or client's condition was the direct result of the intervention or preventive measure applied. Specifically, the intervention must have occurred *before* the outcome was measured to increase one's confidence that it was the technique of interest that made a difference in the subjects' status or performance.

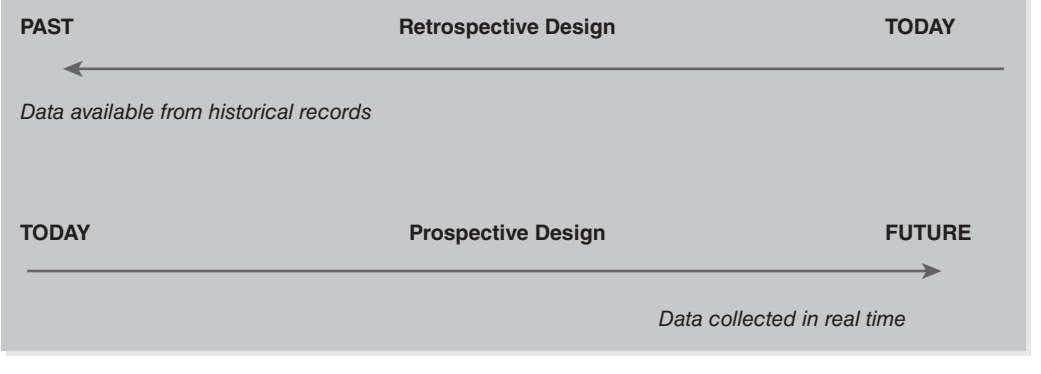

Figure 2.2 Graphic depiction of retrospective and prospective research designs.

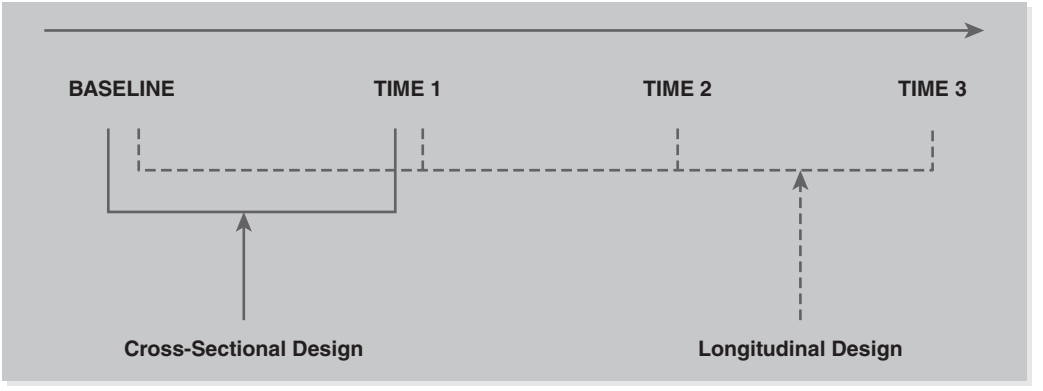

Figure 2.3 Graphic depiction of cross-sectional and longitudinal research designs.

Research Designs: What Is the Question?

Remember that the clinical question the physical therapist wants to answer will determine which of these forms of evidence to seek. For example, a question about the best clinical test to identify a rotator cuff tear (diagnosis) is likely to be addressed by a cross-sectional nonexperimental study of patients who are suspected to have the problem based on results from the physical examination. However, a question about risk factors for falls in the elderly may be answered in one of two ways: (1) a prospective study in which two groups of elderly subjects are followed in real time to determine who falls and who does not or (2) a retrospective study that starts with subjects with documented falls and evaluates possible precipitating characteristics (e.g., visual deficits) in comparison to non-fallers. Finally, a question about the effectiveness of joint mobilization in the management of cervical spine disorders is best answered by a prospective RCT of patients classified with neck pain. Physical therapists should anticipate these differences when planning their search strategies to increase the efficiency of the evidence identification process.

You must also recall that a search for the "best available clinical evidence" may result in the discovery of research that is limited in content and/or quality. In other words, the current state of knowledge in an area may be such that the "best" (and only) evidence available is from studies (or unpublished clinical data) in which the chance of bias is higher because of weaknesses in the research designs. Physical therapists will find this scenario to be true for many of the clinical questions they pose in practice. This reality is not a reason to reject EBPT practice; rather, it is a reaffirmation that clinical judgment and expertise are required to decide whether and how to use evidence that is limited in form.

Hierarchies of Evidence

Previous research has identified a number of barriers to using evidence in physical therapist practice, one of which is the lack of time available to search for, select, and read professional literature.[13] The selection process may be eased somewhat by ranking research designs based on their ability to minimize bias. Proponents of evidence-based medicine have attempted to make the study selection process more efficient for busy clinicians by developing hierarchies, or levels, of evidence. In 2011, Howick and colleagues at the Oxford Centre for Evidence-Based Medicine (OCEBM) in England consolidated previously developed individual hierarchies for evidence about diagnostic tests, prognostic indicators, and treatment techniques into one reference table for easier use (reprinted in **Table 2.3**).[14-16] The variety of hierarchies is necessary because of the point made previously: Different research designs are required

Table 2.3 Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence

Question	Step 1 (Level 1*)	Step 2 (Level 2*)	Step 3 (Level 3*)	Step 4 (Level 4*)	Step 5 (Level 5)
How common is the problem?	Local and current random sample surveys (or censuses)	Systematic review of surveys that allow matching to local circumstances**	Local non-random sample**	Case-series**	n/a
Is this diagnostic or monitoring test accurate? (Diagnosis)	Systematic review of cross sectional studies with consistently applied reference standard and blinding	Individual cross sectional studies with consistently applied reference standard and blinding	Non-consecutive studies, or studies without consistently applied reference standards**	Case-control studies, or "poor or non-independent reference standard**	Mechanism-based reasoning
What will happen if we do not add a therapy? (Prognosis)	Systematic review of inception cohort studies	Inception cohort studies	Cohort study or control arm of randomized trial*	Case-series or case-control studies, or poor quality prognostic cohort study**	n/a
Does this intervention help? (Treatment Benefits)	Systematic review of randomized trials or *n*-of-1 trials	Randomized trial or observational study with dramatic effect	Non-randomized controlled cohort/follow-up study**	Case-series, case-control studies, or historically controlled studies**	Mechanism-based reasoning
What are the COMMON harms? (Treatment Harms)	Systematic review of randomized trials, systematic review of nested case-control studies, *n*-of-1 trial with the patient you are raising the question about, or observational study with dramatic effect	Individual randomized trial or (exceptionally) observational study with dramatic effect	Non-randomized controlled cohort/follow-up study (post-marketing surveillance) provided there are sufficient numbers to rule out a common harm. (For long-term harms the duration of follow-up must be sufficient.)**	Case-series, case-control, or historically controlled studies**	Mechanism-based reasoning
What are the RARE harms? (Treatment Harms)	Systematic review of randomized trials or *n*-of-1 trial	Randomized trial or (exceptionally) observational study with dramatic effect			
Is this (early detection) test worthwhile? (Screening)	Systematic review of randomized trials	Randomized trial	Non-randomized controlled cohort/follow-up study**	Case-series, case-control, or historically controlled studies**	Mechanism-based reasoning

* Level may be graded down on the basis of study quality, imprecision, indirectness (study PICO does not match questions PICO), because of inconsistency between studies, or because the absolute effect size is very small; level may be graded up if there is a large or very large effect size.

** As always, a systematic review is generally better than an individual study.

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to answer different types of clinical questions. Understanding the nuances of each hierarchy is an important skill to develop in order to use them appropriately.

These ranking schemes are similar to one another in that they place systematic reviews at the top of each list. Systematic reviews are valued because they may produce conclusions based on a critical appraisal of several individual studies that have been selected according to preestablished criteria. Ideally, the studies reviewed have research designs that minimize the chance of bias (i.e., "high-quality evidence"), are pertinent to the physical therapist's question, and provide a more definitive answer to the question. This ideal is akin to the "holy grail" in EBPT practice; however, systematic reviews also have their limitations. As a result, individual studies may provide stronger evidence in answer to a clinical question.

At the lowest end of each OCEBM hierarchy are physiologic studies and research based on **biologic plausibility**. These studies are classified as such because of their focus on the anatomic and/or physiologic mechanisms underlying a pathologic condition or treatment technique. Clinicians who locate studies that fall into this level of evidence must consider the extent to which they can reasonably apply the findings at the person level for an individual patient or client.

Details about each evidence level between these end points vary because of the types of questions being addressed; however, some common themes regarding use of the hierarchies can be identified. First, level of rank depends on the strength of the study design. For example, an RCT is highly ranked because it is a more rigorous research design than an observational study for investigation of the therapeutic effects of an intervention such as joint mobilization in people with neck pain. Second, individual studies with strong designs should be "graded up" above systematic reviews of studies with weaker designs. For example, a single prospective study of fall risk in the elderly that includes a comprehensive list of predisposing factors for falls in a large number of subjects is more valuable than a systematic review of retrospective studies that failed to include medications, living environment, and mental status as potential contributors to fall risk. Third, systematic reviews of studies with similar directions and degrees of results (e.g., subjects improved in most studies) make a stronger case as a result of this consistency than systematic reviews of studies with significant variation in their individual findings (e.g., subjects improved in some studies and not others).

Figure 2.4 summarizes the commonalities among the OCEBM evidence hierarchies. Howick and colleagues also acknowledged some preliminary findings regarding the potential value of individual patient cases and anecdotes in evidence-based decision making.[14] Although not included in the current edition of the OCEBM hierarchies, these sources of information are reflected in the figure here to illustrate their rank relative to planned, systematic research efforts.

Other Hierarchy Schemas

Selection of studies through the use of hierarchies may improve the efficiency of the search process for busy clinicians. These schemas also are used

Figure 2.4 General ranking of evidence within hierarchies.

regularly to grade evidence to facilitate the decision-making process about which information to use. This strategy is most apparent in published clinical practice guidelines. National and international government agencies and professional associations produce guidelines to promote effective and efficient health care.[17] A few examples relevant to physical therapist practice include the following:

- VA/DoD "Clinical Practice Guideline: Management of Post-Acute Mild Traumatic Brain Injury" (2021).[18]
- British Thoracic Society's "The BTS Guideline on Pulmonary Rehabilitation in Adults" (2013).[19]
- Academy of Orthopedic Physical Therapy's "Physical Therapy Management of Older Adults with Hip Fracture (2021).[20]

Each of these documents, as well as numerous other similar publications, contains recommendations based on a review and ranking of available evidence. Grading schemes are described in the guidelines and used to qualify the recommendations made. For example, the Academy of Orthopedic Physical Therapy (AOPT) assigned the letter grades A, B, C, D, E, and F to rate the strength of the evidence supporting the guideline's recommendations (**Table 2.4**). On the other hand, the Department of Veterans Affairs/Department of Defense (VA/DoD) used the categories "strong for," "weak for," "neither for nor against," "weak against," and "strong against" based on the quality of the evidence and the balance between desirable and undesirable outcomes of the intervention(s) recommended. The differences in the scales in these examples can add confusion to the appraisal process for busy clinicians. For that reason, it is helpful to remember what they all have in common: Stronger evidence receives the most positive rating or "highest grade," whereas weaker evidence receives the most negative rating or "lowest grade."

Assuming the evidence ranking does not pose a problem, physical therapists using any of these guidelines could go straight to the recommendations and make decisions about how to change their practice based on these evidence grades. However, clinical practice guidelines should be assessed for quality in their own right before a clinician blindly adopts the practice behaviors they address.

DiCenso and colleagues developed the "6S model" to aid in the selection of "pre-appraised" evidence such as clinical practice guidelines (**Figure 2.5**).[21] The pyramid structure places computerized decision support **systems** at the top because they are designed to provide clinicians with an efficient method for accessing pre-appraised collections of studies with subjects that match relevant patient or client characteristics. At the bottom of the pyramid are individual studies that, on their own, may be unable to provide a definitive answer to the clinical question

Table 2.4 Grades of Recommendation and Strength of Evidence in the AOPT Guideline for Hip Fracture

A	**Strong evidence**	A preponderance of level I and/or level II studies support the recommendation. This must include at least one level I study.
B	**Moderate evidence**	A single high-quality randomized controlled trial or a preponderance of level II studies support the recommendation.
C	**Weak evidence**	A single level II study or a preponderance of level III and IV studies, including statements of consensus by content experts, support the recommendation.
D	**Conflicting evidence**	Higher-quality studies conducted on this topic disagree with respect to their conclusions. The recommendation is based on these conflicting studies.

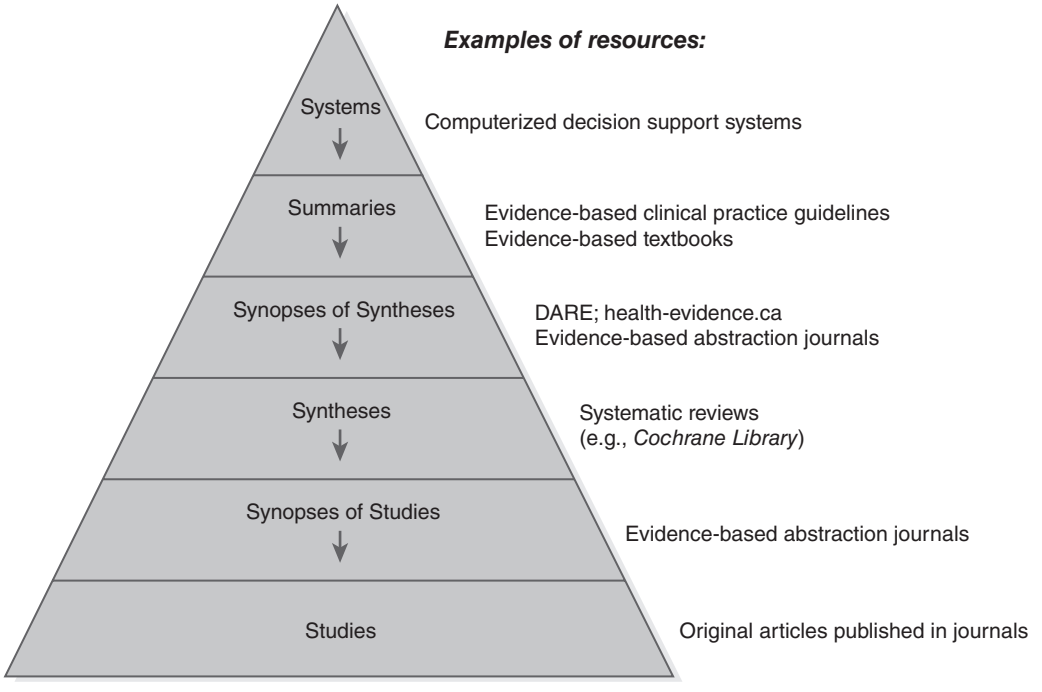

Figure 2.5 The 6S hierarchy of pre-appraised evidence.

Reproduced from DiCenso, A., Bayley, L., & Haynes, R. B. (2009). Accessing pre-appraised evidence: fine-tuning the 5S model into a 6S model. *Evidence-based Nursing, 12*(4), 99–101.

even when they are of high quality. The levels in between represent different methods for pre-appraising evidence ranked from bottom to top in terms of the rigor of their methods.

Robeson and colleagues explored the availability of these different forms of pre-processed evidence for questions related to the effectiveness of public health.[22] As **Figure 2.6** suggests, the number of research products in each category varies considerably with a predictably higher volume of traditional evidence formats (i.e., individual studies, systematic reviews and meta-analyses). Development of **synopses**, syntheses, summaries, and systems is dependent upon groups with sufficient expertise and resources to locate and critically appraise individual studies and then write and publish cohesive analyses and practice recommendations based on the evidence gathered. As such, physical therapists may find it challenging to locate pre-appraised evidence that addresses their clinical questions.

The Quality of Evidence Generated from Words

The quantitative research designs described previously and the hierarchies used to rank them are consistent with an investigative paradigm that emphasizes objectivity, faithfulness to rules of engagement with subjects, and use of quantitative data to describe clinical phenomena. Even the subjective perspectives of patients or clients are standardized into controlled survey responses through questions with a limited set of options of known value. The evidence-based practice movement is solidly built on these scientific traditions.

More recently, research generated by thematic analysis of the words people use to describe their

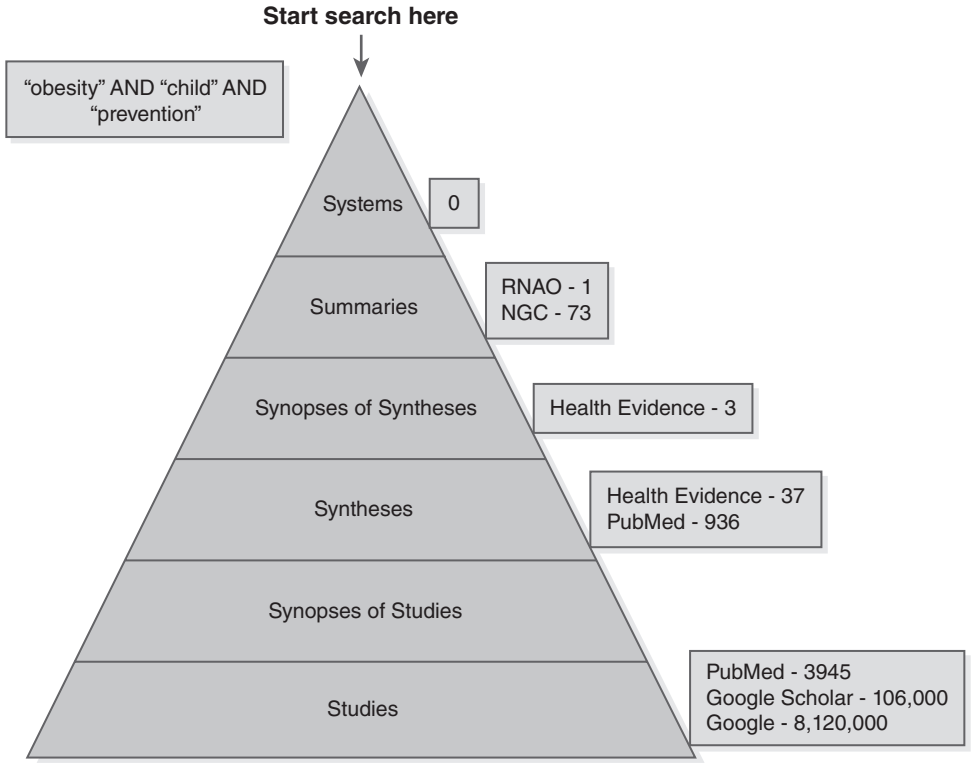

Figure 2.6 Search results mapped to 6S pyramid.

Reproduced from DiCenso, A., Bayley, L., & Haynes, R. B. (2009). Accessing pre-appraised evidence: fine-tuning the 5S model into a 6S model. *Evidence-based Nursing, 12*(4), 99–101.

experiences, beliefs, opinions, and attitudes has gained legitimacy as a contributor to evidence-based practice in the health care professions. As these qualitative studies have proliferated and their potential value has been embraced, a limited effort has been made to help clinicians understand what makes a strong qualitative research design. Daly and colleagues proposed the four-level hierarchy depicted in **Table 2.5**.[23] Consistent with evidence hierarchies constructed for use with quantitative studies, these authors lay out a progression of increasingly rigorous designs that follow established methods for subject recruitment, data gathering and analysis. The strongest designs are at the top of the table, and the less useful designs are at the bottom. This hierarchy has not been universally adopted by academics, research groups, journal publishers, or professional societies but may be useful to readers unfamiliar with the research methods implemented in this body of work.

Limitations of Evidence Hierarchies

In 2002, the Agency for Healthcare Research and Quality (formerly known as the Agency for Healthcare Policy and Research) published an evidence report titled "Systems to Rate the Strength of Scientific Evidence."[24] The authors of this report performed an extensive literature review to identify quality assessment methods used to assess the strength of evidence for systematic reviews and meta-analyses, RCTs, observational studies, and diagnostic studies as well as methods for evaluating the strength of an entire body of evidence

Table 2.5 A Hierarchy of Evidence for Practice in Qualitative Research—Summary Features

Study Type	Features	Limitations	Evidence for Practice
Generalizable studies (level I)	Sampling focused by theory and literature, extended as a result of analysis to capture diversity of experience. Analytic procedures comprehensive and clear. Located in literature to assess relevance to other settings.	Main limitations are in reporting when the word length of articles does not allow a comprehensive account of complex procedures.	Clear indications for practice or policy may offer support for current practice, or critique with indicated directions for change.
Conceptual studies (level II)	Theoretical concepts guide sample selection, based on analysis of literature. May be limited to one group about which little is known or a number of important subgroups. Conceptual analysis recognizes diversity in participants' views.	Theoretical concepts and minority or divergent views that emerge during analysis do not lead to further sampling. Categories for analysis may not be saturated.	Weaker designs identify the need for further research on other groups, or urge caution in practice. Well-developed studies can provide good evidence if residual uncertainties are clearly identified.
Descriptive studies (level III)	Sample selected to illustrate practical rather than theoretical issues. Record a range of illustrative quotes including themes from the accounts of "many," "most," or "some" study participants.	Do not report full range of responses. Sample not diversified to analyze how or why differences occur.	Demonstrate that a phenomenon exists in a defined group. Identify practice issues for further consideration.
Single case study (level IV)	Provides rich data on the views or experiences of one person. Can provide insights in unexplored contexts.	Does not analyze applicability to other contexts.	Alerts practitioners to the existence of an unusual phenomenon.

on a particular topic. In addition, they examined evidence evaluation methods used by agency-sponsored Evidence-Based Practice Centers and other organizations focused on evidence-based medicine, such as the Cochrane Collaboration.

Of the 121 systems reviewed, only 26 fully addressed quality criteria established by the authors for each type of study. Many of these lengthy systems required an inconvenient amount of time to complete. Also noted was the greater number of quality assessment methods for RCTs as compared with other types of research. The other 95 assessment methods that the authors reviewed were limited in the quality domains addressed, by a "one-size-fits-all" approach that did not distinguish among critical features of different study designs, or by lack of validation. Few of the methods had been tested for reliability or validity. Katrak and colleagues reported similar findings from their investigation into the utility of critical appraisal tools for evaluation of literature relevant to the allied health professions.[25]

In an effort to address some of these limitations, Atkins and colleagues conducted a pilot study to refine one of the established grading systems. These authors discovered that statistical agreement among raters on evidence quality ranged from zero to a nearly perfect score (kappa = 0 to 0.82).[26] The take-home message from these reports is that the strength of evidence depends, in part, on the scale against which it is being rated. In response to the potential misuse of evidence

grading systems, Glasziou and colleagues suggested that quality ratings or scales should address different types of research and would be improved by the addition of qualitative statements as well as more information regarding ratings criteria.[27] More recently, Gugiu and Gugiu proposed a new grading system that is intended to be more inclusive of treatment studies that are not RCTs.[28,29]

Understanding the details and bases for evidence hierarchies will help physical therapists select evidence to answer clinical questions about patients or clients. However, a hierarchy is only a tool to facilitate the process; it should not be used to make a final judgment about a study's value and relevance. Physical therapists must still read and critically appraise the evidence they find, whether it is a single study or a filtered synthesis of a collection of studies, before incorporating any results into their clinical decisions. This point is emphasized by an ongoing debate about the relative merits of RCTs versus quasi-experimental and observational studies. Some evidence indicates that the bias in the latter study designs results in overestimations of treatment effects, whereas other authors have reported that none of the study designs consistently estimates an intervention's impact.[30-32] Clinical judgment and expertise are essential to EBPT practice. The variability in research quality requires physical therapists to use their knowledge and skills to determine whether the evidence they find, no matter how high or low on a hierarchy, is useful for an individual patient or client.

WRAP-UP

Summary

Evidence-based physical therapist (EBPT) practice requires clinicians to select the "best available clinical evidence" from studies whose quality depends on their relevance to the question asked, their timeliness, and the level of prior scrutiny of their merits as well as on their research design and execution. Evidence hierarchies may facilitate study selection because of the ranking structure they create based on important research attributes. Different hierarchies have been designed to address evidence about diagnostic tests, prognostic indicators, interventions and subjects' perspectives. Producers of clinical practice guidelines also have defined various levels of evidence to demonstrate the degree to which their recommendations are supported by research. No matter what form a hierarchy takes, it is only a tool to facilitate the process; it should not be used to make a final judgment about a study's value and relevance. Physical therapists must still read and critically appraise the evidence they find before incorporating any results into their clinical decision-making process.

Exercises

1. What does the phrase "best available clinical evidence" mean with respect to a physical therapist's selection and use of studies? Provide an example relevant to physical therapist practice to illustrate your points.
2. Discuss the differences between a randomized controlled trial and an observational study. Under which circumstances might each study design be appropriate? Provide examples of each relevant to physical therapist practice to illustrate your points.
3. Discuss the difference between a retrospective and prospective research design and give an example of each

that reflects a study question relevant to physical therapist practice.

4. Discuss the difference between a cross-sectional research design and a longitudinal research design and give an example of each that reflects a study question relevant to physical therapist practice.
5. Explain the importance of similarities between an individual patient or client and subjects in a research study. Provide three examples of personal or clinical characteristics from a patient or client with whom you have worked recently to illustrate your points.
6. Describe the common organizational characteristics of evidence hierarchies.
7. Discuss the rationale behind the creation of different hierarchies for evidence about diagnostic tests, prognostic factors, and interventions.
8. Discuss the potential difference in value between pre-appraised collections of individual studies and individual research reports. Why is the hierarchy for pre-appraised collections structured the way that it is?
9. Discuss the limitations of evidence hierarchies. Why is a hierarchy only a starting point in evidence-based physical therapist practice?

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CHAPTER 3

The Quest for Evidence: Getting Started

OBJECTIVES

Upon completion of this chapter the student/practitioner will be able to do the following:

1. Distinguish between and provide examples of background and foreground clinical questions.
2. Write questions pertaining to each of these aspects of physical therapist practice:
   - **a.** Diagnostic tests and clinical measures
   - **b.** Prognostic factors
   - **c.** Interventions
   - **d.** Clinical prediction rules
   - **e.** Outcomes
   - **f.** Self-report outcomes measures
   - **g.** Patient or client perspectives or experiences
3. Use electronic databases reviewed in this chapter to search for evidence about a clinical question.
4. Identify research review services that may be helpful in physical therapist practice.

Introduction

The first step toward evidence-based physical therapist (EBPT) practice is a professional commitment to make the attempt as best one can, given individual work environments and resource constraints. Once that commitment is made, the next step is to consider the questions that arise during the daily management of a patient's or client's problems or needs. These questions direct the search for **evidence** that may inform clinical decision-making. This chapter focuses on the types of questions physical therapists and their patients or clients might ask. Several electronic **databases** and search techniques that are available to support the quest for evidence are described in this chapter.

Formulating Clinical Questions

Evidence-based physical therapist (EBPT) practice starts and ends with a physical therapist's patient or client. As the therapeutic relationship develops, questions naturally arise regarding the individual's problems and concerns and the best course of action with which to address them. Questions may pertain to (1) the anatomic, physiologic, or pathophysiologic nature of the problem or issue; (2) the medical and surgical management options; (3) the usefulness