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Physical Agents in Clinical Practice

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CHAPTER OUTLINE

History of Physical Agents in Medicine and Rehabilitation
Approaches to Rehabilitation
The Role of Physical Agents in Rehabilitation
Practitioners Using Physical Agents
Evidence-Based Practice
Using Physical Agents Within Different Health Care Delivery Systems
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CHAPTER OBJECTIVES

After reading this chapter, the reader will be able to do the following:

- Describe the history of the use of physical agents in medicine and rehabilitation.
- Explain the role of physical agents as components of rehabilitation intervention.
- Use evidence to guide the integration of physical agents within rehabilitation.
- Use physical agents in rehabilitation within different health care delivery systems.

History of Physical Agents in Medicine and Rehabilitation

Physical agents have been a component of medical and rehabilitative treatment for many centuries and are used across a wide variety of cultures. Ancient Romans and Greeks used heat and water to maintain health and to treat various musculoskeletal and respiratory problems, as evidenced by the remains of ancient bathhouses with steam rooms and pools of hot and cold water still present in many major Roman and Greek cities.[1] The benefits from soaking and exercising in hot water regained popularity in the late 19th century with the advent of health spas in Europe in areas of natural hot springs. Today, the practices of soaking and exercising in water continue to be popular throughout the world because water provides resistance and buoyancy, allowing the development of strength and endurance while reducing weight bearing on compression-sensitive joints.

Other historical applications of physical agents include the use of electrical torpedo fish in approximately 400 BCE to treat headaches and arthritis by applying electrical shocks to the head and feet. Amber was used in the 17th century to generate static electricity to treat skin diseases, inflammation, and hemorrhage.[2] Reports from the 17th century describe the use of charged gold leaf to prevent scarring from smallpox lesions.[3]

Before the widespread availability of antibiotics and effective analgesic and antiinflammatory drugs, physical agents were commonly used to treat infection, pain, and inflammation. Sunlight was used for the treatment of tuberculosis, bone and joint diseases, and dermatological disorders and infections. Warm Epsom salt baths were used to treat sore or swollen limbs.

Although physical agents have been used for their therapeutic benefits throughout history, over time, new uses, applications, and agents have been developed, and certain agents and applications have fallen out of favor. New uses of physical agents have been discovered as a result of increased understanding of the biological processes underlying disease, dysfunction, and recovery and in response to the availability of advanced technology. For example, **transcutaneous electrical nerve stimulation (TENS)** for the treatment of pain was developed on the basis of the **gate control theory of pain modulation,** as proposed by Melzack and Wall.[4] The gate control theory states that nonpainful stimuli can inhibit the transmission of pain at the spinal cord level. Various available modes of TENS application are primarily the result of the development of electrical current generators that allow fine control of the applied electrical current.

A physical agent usually falls out of favor because the intervention is found to be ineffective or because more effective interventions are developed. For example, the superficial heat that infrared (IR) lamps produce was commonly used to dry out open wounds, but IR lamps are no longer used for this application because we now know that wounds heal more rapidly when kept moist.[5,6] During the early years of the 20th century, sunlight was used to treat tuberculosis; however, since the advent of antibiotics to eliminate bacterial infections, physical agents are rarely used to treat tuberculosis or other infectious diseases.

Most recently, the use of a number of physical agents has fallen out of favor. The first of five recommendations in the American Physical Therapy Association (APTA) Choosing Wisely initiative, most recently updated in 2015, is "don't use (superficial or deep) heat to obtain clinically important, long-term outcomes in musculoskeletal conditions."[7] The APTA clarifies this recommendation with the following statement:

There is limited evidence for use of superficial or deep heat to obtain clinically important long-term outcomes for musculoskeletal conditions. While there is some evidence of short-term pain relief for heat, the addition of heat should be

supported by evidence and used to facilitate an active treatment program. A carefully designed active treatment plan has a greater impact on pain, mobility, function and quality of life. There is emerging evidence that passive treatment strategies can harm patients by exacerbating fears and anxiety about being physically active when in pain, which can prolong recovery, increase costs and increase the risk of exposure to invasive and costly interventions such as injections or surgery.

Looking at this statement carefully, it does imply that heat can be used to facilitate an active treatment program, as recommended in this book.

In addition, the fifth recommendation of the APTA Choosing Wisely initiative is "don't use whirlpools for wound management." The APTA clarifies this recommendation with the following statement:

Whirlpools are a non-selective form of mechanical debridement. Utilizing whirlpools to treat wounds predisposes the patient to risks of bacterial cross-contamination, damage to fragile tissue from high turbine forces, and complications in extremity edema when arms and legs are treated in a dependent position in warm water. Other more selective forms of hydrotherapy should be utilized, such as directed wound irrigation or a pulsed lavage with suction.

Based on the evidence and this recommendation, the use of whirlpools for wound management was deleted from the fifth and subsequent editions of this book, and details on directed wound irrigation and pulsed lavage with suction are provided.

Furthermore, spinal traction, particularly for the lumbar spine, has come into question in recent years because evidence from randomized controlled trials (RCTs) has failed to prove its benefits and because of concerns that this passive form of treatment may increase the risk of illness behavior and chronicity.[8] Spinal traction is still covered in this book because, as recently as 2015, over 75% of physical therapists reported using lumbar traction[9] for managing low back pain, because there is substantial evidence of traction being associated with effects that may be beneficial in certain patients, and because the evidence for the efficacy of cervical spine traction is more positive.

Physical agents also sometimes wane in popularity because they are cumbersome, have excessive associated risks, interfere with other aspects of treatment, or have just fallen out of fashion. For example, the use of diathermy as a deep-heating agent was very popular over 30 years ago, but because the machines are large and awkward to move around and set up, and because this agent can easily burn patients if not used appropriately and can interfere with the functioning of nearby computer-controlled equipment, diathermy was not commonly used in the United States until more recently. With the development of less cumbersome and safer devices, diathermy is regaining popularity and is presented in this book as a means of deep heating to facilitate an active treatment program and as a nonthermal agent to promote tissue healing.

This book focuses on the physical agents most commonly used in the United States at the present time. Physical agents that are not commonly used in the United States but that were popular in the recent past, as well as agents that are popular abroad or are expected to come back into favor as new delivery systems and applications are developed, are covered briefly. The popularity of particular physical agents is based on their history of clinical use and, in most cases, on evidence to support their efficacy; however, in some cases, their clinical application has continued despite a lack of or limited supporting evidence. More research is needed to clarify which interventions and patient characteristics provide optimal results. Further study is also needed to determine precisely what outcomes should be expected from the application of physical agents in rehabilitation.

Approaches to Rehabilitation

Rehabilitation is a goal-oriented intervention designed to maximize independence in individuals with compromised function. Function is usually compromised because of an underlying pathology and secondary **impairments** and is affected by environmental and personal factors. Compromised function may lead to **disability.** Rehabilitation generally addresses the sequelae of pathology to maximize a patient's function and ability to participate in usual activities, rather than being directed at resolving the pathology itself, and should take into consideration the environmental and personal factors affecting each patient's individual activity and participation limitations and goals.

A number of classification schemes exist to categorize the sequelae of pathology. In 1980, the World Health Organization (WHO) published the first scheme to classify the consequences of diseases, known as the International Classification of Impairments, Disabilities, and Handicaps (ICIDH).[10] This scheme, derived primarily from the work of Wood, is based on a linear model in which the sequelae of pathology or disease are impairments that lead to disabilities and handicaps.[11,12] In this scheme, *impairment* is characterized as an abnormality of structure or function of the body or an organ, including mental function. *Disability* is characterized as a restriction of activities resulting from impairment, and *handicap* is the social level of the consequences of diseases, characterized as the individual's disadvantage resulting from impairment or disability. Shortly after the **ICIDH model** was published, Nagi developed a similar model that classified the sequelae of pathology as impairments, **functional limitations,** and disabilities.[13] He defined *impairments* as alterations in anatomical, physiological, or psychological structures or functions that result from an underlying pathology. In the **Nagi model,** *functional limitations* were defined as restrictions in the ability to perform an activity in an efficient, typically expected, or competent manner, and *disabilities* were defined as the inability to perform activities required for self-care, home, work, and community roles.

The WHO updated the ICIDH model in 2001 to reflect and create changes in perceptions of people with disabilities and to meet the needs of different groups of individuals. The updated version of the ICIDH model is known as the *ICIDH-2* or the *International Classification of Functioning, Disability and Health (ICF)* (Fig. 2.1).[14] The ICF is a classification of health and health-related domains and is the WHO framework for measuring health and disability at both individual and population levels. In contrast to the earlier linear model, the **ICF model** views functioning and disability as a complex,

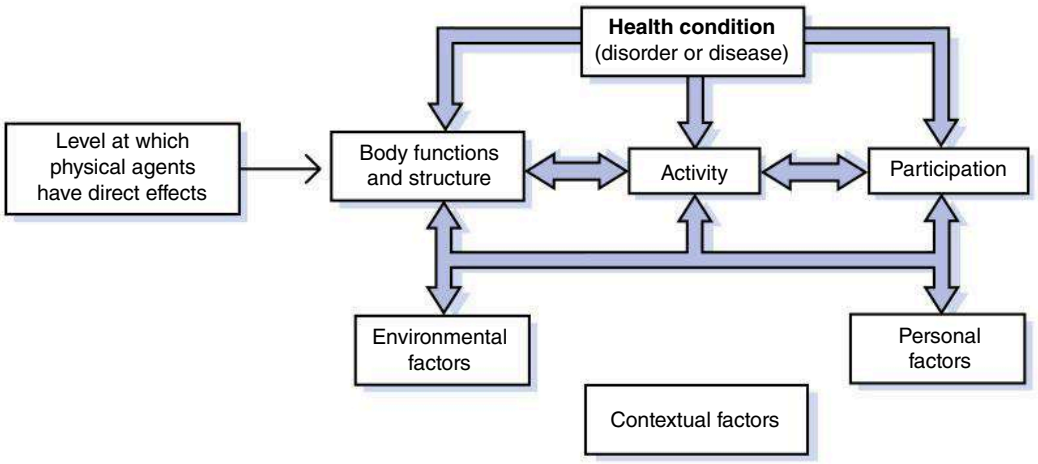

FIGURE 2.1 Model for the International Classification of Functioning, Disability and Health (ICF). (From World Health Organization [WHO]: *ICIDH-2: International Classification of Functioning, Disability and Health,* Geneva, 2001, WHO.)

dynamic interaction between the health condition of the individual and contextual factors of the environment, as well as personal factors. It is applicable to all people, whatever their health condition. The language of the ICF model is neutral to cause, placing the emphasis on function rather than on the condition or disease. It is designed to be relevant across cultures, as well as age groups and genders, making it appropriate for heterogeneous populations. The ICF is operationalized through the WHO Disability Assessment Schedule (WHODAS 2.0).[15]

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The International Classification of Functioning, Disability and Health (ICF) model views functioning and disability as a complex, dynamic interaction between the health condition of the individual and contextual factors of the environment, as well as personal factors. The ICF model emphasizes function and considers the body, the whole person, and the person in society.

The original ICIDH and Nagi models, developed primarily for use by rehabilitation professionals, were intended to differentiate disease and pathology from the limitations they produced. The new ICF model has a more positive perspective on the changes associated with pathology and disease and is intended for use by a wide range of people, including members of the community, as well as national and global institutions that create policy and allocate resources for persons with disabilities. The ICF model has tried to change the perspective of disability from the negative focus of "consequences of disease" used in the ICIDH model to a more positive focus on "components of health." The ICIDH model used categories of impairments, disabilities, and handicaps to describe sequelae of and limitations associated with pathology, whereas the ICF model uses categories of health conditions, body functions, activities, and participation to focus on abilities rather than limitations.

Consistent with the most recent edition of the APTA's *Guide to Physical Therapist Practice 3.0 (Guide 3.0),*[16] this book uses the terminology and framework of the ICF model to evaluate clinical findings and determine a plan of care for the individuals described in the case studies. The ICF model reflects the interactions between health conditions and contextual factors as they affect disability and functioning. Health conditions include diseases, disorders, and injuries. Contextual factors include environmental factors, such as social attitudes, legal structures, and one's community, and personal factors, such as gender, age, education, experience, and character. The ICF model is intended to be used in conjunction with the International Classification of Diseases (ICD), a classification system used throughout the U.S. health care system to document and code medical diagnoses.

The ICF model is structured around three levels of functioning: (1) the body or a part of the body, (2) the whole person, and (3) the whole person in a social context. Dysfunction at any of these levels is termed a *disability* and results in impairments (at the body level), activity limitations (at the whole-person level), and participation restrictions (at the social level). For example, a person who experienced a stroke may be weak on one side of the body (impairment). This impairment may cause difficulty with activities of daily living (activity limitation). The person may be unable to attend social gatherings that they previously enjoyed (participation restriction).

The ICF model was developed by combining medical and social models of disability. In the medical model, disability is the result of an underlying pathology, and to treat the disability, one must treat the pathology. In the social model, disability is the result of the social environment, and to treat the disability, one must change the social environment to make it more accommodating.

Medical treatment is generally directed at the underlying pathology or disease, whereas rehabilitation focuses primarily on reversing or minimizing impairments, activity limitations, and participation restrictions. Rehabilitation professionals must assess and set goals not only at the levels of impairment, such as pain, decreased range of motion, and **hypertonicity** (increased muscle tone) but also at the levels of activity and participation. These goals should include the patient's goals, such as being able to get out of bed, ride a bicycle, work, or run a marathon.

The Role of Physical Agents in Rehabilitation

Physical agents are tools to be used when appropriate as components of rehabilitation. The position statement of the APTA regarding the *exclusive* use of physical agents, first published in 1995 and reiterated in 2005, stated, "Without documentation which justifies the necessity of the exclusive use of physical agents/modalities, the use of physical agents/modalities, in the absence of other skilled therapeutic or educational interventions, should not be considered physical therapy."[17] In 2015, related to physical agents, as part of its Choosing Wisely initiative, the APTA specifically stated with regard to heat, "don't use (superficial or deep) heat to obtain clinically important long term outcomes in musculoskeletal conditions … the addition of heat should be supported by evidence and used to facilitate an active treatment program."[7] Most recently, in 2018, the APTA updated its position statement on the exclusive use of biophysical agents, stating, "The use of biophysical agents as a standalone intervention, or the use of multiple biophysical agents with a similar physiologic effect, is not considered physical therapy nor is it considered medically necessary without documentation that justifies the use of the biophysical agents for those purposes."[18] In other words, the APTA believes that the use of single or multiple physical agents alone does not constitute physical therapy.

The use of physical agents as a component of rehabilitation involves integration with other appropriate interventions. This integration may include applying a physical agent or educating the patient in its application as part of a complete program to help patients achieve their activity and participation goals. However, because the aim of this book is to give clinicians a better understanding of the theory and appropriate application of physical agents, the emphasis is on the use of physical agents, and other components of the rehabilitation program are described in less detail.

Practitioners Using Physical Agents

Physical therapists, physical therapist assistants, occupational therapists, occupational therapy assistants, athletic trainers, physiatrists, chiropractors, acupuncturists, and patients all apply physical agents. These individuals may have slightly different goals when applying these interventions and slightly different training and educational requirements for their use.

Physical therapists commonly use physical agents and supervise physical therapist assistants in the application of physical agents. The APTA includes physical agents within the interventions that define the practice of physical therapy and notes that when physical agents are used, this should be as a part of a complete rehabilitation program.[19] Training in the use of physical agents is a required part of entry-level education and licensure for physical therapists and physical therapist assistants. The Commission on Accreditation in Physical Therapy Education (CAPTE), the granting agency for the accreditation of physical therapist and physical therapist assistant education programs, requires evidence of "content, learning experiences, and student testing and evaluation" to ensure competent use of biophysical agents.[20] The APTA states that the minimum required skills of a physical therapist graduate at the entry level include competency in the use of physical agents such as cryotherapy, hydrotherapy, ultrasound, and thermotherapy; mechanical modalities such as compression therapies and traction devices; and electrotherapeutic modalities such as biofeedback, electrotherapeutic delivery of medications (e.g., iontophoresis), and electrical stimulation.[21] When caring for patients, physical therapists are expected to select and use the most appropriate interventions according to the best scientific evidence while considering the patient's perspective and exercising professional judgment.

Occupational therapists and occupational therapy assistants, especially those involved in hand therapy, also commonly use physical agents. In its most recent position paper,[22] published in 2018, the American Occupational Therapy Association (AOTA) referenced a 2014 document supporting that physical agents and mechanical modalities "may be used by occupational therapy practitioners as part of a comprehensive plan of intervention designed to enhance engagement in occupation.[23]" The AOTA discourages exclusive or standalone use of physical agents and mechanical modalities and promotes their use as adjunctive to "purposeful and occupation-based intervention activities."[24] Occupational therapists and occupational therapy assistants, under the supervision of occupational therapists, integrate physical agents and mechanical modalities into the intervention plan to prepare clients to complete purposeful and meaningful activities in the areas of activities of daily living, instrumental activities of daily living, rest and sleep, education, work, play, leisure, and social participation, with the overall goal of maximizing functional independence in activities.

The Accreditation Council for Occupational Therapy Education (ACOTE), the body that accredits occupational therapy educational programs in the United States, first introduced physical and mechanical agents into educational standards in 2006 to go into effect in 2008.[25] As of 2018, the ACOTE mandates that entry-level occupational therapy programs include in their curricula coursework that prepares practitioners who can "demonstrate knowledge and use of the safe and effective application of superficial thermal agents, deep thermal agents, electrotherapeutic agents, and mechanical devices as a preparatory measure to improve occupational performance."[26] Similarly, occupational therapy assistant programs must include in their curricula coursework that prepares occupational therapy assistants to understand "the safe and effective application of superficial thermal agents, deep thermal agents, electrotherapeutic agents, and mechanical devices as a preparatory measure to improve occupational performance."[26] Both occupational therapists and occupational therapy assistants must know the indications, contraindications, and precautions for the use of physical agents and mechanical modalities.

As the AOTA notes, it is important for professionals to understand that an association's policies and position do not take precedence over state laws and regulations.[23] Laws and regulations regarding the use of physical agents by occupational therapists vary among states, with many requiring additional training and experience beyond that offered during entry-level education. As of June 2019, only 15 states did not have statutes or regulations regarding the use of physical agents and mechanical modalities by occupational therapy practitioners, whereas the remaining states have, pending or in effect, such statutes or regulations.[26] Occupational therapists and occupational therapy assistants who wish to use physical agents and mechanical modalities in their clinical

practice should check the laws and regulations in the state in which they practice and are licensed.

ACOTE requires all accredited occupational therapy programs to address the safe and effective application of superficial thermal and mechanical modalities for pain management and improvement of occupational performance. ACOTE first introduced modalities into educational standards in 2006 to go into effect in 2008. This education must include "foundational knowledge, underlying principles, indications, contraindications, and precautions." Students must also be able to explain the use of deep thermal and electrotherapeutic modalities to improve occupational performance and must know the indications, contraindications, and precautions for the clinical application of these physical agents. ACOTE also requires accredited occupational therapy assistant programs to recognize the use of superficial thermal and mechanical modalities as a preparatory method for other occupational therapy interventions.[25]

The National Athletic Trainers' Association (NATA) states that training in therapeutic modalities is a required part of the curriculum to become a certified athletic trainer for accredited programs.[28,29] Continuing education in modality devices is also a component of required athletic trainer continuing education.[30]

In addition to having physical agents applied by professionals, patients can learn about and apply modalities independently. For example, agents such as heat, cold, compression, and TENS can be safely applied at home after the patient is instructed in and demonstrates proper use of the agent. Patient education has several advantages, including the option for more prolonged and frequent application, decreased cost, and increased convenience for the patient. Most important, education allows patients to be active participants in achieving their own therapeutic goals.

Evidence-Based Practice

If several agents could promote progress toward the goals of treatment, they are not contraindicated, and they can be applied with appropriate precautions, selecting which to use should be based on evidence for or against the intervention. **Evidence-based practice (EBP)** is "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients."[31,32] EBP is based on the application of the scientific method to clinical practice. EBP requires that clinical practice decisions be guided by the best available relevant clinical research data in conjunction with the clinician's experience and individual patient's pathology and preferences.

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Evidence-based practice (EBP) requires that clinical practice decisions be guided by the best available relevant clinical research data *in conjunction with* the clinician's experience and individual patient's pathology and preferences.

The goal of EBP is to provide the best possible patient care by assessing available research and applying it to each individual patient. When searching for evidence, one may encounter thousands of studies to sift through or very few studies. It is important to understand which studies constitute the highest level of evidence. To use EBP, the clinician should understand the differences between types of research studies and the advantages and disadvantages of each. Evidence used in EBP can be classified by factors such as study design, types of subjects, the nature of controls, outcome measures, and types of statistical analysis.[33]

Study design: Research studies range in quality from the low-level case report (an individual description of a particular patient that does not necessarily reflect the population as a whole) to the high-level meta-analysis of RCTs (the gold standard of EBP, a quantitative synthesis and summary of the results from previously published high-quality RCTs on the same topic). When directly relevant **meta-analyses** do not exist on a particular therapy or treatment, **systematic reviews** or individual RCTs are preferred to case reports and nonrandomized studies. RCTs minimize bias through blinded, randomized assignment to an intervention or a control group and assessment of outcomes.[34] A general overview of study types is presented in Table 2.1.[35] This table provides the general hierarchy as accepted by

TABLE 2.1 Levels of Evidence From Highest Quality to Lowest[35]

Meta-analyses (highest quality)	The use of statistical methodology to quantify the conclusions of many previously published trials evaluating a particular treatment or intervention. Studies are included in the meta-analysis if they meet predetermined criteria, and the statistical methods used should be well documented.
Systematic reviews	An applied, methodical search of existing literature on a specific treatment and/or pathology. Studies meeting predetermined parameters are included, and a narrative conclusion summarizes the findings. Systematic reviews should include the search strategy used when surveying studies so that the search can be reproduced at a later date.
Randomized controlled trials	A preplanned study that uses random assignment to one of two groups, and blinding of both the investigators to group assignment, in order to minimize bias. One group receives the treatment being evaluated, and the other group does not. In general, the group not receiving the active treatment receives a placebo. The same outcome measures are performed in each group.
Cohort studies	An observational study comparing participants who receive a treatment, or have certain features, to participants who do not receive that treatment, or do not have those features.
Case-control study	An observational study comparing a group of participants with the same diagnosis or pathology with a healthy group without the diagnosis.
Case report	A report of the signs, symptoms, interventions, and outcomes for a single patient.

the clinical community, but there are exceptions. For example, a well-powered observational study run over several decades could provide stronger evidence for a particular treatment than a single RCT with a small sample size. Additionally, not all publications that call themselves "systematic reviews" are equally rigorous. A high-quality systematic review should be exhaustive and reproducible.[36] It should utilize multiple databases so that all relevant literature is found. It should also include the names of the databases searched, the search terms and search strategy used in each database, and the dates the searches were run, and it should provide a **Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)** flow diagram giving the number of studies initially found in the search and the final studies selected for inclusion.[37]

Subject type: Studies with demographic variety that include male and female participants of varying ages and from different backgrounds are preferred if the ailment or condition under study affects both sexes across a wide age spectrum. For example, because low back pain commonly affects both men and women of a wide range of ages, with no particular predilection for a specific racial group, studies on the treatment of low back pain should include men and women of various ages and various races to make the results generalizable to the target population. In addition, studies with many participants having homogeneous ailments are preferred over small, heterogeneous groups of participants with varying degrees of ailment, so a study of many people with acute low back pain is better than a study of few people with back pain of varying duration. When an intervention is applied to a group with varying degrees of ailment, the effectiveness of the treatment may be difficult to assess. When the sample size is large and all participants experience the same degree of ailment, the outcomes are more likely to be valid. Subjects with confounding pathologies that may affect the results of treatment should generally be excluded from the study.

Outcome measures: Outcome measures are the assessment strategies used to determine if a treatment is successful. Measures should be reliable—reproducing the same or similar result when repeated, regardless of the test administrator. Measures should also be valid, appropriately assessing the property, unit, or characteristic they intend to measure. Outcome measures can be patient reported,[38] such as self-report on a quality-of-life questionnaire, or clinician measured,[39] such as the speed at which a patient completes a timed walk. Outcome measures can assess functional limitations or the degree of impairment and be sufficiently generic to use across pathologies or specific to pathologies with a specific diagnosis.[40] When considering the quality of outcome measurements, it is important that one consider the reliability and validity of the measure and whether the measurement will provide meaningful data.[41]

Statistical analysis: Once the outcome data have been collected, a study should report the results of preplanned statistical analyses. Results are often considered statistically significant when there is less than a 5% chance that the findings occurred by chance. This is denoted by "$p < 0.05$." Using EBP to guide the selection and application of physical agents as part of rehabilitation is often challenging. It can be difficult to find published high-quality studies because high-quality studies are difficult to perform. Blinding patients and clinicians to rehabilitation treatments may not be possible, outcomes may be difficult to assess, and it is costly and time consuming to include large numbers of subjects. A good initial approach to evaluating the quality of an individual study is to examine the quality of the question being asked. All well-built questions should have four readily identifiable components: (1) the patients, (2) the intervention, (3) the comparison intervention, and (4) the outcome. These components can be readily remembered by the mnemonic *PICO* (Table 2.2).

TABLE 2.2 PICO Table Used by Clinicians When Structuring Questions

P	Patient or Population	The question should apply to a specific person or group (e.g., adults with low back pain; children with lower-extremity spasticity)
I	Intervention	The question should focus on a specific intervention (e.g., specified exercise applied at a specified frequency and duration)
C	Comparison or Control	The question should compare the selected intervention with the gold-standard treatment or no intervention at all
O	Outcome	The question should state clearly the desired outcome from the intervention (e.g., increased walking speed, decrease in self-reported pain)

When exploring the literature to find applicable evidence, one should use the PICO table to structure well-defined searches. Most databases of the clinical literature rely on the use of **Medical Subject Headings (MeSH)** and other specialized vocabulary when indexing or inputting the literature. Translating PICO terms to the specialized language of the database facilitates a strategic and efficient search. At the end of each subsequent chapter in this book, case studies present various pathologies with structured PICO searches for treatment approaches mapped to MeSH terms that you can apply for yourself in PubMed (Table 2.3). This search will provide citations with abstracts, and often full-text articles, that are continuously updated by the National Library of Medicine.

As noted previously, meta-analyses and systematic reviews typically provide the highest-quality evidence. There are several specialized databases of systematic reviews and meta-analyses of medical and rehabilitation-related research, including the well-respected Cochrane Database of Systematic Reviews and PubMed Health (Box 2.1). For clinical questions not included in these databases, individual studies may be found in other online databases of medical and rehabilitation-oriented publications, such as MEDLINE, which is accessed via PubMed; CINAHL (Cumulative Index of Nursing and Allied Health Literature); and PEDro (Physiotherapy Evidence Database) (Box 2.2). When searching the literature to find and evaluate the latest and most relevant evidence, it is important to understand the strengths and limitations of each database you plan to use. A librarian can suggest the best

TABLE 2.3 Sample Find the Evidence Table With PICO Elements Mapped to MeSH Terms

PICO Terms	Natural-Language Example	Sample PubMed Search
P (Population)	Patients with symptoms due to soft tissue shortening	("Contracture*"[MeSH] OR "Contracture"[Text Word] OR "Therapy, Soft Tissue"[MeSH] OR "Tissue Shortening"[Text Word])
I (Intervention)	Ultrasound therapy	AND "Ultrasonic Therapy*"[MeSH] AND English[lang] AND "Humans"[MeSH Terms]
C (Comparison)	No ultrasound therapy	
O (Outcome)	Increased range of motion	

Box 2.1 Databases of Systematic Reviews and Meta-Analyses

The Cochrane Database of Systematic Reviews	A collection of systematic reviews and corresponding editorials that have been carried out by highly trained Cochrane Review Groups
PubMed Health	A resource for systematic reviews provided by the National Library of Medicine including Cochrane's DARE database
Joanna Briggs Institute	A refereed, online library that publishes systematic review protocols and systematic reviews of health care research, as performed by Joanna Briggs Library and international collaboration centers
PROSPERO	An international prospective register of systematic reviews
Epistemonikos	A multilingual database of published research reviews in the clinical, rehabilitation, and public health fields

databases for your study question and demonstrate the various features of the platform so that you can efficiently find relevant literature.

Most databases have advanced search features. For example, when searching MEDLINE through the PubMed interface, you can limit your searches to review articles or randomized trials only. You can also search by keyword at the title level to retrieve only citations that include your selected term or terms in the title. Additionally, in PubMed, articles related to the last selected citation are suggested to you, and references within selected articles are hyperlinked to ease the search and discovery process.

Box 2.2 Sources of Studies Answering Specific Clinical Questions

TRIP Database	A clinical search engine that allows users to structure searches by PICO terms to quickly locate high-quality research evidence
PEDro	An Australian database with citations, abstracts, and full-text articles of more than 23,000 randomized controlled trials, 5200 systematic reviews, and 513 evidence-based clinical practice guides in physiotherapy
MEDLINE (searchable via PubMed)	An online database of over 25 million citations and abstracts from health and medical journals and other news sources
CINAHL	A database of studies and evidence-based care sheets from over 1300 nursing journals
GuidelineCentral	GuidelineCentral is the publisher of American Medical Association guidelines. GuidelineCentral provides a free app and covers a range of rehabilitation topics.

Clinical practice guidelines can also be good sources of evidence. Clinical practice guidelines are systematically developed statements that attempt to interpret current research to provide evidence-based guidelines to guide practitioner and patient decisions about appropriate health care for specific clinical circumstances.[42] Clinical practice guidelines give recommendations for diagnostic and prognostic measures and for preventive and therapeutic interventions. For any of these, the specific types of patients or problems, the nature of the intervention or test, alternatives to the intervention being evaluated, and outcomes of the intervention for which these guidelines apply will be stated. For example, some guidelines for the treatment of acute low back pain and for the treatment of pressure ulcers include evidence-based recommendations for tests and measures, interventions, prevention, and prognosis. Often, such recommendations are classified according to the strength of the evidence supporting them. General clinical practice guidelines used to be available on the Agency for Healthcare Research and Quality (AHRQ) National Guideline Clearinghouse (NGC) website, but funding for this clearinghouse ended, and the clearinghouse closed on July 16, 2018, and has yet to be replaced. Other repositories and libraries with guidelines include the International Guideline Library[44]; the National Institute for Health and Care Excellence (NICE) United Kingdom–based searchable website of evidence-based guidance; and the CPG Infobase, which is the Canadian repository for guidelines.[44] In addition, GuidelineCentral,[45] which provides free access to thousands of current clinical practice guidelines and guideline summaries online and via an app, is currently working with a handful of other organizations to establish a new nonprofit initiative that will aim to fill the gap left by the sudden closure of AHRQ's NGC. This new initiative will include a

Box 2.3 Sources of Clinical Practice Guidelines

International Guideline Library	The International Guideline Library contains around 3000 guidelines, which have mainly been developed or endorsed by organizational members of the Guideline International Network (GIN). The library is free to access.
National Institute for Health and Care Excellence (NICE)	NICE guidelines provide evidence-based recommendations developed by independent committees, including professionals and lay members, and consulted on by stakeholders.
CPG Infobase	This database contains approximately 1200 evidence-based Canadian clinical practice guidelines (CPGs) developed or endorsed by authoritative medical or health organizations in Canada.
Centre for Evidence-Based Medicine (CEBM)	The CEBM website includes information for health care professionals on learning, practicing, and teaching EBM, as well as definitions of terminology and calculators.

database of quick-reference guideline summaries, along with a focus on developing a repository of various guideline-implementation tools (including machine-computable guidelines for electronic health records [EHRs]). This new database will be made available for free to all health care providers in both web and mobile app formats (Box 2.3).

EBP is accepted practice and should be incorporated into every patient's plan of care. However, it is important to remember that every study cannot be applied to every patient, and research-supported interventions should not be applied without considering each patient's situation. EBP requires the careful combination of patient preference, clinical circumstances, clinician expertise, and research findings.

Using Physical Agents Within Different Health Care Delivery Systems

Clinicians may be called on to treat patients within different health care delivery systems in the United States and abroad. These systems may vary in terms of the quantity and nature of available health care resources. Some systems provide high levels of resources in the form of skilled clinicians and costly equipment, and others do not. Over the last several years, the health care delivery system in the United States has tried to contain the growing costs of medical care and focused on the cost-effective use of resources. The emphasis on cost-effectiveness is even greater in socialized medical systems, where there are fewer counterpressures from the for-profit provision of health care.

To help control costs, services that can be self-administered are often not paid for by insurance. For example, since 1997, Medicare has bundled the payment for hot-pack and cold-pack treatments into the payment for all other services, rather than reimbursing separately for these treatments, because hot and cold packs can be administered by patients independently.[46] Nonetheless, this intervention may be indicated, and patients may benefit from education on how and when to apply these agents themselves at home.

Within the context of attending to cost-effectiveness, the goals of health care continue to be, as they always have been, to obtain the best outcome for the patient within the constraints of the health care delivery system. The clinician should find and use the most efficient ways to provide interventions to help patients progress toward the goals of treatment. To use physical agents in this manner, the clinician must be able to assess the presenting problem and know when a physical agent is or is not likely to be an effective component of treatment. The clinician must know when and how to use physical agents most effectively, which ones can be used by patients to treat themselves, and which are not likely to be effective (Box 2.4). To achieve the most cost-effective treatment, the clinician should use evidence-based interventions and optimize the use of practitioners of varying skill levels and of home programs when appropriate. In many cases, the licensed therapist may not need to apply the physical agent but instead may assess and analyze the presenting clinical findings; determine the intervention plan; provide the aspects of care that require the skills of the licensed therapist; and train the patient to apply, or supervise other personnel in applying, interventions that require a lower level of skill. The therapist can then reassess the patient regularly to determine the effectiveness of the interventions provided and the patient's progress toward their goals and can adjust the plan of care accordingly.

Cost-efficiency may also be increased by providing an intervention to groups of patients, such as group water exercise programs for patients recovering from total joint arthroplasty or for patients with osteoarthritis. Such programs may be designed to facilitate the transition to a community-based exercise program when the patient reaches the appropriate level of function and recovery. When used in this manner, physical agents can provide cost-effective care and can involve the patient in promoting recovery and achieving the goals of treatment.

Box 2.4 Requirements for Cost-Effective Use of Physical Agents

- Assess and analyze the presenting problem.
- Know when physical agents can be an effective component of treatment.
- Know when and how to use physical agents most effectively.
- Know the skill level required to apply the different physical agents.
- Optimize the use of different practitioners' skill levels.
- Use home programs when appropriate.
- Treat in groups when appropriate.
- Reassess patients regularly to determine the efficacy of treatments provided.
- Adjust the plan of care according to the findings of reassessments.

Chapter Review

1. The ICF model assesses the impact of a disease or condition on a patient's function. This model considers the effects of a patient's health condition, environment, and personal circumstances on their impairments, activity limitations, and participation restrictions. The ICF model looks at the patient on three levels: body, whole person, and social. Physical agents primarily affect the patient at the body, or impairment, level. A complete rehabilitation program should affect the patient at all levels of functioning, disability, and health.
2. EBP is the incorporation of research-based evidence into a patient's rehabilitation plan. EBP integrates the clinician's experience and judgment with the patient's preferences, the clinical situation, and available evidence. This book attempts to include the current, best-quality evidence available while teaching readers how to conduct independent searches to get the most relevant and up-to-date information when they need it.
3. Physical agents are used in the clinic, at home, and in various health care delivery systems. Depending on the system, the selection and application of physical agents may vary. Reimbursement for applying physical agents is constantly in flux, and the potential for conflict between minimizing cost and maximizing benefit can make intervention selection difficult.

Glossary

Clinical practice guidelines: Systematically developed statements that attempt to interpret current research to provide evidence-based guidelines to guide practitioner and patient decisions about appropriate health care for specific clinical circumstances.

Disability: The inability to perform activities required for self-care, home, work, and community roles.

Evidence-based practice (EBP): The conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients.

Functional limitations: Restrictions in the ability to perform an activity in an efficient, typically expected, or competent manner.

Gate control theory of pain modulation: Theory of pain control and modulation that states that pain is modulated at the spinal cord level by inhibitory effects of nonnoxious afferent input.

Hypertonicity: High muscle tone or increased resistance to stretch compared with normal muscles.

ICF model: International Classification of Functioning, Disability and Health (ICF) model of disability and health created by the World Health Organization (WHO) that views functioning and disability as a complex interaction between the health condition of the individual and contextual factors, including environmental and personal factors. ICF uses categories of health conditions, body functions, activities, and participation to focus on abilities rather than limitations.

ICIDH model: International Classification of Impairments, Disabilities, and Handicaps (ICIDH) model of disability created by the World Health Organization (WHO) that was a precursor to the International Classification of Functioning, Disability, and Health (ICF) model and focused on disability rather than ability.

Impairments: Alterations in anatomical, physiological, or psychological structures or functions as the result of an underlying pathology.

Medical Subject Headings (MeSH): The National Library of Medicine's controlled vocabulary thesaurus.

Meta-analyses: Systematic reviews that use statistical analysis to integrate data from a number of independent studies.

Nagi model: A linear model of disability in which pathology causes impairments, leading to functional limitations that result in disabilities; this was a precursor to the International Classification of Functioning, Disability and Health (ICF) model.

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA): An evidence-based minimum set of items for reporting in systematic reviews and meta-analyses. The aim of the PRISMA Statement is to help authors improve the reporting of systematic reviews and meta-analyses.

Systematic reviews: Reviews of studies that answer clearly formulated questions by systematically searching for, assessing, and evaluating literature from multiple sources.

Transcutaneous electrical nerve stimulation (TENS): The application of electrical current through the skin to modulate pain.

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