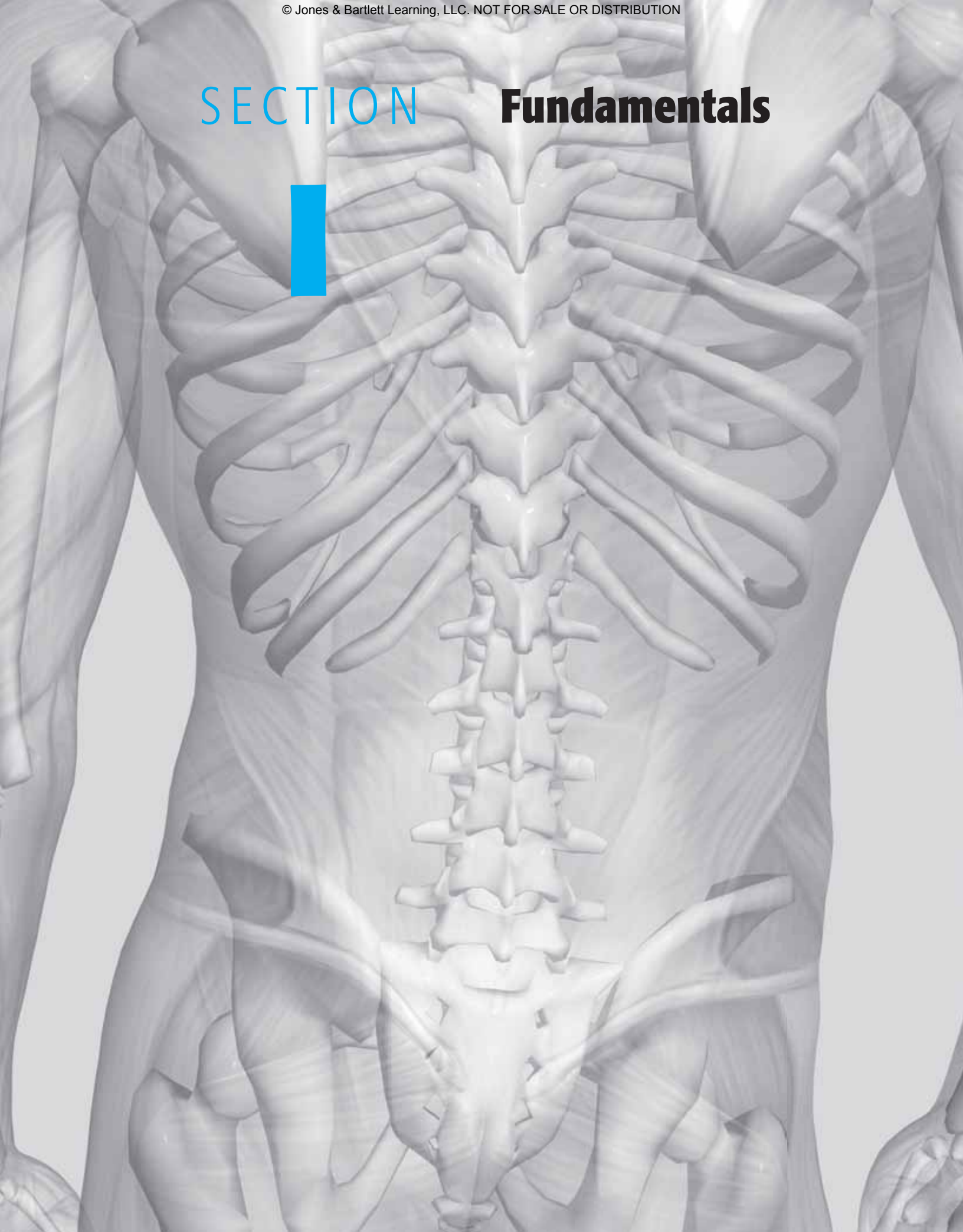
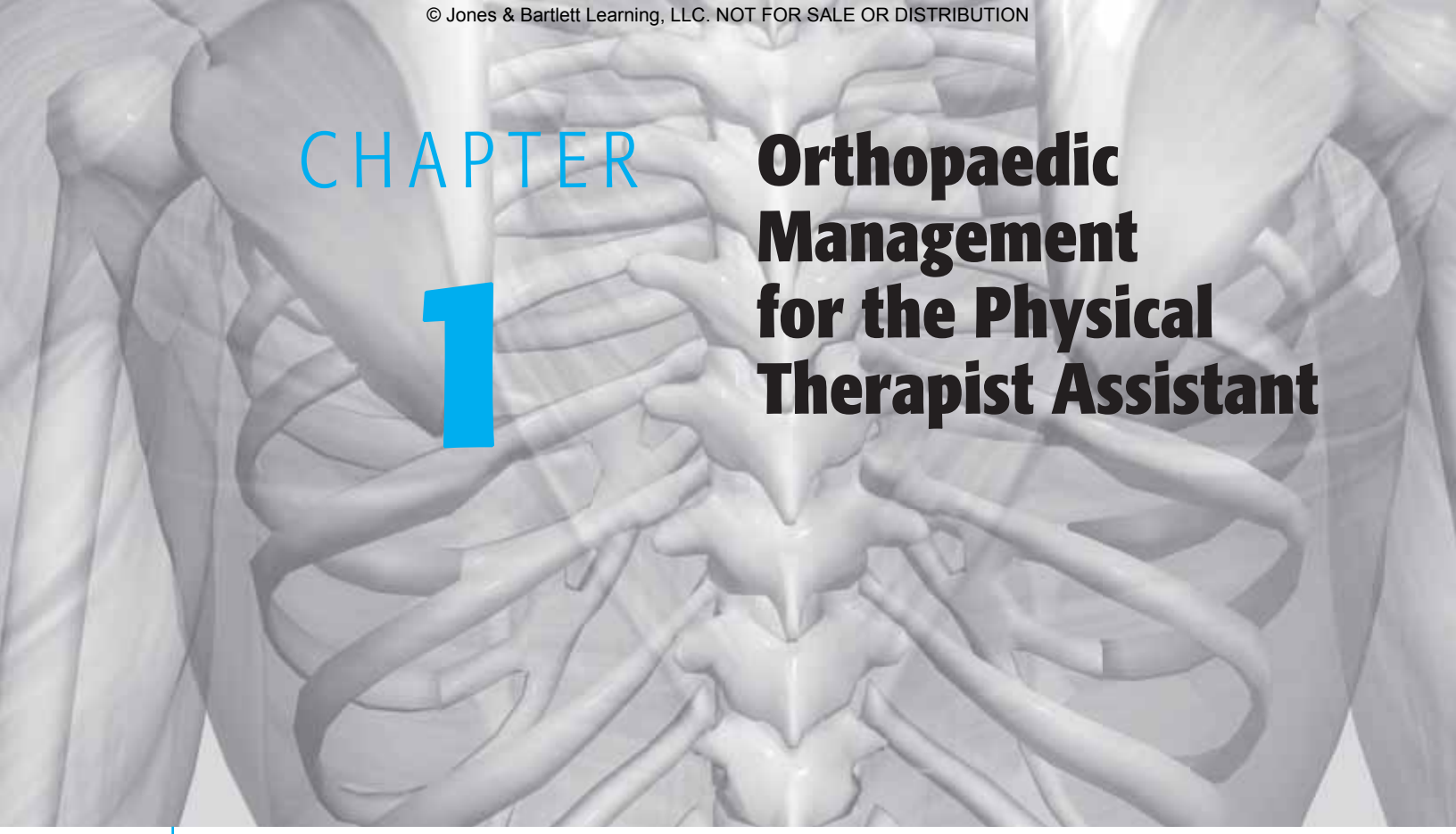
SECTION I Fundamentals





CHAPTER 1

Orthopaedic Management for the Physical Therapist Assistant

Chapter Objectives

At the completion of this chapter, the reader will be able to:

1. Describe the role of the physical therapist assistant in the orthopaedic setting.
2. List the different members of the orthopaedic rehabilitation team and describe their respective roles.
3. Describe the model of disablement used by the *Guide to Physical Therapist Practice.*
4. Recognize a medical emergency in the orthopaedic setting.
5. Understand the importance of monitoring vital signs.
6. Outline some of the common causes of edema.
7. Discuss the important concepts of an intervention.
8. Describe some of the medications used in orthopaedics and their potential impact.
9. Discuss what the SOAP note is, and the importance of accurate documentation.
10. Have a working knowledge of the types of abbreviations used in the orthopaedic setting.

Overview

The management of the orthopaedic patient involves a complex relationship between the clinician and the patient. The aim of the management process is to develop a rapport between clinician and patient while providing an efficient and effective exchange. The success of this process involves a myriad of skills. Successful clinicians demonstrate effective communication skills, clinical reasoning, critical judgment, creative decision-making, knowledge, and competence.

The Role of the Physical Therapist Assistant

The *Guide to Physical Therapist Practice* was developed by the American Physical Therapy Association (APTA) "to encourage a uniform approach to physical therapist practice and to explain to the world the nature of that practice."[1] The *Guide* is divided into two parts:

- Part 1 delineates the physical therapist's scope of practice and describes patient management by physical therapists (PTs).
- Part 2 describes each of the diagnostic preferred practice patterns of patients typically treated by PTs.

Physical therapy is defined as the care and services provided by or under the direction and supervision of a physical therapist. Physical therapists are the only professionals who provide physical therapy. Physical therapist assistants (PTAs)—under the direction and supervision of the physical therapist—are the only paraprofessionals who assist in the provision of physical therapy interventions. The *Guide for Conduct of the Physical Therapist Assistant*[2] is provided in Appendix A.

Key Point The APTA House of Delegates (HOD) first authorized the training of PTAs at the 1967 Annual Conference by adopting the policy statement *Training and Utilization of the Physical Therapist Assistant*. In 1977, the Commission on Accreditation in Education (CAE), the precursor to the Commission on Accreditation in Physical Therapy Education (CAPTE), was established and recognized by the U.S. Department of Education and by the Council on Postsecondary Accreditation. The activities of the CAE included accreditation of programs for PTAs.

The role of the PTA has continued to evolve since its conception, and PTAs practice in a broad range of inpatient, outpatient, and community-based settings. According to the APTA's HOD (HOD 06-96-39 and HOD 06-00-16-27), the PTA is specifically defined as "a technically educated health care provider who assists the physical therapist in the provision of physical therapy. … In the contemporary provision of physical therapy services, the physical therapist is considered the professional practitioner of physical therapy, while the physical therapist assistant, educated at the technical level, is considered the paraprofessional."

Key Point Supervision of the PTA is governed by a number of factors including:

- APTA standards.
- Individual state and federal laws regulating practice acts, including administrative rules for practice. Supervision of the PTA may be spelled out separately from other support personnel, or the PTA may be included in language that defines supervision for all support personnel. When the state laws do not delineate supervision requirements, PTs and PTAs should rely on the APTA guidelines. State regulations always supersede the APTA guidelines.
- Specifications of entitlement programs such as Medicare.

It is the responsibility of the PT to examine the patient; evaluate the data and identify problems; determine the diagnosis, prognosis, and plan of care (POC); and implement the POC (intervention).[3] The PTA may help the PT with the initial examination, gathering specific data that the PT requests. The PT evaluates the results of data collection and makes a judgment about data value. The PTA does not interpret the results of the initial examination. The PT establishes the goals or outcomes to be accomplished by the POC and treatment plan and performs the patient's interventions. The PTA performs selected interventions as directed by the PT. The PTA must also recognize when involvement of the PT is warranted.

Key Point The PTA is responsible for data collection, carrying out the PT's POC, providing proper patient supervision, communicating with the PT, recording the patient's progress or lack of progress since the initial examination and evaluation, and providing clinical observation during treatment sessions.

The PTA is frequently called upon to modify or adjust therapeutic interventions, either to progress the patient as directed by the PT or to ensure patient safety and comfort. These modifications or adjustments include, but are not limited to, any or all interventions in response to changes in a patient's signs and symptoms, range of motion (ROM), strength, endurance, function, balance, and coordination (**Table 1-1**). The PTA also may ask the PT to perform a re-examination.

Key Point When performing data collection, it is important for the PTA to consider why a change in patient status has occurred. For example, when the PTA is using a goniometer to measure knee range of motion of a patient and finds that the patient is unable to perform the last 5 degrees of extension, the PTA should begin thinking about possible reasons why the patient is unable to achieve full knee extension. However, the PTA is obligated to consult with the supervising PT before making any changes outside of the POC.

TABLE 1-1 Essential Data Collection Skills for Carrying Out an Orthopaedic Plan of Care

Aerobic Capacity and Endurance
Measures standard vital signs
Recognizes and monitors responses to positional changes and activities
Observes and monitors thoracoabdominal movements and breathing patterns with activity

Anthropometrical Characteristics
Measures height, weight, length, and girth

Arousal, Mentation, and Cognition
Recognizes changes in the direction and magnitude of patient's state of arousal, mentation, and cognition

Assistive, Adaptive, Orthotic, Protective, Supportive, and Prosthetic Devices
Identifies the individual's and caregiver's ability to care for the device
Recognizes changes in skin condition while using devices and equipment
Recognizes safety factors while using the device

Gait, Locomotion, and Balance
Describes the safety, status, and progression of a patient while engaged in gait, locomotion, and balance

Integumentary Integrity
Recognizes absent or altered sensation
Recognizes normal and abnormal integumentary changes

Joint Integrity and Mobility
Recognizes normal and abnormal joint movement

Muscle Performance
Measures muscle strength by manual muscle testing
Observes the presence or absence of muscle mass
Recognizes normal and abnormal muscle length
Recognizes changes in muscle tone

Pain
Administers standardized questionnaires, graphs, behavioral scales, or visual analog scales for pain
Recognizes activities, positioning, and postures that aggravate or relieve pain or altered sensations

Posture
Describes resting posture in any position
Recognizes alignment of trunk and extremities at rest and during activities

Range of Motion
Measures functional range of motion
Measures range of motion using a goniometer

Applicable Standards
3.3.2.9. Adjusts interventions within the plan of care established by the physical therapist in response to patient clinical indications and reports this to the supervising physical therapist
3.3.2.10. Recognizes when intervention should not be provided due to changes in the patient's status and reports this to the supervising physical therapist
3.3.2.11. Reports any changes in the patient's status to the supervising physical therapist
3.3.2.12. Recognizes when the direction to perform an intervention is beyond that which is appropriate for a physical therapist assistant and initiates clarification with the physical therapist
3.3.2.13. Participates in educating patients and caregivers as directed by the supervising physical therapist
3.3.2.14. Provides patient-related instruction to patients, family members, and caregivers to achieve patient outcomes based on the plan of care established by the physical therapist
3.3.2.15. Takes appropriate action in an emergency situation
3.3.2.16. Completes thorough, accurate, logical, concise, timely, and legible documentation that follows guidelines and specific documentation formats required by state practice acts, the practice setting, and other regulatory agencies
3.3.2.17. Participates in discharge planning and follow-up as directed by the supervising physical therapist
3.3.2.18. Reads and understands the healthcare literature

Data from Accreditation Handbook: PTA Criteria, Appendix A-32.

Strong interpersonal communication between the patient, the physical therapist, and the PTA; keen observation; and sound clinical decision-making are needed for the PTA to function effectively and efficiently.

The Rehabilitation Team

The PTA is only one vital member of the rehabilitation team (Table 1-2).[2] The PTA is responsible and accountable to the other members of the team. However, the responsibility for the patient care is shared by the entire rehabilitation team and requires the active participation of the patient. Table 1-3 provides the standards for the PTA's role in administering physical therapy.

Key Point The PTA should always be looking for ways to establish relationships with the other team members and to use the resources that they can provide.

Fundamental differences involving protocols and treatment approaches can exist among the members of the rehabilitation team due to different backgrounds and types of education; these can place the PTA in uncomfortable situations. For example, when transferring the patient from bed to chair, a nurse may insist that the PTA transfers the patient using a technique that the PTA considers will put the patient at increased risk. The PTA must use these scenarios as opportunities for communication, learning, and increased understanding of the other team members.

TABLE 1-2 Potential Key Members of the Orthopaedic Rehabilitation Team

Personnel	Function
Orthopaedic surgeon	A surgeon concerned with conditions involving the musculoskeletal system. Orthopaedic surgeons use both surgical and nonsurgical approaches to treat musculoskeletal trauma, sports injuries, degenerative diseases, infections, tumors, and congenital disorders.
Physiatrist	A physician specializing in physical medicine and rehabilitation, who has been certified by the American Board of Physical Medicine and Rehabilitation. The primary role of the physiatrist is to diagnose and treat patients with disabilities involving musculoskeletal, neurological, cardiovascular, or other body systems.
Primary care physician (PCP)	A practitioner, usually an internist, general practitioner, or family medicine physician, providing primary care services and managing routine healthcare needs. Most PCPs serve as gatekeepers for managed-care health organizations, providing authorization for referrals to other specialty physicians or services, including physical therapy.
Chiropractor (DC)	A doctor trained in the science, art, and philosophy of chiropractic. A chiropractic evaluation and treatment is directed at providing a structural analysis of the musculoskeletal and neurologic systems of the body. According to chiropractic doctrine, abnormal function of these two systems may affect function of other systems in the body.
Physical therapy director/ manager	The director or manager is typically a physical therapist who has demonstrated qualifications based on education and experience in the field of physical therapy and who has accepted the inherent responsibilities of the role. He or she establishes guidelines and procedures that will delineate the functions and responsibilities of all levels of physical therapy personnel in the department and the supervisory relationships inherent to the functions of the department and the health system. This person also ensures that the objectives of the service are efficiently and effectively achieved within the framework of the stated purpose of the organization and in accordance with safe physical therapist practice, interprets administrative policies, acts as a liaison between line staff and administration, and fosters the professional growth of the staff.
Staff physical therapist (PT)	The staff PT is responsible for the examination, evaluation, diagnosis, prognosis, and intervention of patients. He or she assists in the supervision of physical therapy personnel in the service.
Physical therapist assistant (PTA)	A PTA works under the supervision of a physical therapist. Care provided by a PTA may include teaching patients/clients exercise for mobility, strength, and coordination, and training patients for activities such as walking with crutches, canes, or walkers, and using adjunctive interventions. The PTA may modify an intervention only in accordance with changes in patient status and within the established plan of care developed by the physical therapist.

TABLE 1-2 Potential Key Members of the Orthopaedic Rehabilitation Team (continued)

Personnel	Function
PT/OT aide	Aides are support personnel who may be involved in support services directed by PTs and PTAs. They receive on-the-job training and are permitted to function only with continuous on-site supervision by a physical therapist, or in some cases, a physical therapist assistant. Their duties are limited to those methods and techniques that do not require clinical decision making or clinical problem solving by a physical therapist or a physical therapist assistant.
PT or PTA student	The PT or PTA student can perform duties commensurate with their level of education. The PT clinical instructor (CI) is responsible for all actions and duties of the affiliating student, and can supervise both physical therapy and physical therapist assistant students. (A PTA may only supervise a PTA student, not a PT student.)
Volunteer	A member of the community who is interested in assisting with rehab departmental activities. Responsibilities include taking phone messages and basic nonclinical/secretarial duties. Volunteers may not provide or set up patient treatment, transfer patients, clean whirlpools, or maintain equipment.
Occupational therapist (OT)	OTs assess functioning in activities of everyday living, including dressing, bathing, grooming, meal preparation, writing, and driving, which are essential for independent living. The minimum educational requirements for the registered occupational therapist are described in the current *Essentials and Guidelines of an Accredited Educational Program for the Occupational Therapist.*
Certified OT assistant (COTA)	An OT assistant works under the direction of an occupational therapist. He or she performs a variety of rehabilitative activities and exercises as outlined in an established treatment plan. The minimum educational requirements for the COTA are described in the current *Essentials and Guidelines of an Accredited Educational Program for the Occupational Therapy Assistant.*
Certified orthotist (CO)	A CO designs, fabricates, and fits orthoses (e.g., braces, splints, collars, corsets), prescribed by physicians, to patients with disabling conditions of the limbs and spine.
Certified prosthetist (CP)	A CP designs, fabricates, and fits prostheses for patients with partial or total absence of a limb.
Physician's assistant (PA)	A PA is a medically trained professional who can provide many of the healthcare services traditionally performed by a physician, such as taking medical histories and doing physical examinations, making a diagnosis, and prescribing and administering therapies.
Nurse practitioner (NP)	An NP is a registered nurse with additional specialized graduate-level training who can perform physical exams and diagnostic tests, counsel patients, and develop treatment programs.
Certified athletic trainer (ATC)	The certified athletic trainer is a professional specializing in athletic health care. In cooperation with the physician and other allied health personnel, the athletic trainer functions as an integral member of the athletic healthcare team in secondary schools, colleges and universities, sports medicine clinics, professional sports programs, and other athletic healthcare settings.

TABLE 1-3 The PTA's Role in Administration

Administration

Standard 3.3.2.21. Interacts with other members of the health care team in patient-care and nonpatient-care activities

Standard 3.3.2.22. Provides accurate and timely information for billing and reimbursement purposes

Standard 3.3.2.23. Describes aspects of organizational planning and operation of the physical therapy service

Standard 3.3.2.24. Participates in performance improvement activities (quality assurance)

Data from Accreditation Handbook: PTA Criteria, Appendix A-3.

Models of Disablement

A disablement model is designed to detail the functional consequences of and relationships among disease, impairment, and functional limitations (Table 1-4). The PTA's understanding of the process of disablement, and the factors that affect its development, is crucial to achieving the goal of restoring or improving function and reducing disability in the individual. The *Guide to Physical Therapist Practice*[3] employs terminology from the Nagi disablement model (an example of which is shown in Table 1-5)[4]

TABLE 1-4 Disablement Model Comparisons

The International Classification of Functioning, Disability and Health (ICFDH-I)	Nagi Disablement Model	The International Classification of Functioning, Disability and Health (ICFDH-II)
Disease The intrinsic pathology or disorder	**Pathology/Pathophysiology** Interruption of or interference with normal processes and efforts of an organism to regain normal state	**Health Condition** Dysfunction of a body function and/or structure
Impairment Loss or abnormality of psychological, physiologic, or anatomic structure or function	**Impairment** Anatomic, physiologic, mental, or emotional abnormalities or loss	**Impairment** Problems in body function or structure such as a significant deviation or loss
Disability Restriction or lack of ability to perform an activity in a normal manner	**Functional Limitation** Limitation in performance at the level of the whole organism or person	**Activity Limitation** Limitation in execution of a task or action by an individual
Handicap Disadvantage or disability that limits or prevents fulfillment of a normal role (depends on age, sex, and sociocultural factors for the person)	**Disability** Limitation in performance of socially defined roles and tasks within a sociocultural and physical environment	**Participation Restriction** Prevents fulfillment of involvement in a life situation

TABLE 1-5 Example of Nagi Disablement Model

Pathology/Pathophysiology	Impairment	Related Functional Limitation	Disability
Osteoarthritis	Loss of range of motion (ROM) Muscle weakness	Slow, painful gait—unable to ambulate 20 feet in 9 seconds Unable to rise from chair Unable to ascend/descend 10 steps	Does not leave house

but also describes its framework as being consistent with other disablement models.[5] In 1980 the Executive Board of the World Health Organization (WHO) published a document for trial purposes, the *International Classification of Functioning, Disability and Health* (ICFDH-I or ICF). In 2001, a revised edition was published (ICFDH-II) that emphasized "components of health" rather than "consequences of disease" (i.e., participation rather than disability) and environmental and personal factors as important determinants of health.[6] The following defines some of the terms used in that document:

- *Impairment:* Loss or abnormality of anatomic, physiologic, or psychologic structure or function. Not all impairments are modifiable by physical therapy, and not all impairments cause activity limitations and participation restrictions.[1]
- *Primary impairment:* An impairment that can result from active pathology or disease. Examples include loss of sensation and loss of strength. Primary impairment can create secondary impairments and can lead to secondary pathology.

- *Secondary impairment:* An impairment that originates from primary impairment and pathology.[1] Examples include conditions that result from limited mobility (e.g., pressure sores, contractures, and cardiovascular deconditioning).
- *Composite impairment:* When an impairment is the result of multiple underlying causes and arises from a combination of primary or secondary impairments.[7] For example, a patient who sustained a fracture of the tibial plateau and whose knee was immobilized for several weeks is likely to exhibit a balance impairment of the involved lower extremity after the immobilization has been removed. It is important to be able to recognize functionally relevant impairments, because not all impairments are necessarily linked to functional limitations or disability.
- *Functional limitation:* A restriction of the ability to perform at the level of the whole person, a physical action, an activity, or a task in an efficient, typically expected, or competent manner.[1]

The Five Elements of Patient/Client Management

The PTA must be aware of the sequence, organization, and administration of an examination performed by the PT. This awareness increases the PTA's understanding of the rationale for decision making and the plan of care. The five elements of patient/client management are as follows:[3]

1. Examination of the patient
2. Evaluation of the data and identification of problems
3. Determination of the diagnosis
4. Determination of the prognosis and POC
5. Implementation of the POC (intervention)

An outline of the physical therapy examination for each of the joints is provided in the relevant chapters of this book. Throughout the patient's plan of care, the PTA must communicate changes in the patient's status relative to data from the initial examination and make safe and appropriate modifications to the existing program based on consultation with the supervising PT.

Examination

The examination is an ongoing process that begins with the patient referral or initial entry and continues throughout the course of the rehabilitation program. The process of examination includes gathering information from the chart, other caregivers, the patient, the patient's family, caregivers, and friends in order to identify and define the patient's problem(s).[8] The examination consists of three components of equal importance—patient history, systems review, and tests and measures.[3] These components are closely related, in that they often occur concurrently. One further element, observation, occurs throughout.

Key Point A continual assessment by the PTA with each treatment session allows the PT to evaluate progress and modify interventions as appropriate.[3] It is not unusual for a patient to neglect to provide the PT with information pertinent to their condition during the initial examination, often because they felt it was irrelevant. If the patient provides such information to the PTA, he or she must decide whether the information warrants communication with the PT.

Patient History

The patient history involves gathering information from a review of the medical records and interviews with the patient, family members, caregiver, and other interested persons about the patient's history and current functional and health status.[9]

Key Point It is estimated that 80 percent of the information needed to explain the presenting patient problem can be provided by a thorough history.[10]

Systems Review

The systems review is a brief or limited examination that provides additional information about the patient's general health and the continuum of patient/client care throughout the lifespan. The purpose of the systems review is to:

- Help determine the anatomic and physiologic status of all systems (musculoskeletal, neurologic, cardiovascular, pulmonary, integumentary, gastrointestinal, urinary, and genitoreproductive)
- Provide information about communication skills, affect, cognition, language abilities, education needs, and learning style of the patient
- Narrow the focus of subsequent tests and measures
- Define areas that may cause complications or indicate a need for precautions during the examination and intervention processes
- Screen for physical, sexual, and psychological abuse

- Make a determination of the need for further physical therapy services based on an evaluation of the information obtained
- Identify problems that require consultation with, or referral to, another healthcare provider

Tests and Measures

The tests and measures portion of the examination involves the physical examination of the patient and provides the PT with objective data to accurately determine the degree of specific function and dysfunction.[9] A number of recognized tests and measures are commonly performed; however, not all are used every time. The physical examination may be modified by the PT based on the history and the systems review.

Numerous special tests exist for each area of the body. These tests are performed by the PT only if there is some indication that they would be helpful in confirming or implicating a particular structure or providing information as to the degree of tissue damage. For example, in the joints of the spine, special tests include directional stress tests (posterior–anterior pressures and anterior, posterior, and rotational stressing), joint quadrant testing, vascular tests, and repeated movement testing. Examples of special tests in the peripheral joints include ligament stress tests (e.g., Lachman for the anterior cruciate ligament), articular stress testing (valgus stress applied at the elbow), and rotator cuff impingement tests.

Only those special tests that have appeared in peer-reviewed literature are included in the various chapters of this book so that the PTA can have a full appreciation of their purpose and implications. It is important to remember that the interpretation of the findings from the special tests depends on the sensitivity and specificity of the test, the skill and experience of the PT, and the PT's degree of familiarity with the tests.

Evaluation

Following the history, systems review, and tests and measures, the PT makes an evaluation based on an analysis and organization of the collected data and information.[2] An evaluation is the level of judgment necessary to make sense of the findings in order to identify a relationship between the symptoms reported and the signs of disturbed function.[11] The evaluation process also may identify possible problems that require consultation with, or referral to, another provider.

Diagnosis

Diagnosis, as performed by a PT, refers to a cluster of signs and symptoms, syndromes, or categories, and is used to guide the PT in determining the most appropriate intervention strategy for each patient.[12] A physical therapy diagnosis includes a prioritization of the identified impairments, functional limitations, and disabilities.

Prognosis and Plan of Care

The prognosis, determined by the PT, is the predicted level of optimum function that the patient will attain and an identification of the barriers that may impact the achievement of optimal improvement—such as age, medication(s), socioeconomic status, comorbidities, cognitive status, nutrition, social support, medical prognosis, and environment—within a certain time frame.[2] This prediction helps guide the intensity, duration, frequency, and type of the intervention, in addition to providing justifications for the intervention. Knowledge of the severity of an injury; the age, physical status, and health status of a patient; and the healing processes of the various tissues involved are among the factors used by the PT in determining the prognosis.

The plan of care (POC), which outlines anticipated patient management, involves the setting of goals, coordination of care, progression of care, and discharge. The POC:[12]

- Is based on the examination, evaluation, diagnosis, and prognosis, including the predicted level of optimal improvement
- Includes statements that identify anticipated goals and the expected outcomes
- Describes the specific interventions to be used, and the proposed frequency and duration of the interventions that is required to reach the anticipated goals and expected outcomes
- Includes documentation that is dated and appropriately authenticated by the PT who established the plan of care
- Includes patient and family (as appropriate) goals, and a focus on patient education
- Includes plans for discharge of the patient/client, taking into consideration achievement of anticipated goals and expected outcomes, and provides for appropriate follow-up or referral

Intervention

According to the *Guide to Physical Therapist Practice*,[2] an intervention is "the purposeful and skilled

interaction of the PT and the patient/client and, when appropriate, with other individuals involved in the patient/client care, using various physical therapy procedures and techniques to produce changes in the condition consistent with the diagnosis and prognosis." One of the primary purposes of rehabilitative interventions after orthopaedic injury is to improve the tolerance of a healing tissue to tension and stress, and to ensure that the tissue has the capacity to tolerate the various stresses that will be placed on it (see Chapter 4). As an example, with contractile tissues, such as the muscles, this can be accomplished through measured rest, rehabilitative exercise, high-voltage electrical stimulation, central (cardiovascular) aerobics, general conditioning, and absence from overuse.[13]

Key Point Three components comprise the physical therapy intervention:[2]

1. Coordination, communication, and documentation
2. Patient/client-related instruction
3. Direct interventions

The inert structures, such as ligaments and menisci, rely more on the level of tension and force placed on them for their recovery, which stimulates the fibroblasts to produce fiber and glycosaminoglycans (see Chapter 2).[14] Thus, the intervention chosen for these structures must involve the repetitive application of modified tension in the line of stress based on the stress of daily activities or sporting activity.[14]

Key Point The most successful intervention programs are those that are custom designed from a blend of clinical experience and scientific data. The level of improvement achieved is related to accurate goal setting and the attainment of those goals.

The therapeutic strategy is determined solely from the responses obtained from tissue loading and the effect that loading has on symptoms. Once these responses have been determined, the focus of the intervention is to provide for patients sound and effective self-management strategies that avoid harmful tissue loading.[15] Interventions are typically aimed at addressing short- and long-term goals, both of which are dynamic in nature, being altered as the patient's condition changes by designing strategies with which to achieve those goals (**Table 1-6**). Intervention strategies can be subdivided into active (direct) or passive (indirect), with the goal being to make the intervention as active as possible at the earliest opportunity. As part of a comprehensive intervention, the principles listed in **Table 1-7** should be applied (see also Chapter 5).

TABLE 1-6 Acute Intervention Goals and Strategies

Presenting Issue	Goal	Strategies and Implementation
Pain and inflammation	Increase pain-free mobility while promoting tissue repair/regeneration	Rest/ice Supports/braces Gentle ROM Modalities
Decreased strength	Increase muscle strength/endurance	Isometric exercises Concentric exercises Eccentric exercises Isokinetic exercises Stabilization exercises
Decreased range of motion (ROM)	Increase range of motion	Passive, active assisted, and active range of motion Stretching Joint mobilizations
Deconditioning	Increase aerobic capacity	Cardiovascular exercises (e.g., treadmill, upper body ergometer, elliptical)
Decreased function	Enhance function/independence	Address psychosocial factors Improve ergonomic factors Gait progression as appropriate Closed kinetic chain exercises Neuromuscular and agility drills
Poor balance	Improve balance	Eyes open—eyes closed Stable to unstable surfaces Single movements in single planes to multiple movements in multiple planes

Rehabilitative Modalities

Clinicians have at their disposal a battery of physical agents and electrotherapeutic modalities for use throughout all phases of healing. The modalities used during the acute phase involve the application of cryotherapy, electrical

TABLE 1-7 Intervention Principles

Control pain and inflammation
Promote and progress healing
Strengthen or increase flexibility
Correct posture and movement impairment syndromes
Analyze and integrate the entire kinetic chain
Incorporate neuromuscular re-education
Improve functional outcome
Maintain or improve overall fitness
Provide patient education and self-management
Ensure a safe return to function

stimulation, pulsed ultrasound, and iontophoresis (see Chapter 7). These are generally used to decrease pain and inflammation. Modalities used during the later stages of healing include thermotherapy, phonophoresis, electrical stimulation, ultrasound, iontophoresis, and diathermy (see Chapter 7). Thermal modalities are used to promote blood flow to the healing tissues and to prepare the tissues for exercise or manual techniques.

At present, with the exception of cryotherapy, there is simply insufficient evidence to support or reject the use of various modalities.[16–18] However, the absence of evidence does not always mean that there is evidence of absence of effect, and there is always the risk of rejecting therapeutic approaches that are valid.[19]

Key Point It is important for the clinician to understand the principles that relate to a particular modality so the modality is used when indicated and the maximum therapeutic benefit may be derived from its use.

At the earliest opportunity, the patient should be weaned away from these modalities, and the focus of the intervention should shift to the application of movement and the repeated and prolonged functional restoration of the involved structures.

Patient Communication

Much about becoming an effective clinician relates to an ability to communicate with the patient, the patient's family, and to the other members of the healthcare team. Good communication involves an understanding of human behavior, effective listening, and the ability to detect subtle changes in mood, tone of voice, and body language (**Table 1-8**). The nonverbal cues such as mood and body language are especially important, because they often are performed subconsciously.

TABLE 1-8 General Recommendations for Verbal Communication

Verbal commands	Should focus the patient's attention on specifically desired actions for intervention.
Instruction	Should remain as simple as possible and must never incorporate confusing medical terminology.
	The general sequence of events should be explained to the patient before initiating the intervention.
Questions	The patient should be asked questions before and during the intervention to establish a rapport with the patient and to provide feedback as to the status of the current intervention.
Tone of voice	The PTA should speak clearly in moderate tones and vary his or her tone of voice as required by the situation.
Sensitivity	The PTA should be sensitive to the patient/client's level of understanding and cultural background.

Data from Dreeben O: Introduction to physical therapy for physical therapist assistants. Sudbury, MA, Jones & Bartlett Learning, 2007

Key Point Communication involves interacting with the patient using terms he or she can understand.

Communication between clinician and patient begins when the clinician first meets the patient, and continues throughout any future sessions. The introduction to the patient should be handled at eye level and in a professional yet empathetic tone. Listening with empathy involves understanding the ideas being communicated and the emotion behind the ideas. In essence, empathy is seeing another person's viewpoint, so that a deep and true understanding of what the person is experiencing can be obtained.

Key Point From the patient's point of view, there is no substitute for interest, acceptance, and especially empathy on the part of the clinician.[11]

Patient Assessment, Progression, and Compliance

During the physical therapy visits, the PTA and the patient work together to alter the patient's perception of their functional capabilities. Discussions about intervention goals must continue throughout the rehabilitative process and must be mutually acceptable. Open-ended questions or statements, such as "Tell me how you are feeling today," are used initially to encourage the patient to provide narrative information and to decrease the opportunity for bias on the part of the clinician.[10] More specific questions, such as "How would you rate pain today on a scale of 0 to 10?" are asked as the session proceeds. The specific questions help to obtain specific responses and deter irrelevant information. The clinician should provide the patient with encouraging responses, such as a nod of the head, when the information is relevant and when needed to steer the patient into supplying necessary information. *Neutral* questions should be used whenever possible. These questions are structured to avoid leading the patient into giving a particular response. Avoid leading questions, such as "Does it hurt more when you walk?" A more neutral question would be, "What activities make your symptoms worse?" It is also important to use statements that summarize the data that have been collected; for example, "Would I be right in saying that your neck only hurts when you turn your head to the right?" Summarizing the patient's information helps clarify the purpose of the intervention, while increasing patient involvement.

Misjudgments are sometimes made with the intervention. In general, the patient's pain should not last more than a couple of hours after an intervention. Pain that lasts longer than 2 hours is usually an indication that the intensity of the intervention, rather than the intervention itself, has been inappropriate. However, remember that therapeutic exercise has the potential to cause pain, discomfort, and soreness that can last 24–48 hours after exercise.

Key Point The PTA has to remove the patient's notion that all pain is bad. In many respects, a slight increase in pain following an intervention is a more desirable finding than no change in pain, because it indicates that the correct structure is being stressed, albeit too aggressively.

Motivation and Compliance

Many factors can contribute to the patient's resistance to improvement. In some cases, it may be an individual factor that, when eliminated, will allow the patient to respond well. In the majority of cases, the resistance to improvement is based on the interaction of multiple factors, which must be recognized and corrected. Patient motivation and compliance are paramount in the rehabilitation program.

Motivation

Anecdotally, unmotivated patients may progress more slowly. Much literature has conceptualized or reported poor motivation in rehabilitation as secondary to patient-related factors, including depression, apathy, cognitive impairment, low self-efficacy (e.g., low confidence in one's ability to successfully rehabilitate), fatigue, and personality factors.[20]

Compliance

Compliance is vitally important and varies from patient to patient. Several factors have been outlined to improve compliance, among them:[21–23]

- Involving the patient in the intervention planning and goal setting
- Setting realistic short- and long-term goals
- Promoting high expectations regarding final outcome
- Promoting perceived benefits
- Projecting a positive attitude
- Providing clear instructions and demonstrations with appropriate feedback
- Keeping the exercises pain-free or with a low level of pain
- Encouraging patient problem solving

Key Point Various studies have found that compliance with physical therapy programs is approximately 40 percent.[24]

Patient Education

Patient/client-related instruction forms the cornerstone of every intervention and plan of care (**Table 1-9**). It is imperative that the PTA spend time educating the patient about his or her condition, so the patient can fully understand the importance of his or her role in the rehabilitation process and become an educated consumer. Educating the patient about strategies to adopt in order to prevent recurrences, and to

TABLE 1-9 The Role of the PTA in Patient Education

Education
Standard 3.3.2.19. Under the direction and supervision of the physical therapist, instructs other members of the health care team using established techniques, programs, and instructional materials commensurate with the learning characteristics of the audience
Standard 3.3.2.20. Educates others about the role of the physical therapist assistant

Data from Accreditation Handbook: PTA Criteria, Appendix A-3.

self-manage his or her condition, is also very important to ensure an interactive environment. The aim of patient education is to create independence, not dependence, and to foster an atmosphere of learning in the clinic. A detailed explanation should be given to the patient in a language that he or she can understand. This explanation should include the following:

- *The name of the structure(s) involved, and the cause of the problem:* Whenever possible, an illustration or model of the involved structure should be shown to the patient to explain principles in layperson's terms.
- *Information about the interventions that are planned, and the PT's prognosis for the problem:* An estimation of healing time is useful for the patient, so he or she does not become frustrated at a perceived lack of progress.
- *What the patient can and cannot do:* This includes the allowed use of the joint or area, and a brief description about the relevant stage of healing and the vulnerability of the various structures during the pertinent healing phase. This information makes the patient aware and more cautious when performing activities of daily living (ADLs), recreational activities, and the home exercise program. Emphasis should be placed on dispelling the myth of "no pain, no gain." Patients should be encouraged to respect pain. Also, patients often have misconceptions about when to use heat and ice, and it is the role of the clinician to clarify such issues.
- *Home exercise program:* Before instructing a patient on his or her home exercise program (HEP), the PTA should take into consideration the time that will be needed to perform the program. In addition, the level of tolerance and motivation for exercise varies among individuals, and is based on their diagnosis and stage of healing. A short series of exercises, performed more frequently during the day, should be prescribed for patients with poor endurance or when the emphasis is functional re-education. Longer programs, performed less frequently, are aimed at building strength or endurance. Each HEP needs to be individualized to meet the patient's specific needs. The patient's HEP should start on the first day of intervention and continue through and beyond the day of discontinuation of physical therapy. At the earliest opportunity, the patient must be educated about the signs and symptoms that warrant discontinuation of an exercise and when the PT or physician should be contacted (see Section II: Therapeutic Exercise). The HEP must be modified continuously and updated and follow the guidelines in **Table 1-10**. Any prescribed exercise should be simple and instructions should include the frequency, number of repetitions, number of sets, how long to hold, the amount of exercise resistance, and the position for performing the exercise. Whenever possible, pictures of the exercises should be provided to maximize carryover.

Key Point Educational materials need to be written in plain language, consistently using the same words. Sentences should be short and simple, with each item preceded by a bullet point. Instructions should be taught one step at a time using appropriate demonstrations and descriptions.

There are probably as many ways to teach as there are to learn. The PTA needs to be aware that people may have very different preferences for how, when,

TABLE 1-10 Basic Requirements for the Home Exercise Program (HEP)

The HEP should be organized, concise, and written in layperson's terms (fifth or sixth grade reading level) using a font size of 12 points or larger.
The HEP should represent an extension of the interventions.
The HEP should include uncomplicated diagrams or pictures.

Data from Dreeben O: Introduction to physical therapy for physical therapist assistants. Sudbury, MA, Jones & Bartlett Learning, 2007

where, and how often to learn. It is not within the scope of this text to discuss all of the theories on learning, but an overview of the major concepts is merited. Litzinger and Osif[25] organized individuals into four main types of learners, based on instructional strategies:

1. *Accommodators:* This type of learner relies heavily on other people for information rather than on their own analytic ability, often enjoy being active participants in their learning, and will ask many questions, such as, "What if?" and "Why not?" For example, when instructing such a patient about the precautions following a total hip replacement (see Chapter 19), the patient may ask why they are being told not to place any weight through the involved hip.
2. *Divergers:* This type is motivated to discover the relevancy of a given situation and prefers to have information presented in a detailed, systematic, and reasoned manner. For example, this type of learner prefers to have the information provided in a sequential fashion with the rationale for each stage.
3. *Assimilators:* This type is motivated to answer the question, "What is there to know?" These learners like accurate, organized delivery of information, and they tend to respect the knowledge of the expert. They are perhaps less instructor-intensive than some other types of learners and will carefully follow prescribed exercises, provided a resource person is clearly available and able to answer questions. For example, this type would respond well to clear verbal and written instructions, the rationale behind the exercises, and specific details as to how often the exercises should be performed.
4. *Convergers:* This type of learner can make decisions and apply practical ideas to solve problems. Generally, these people can organize knowledge by using hypothetical deductive reasoning. The instructions given to this type of learner should be interactive, not passive. For example, this type responds well to being asked to demonstrate an exercise rather than hearing a description.

Another frequently used way of classifying learners describes three common learning styles:

1. *Visual:* As the name suggests, the visual learner assimilates information by observation, using visual cues and information such as pictures, anatomic models, and physical demonstrations.
2. *Auditory:* Auditory learners prefer to learn by having things explained to them verbally.
3. *Tactile:* Tactile learners, who learn through touch and interaction, are the most difficult of the three groups to teach. Close supervision is required with this group until they have demonstrated to the clinician that they can perform the exercises correctly and independently. Proprioceptive neuromuscular facilitation (PNF) techniques, with the emphasis on physical and tactile cues, often work well with this group (see Chapter 6).

A patient's learning style can be identified by asking how he or she prefers to learn. Some patients will prefer a simple handout with pictures and instructions; others will prefer to see the exercises demonstrated, and then be supervised while they perform the exercises. Some may want to know why they are doing the exercises, which muscles are involved, why they are doing three sets of a particular exercise, and so on. Others will require less explanation.

Key Point When educating a patient who has a hearing impairment, the PTA should choose a quiet environment, face the patient, and speak clearly without exaggerating the pronunciation.

If in doubt as to the patient's learning style, it is recommended that each exercise first be demonstrated by the clinician, and then by the patient, both at the end of a session and at the beginning of the next session. The rationale and purpose behind each of the exercises must be given, as well as the frequency and intensity expected.

Key Point The PTA should always consider cultural diversity and pay attention to nonverbal communication such as voice volume, postures, gestures, and eye contact.

It is important that the patient view his or her rehabilitative progression with a healthy respect for pain, combined with the importance of returning to normal levels of function as early as possible. Pain is, unfortunately, a necessary component of the healing process; however, the patient needs to be educated about what constitutes healing pain in comparison to harmful pain (an increase in pain that lasts more than 2–4 hours). Clear instructions must be given to the patient on how to recognize injurious pain and how to avoid additional strain. The frequency and duration of the patient's care need to be addressed with the PT. The common practice is to see patients two to three times per week; however, this is not always necessary,

particularly with well-motivated patients. It is the duty of all clinicians to make the patient's visit meaningful. Clinic visits must include a level of skilled intervention that the patient cannot receive in the home environment. Placing the patient on a hot pack and then having him or her perform a routine rehabilitation program that is not constantly being updated or modified is a waste of the patient's time, and does little to foster public confidence in the profession. Each session must have a purpose. The PTA should attempt to explain any gains or losses the patient has made since the previous session, and the possible reasons. New goals should be discussed, and any changes to the intervention plan, and their rationale, should be discussed with the PT and then the patient.

Documentation

Documentation of the assessment and intervention processes is an important part of any therapeutic regimen. Documentation in health care includes any entry made in the patient/client record. As a record of client care, documentation provides useful information for the clinician, other members of the healthcare team, and third-party payers. The APTA Board of Directors has approved a number of guidelines for physical therapy documentation that are intended to be a foundation for the development of more specific guidelines in specialty areas, while at the same time providing guidance across all practice settings. The APTA's Documentation Guidelines are outlined in Appendix B. In all instances, it is the APTA's position that the physical therapy examination, evaluation, diagnosis, prognosis, and intervention must be documented, dated, and authenticated by the PT or PTA, as appropriate.

The SOAP (Subjective, Objective, Assessment, Plan) note format has traditionally been used to document the examination and intervention process.

- *Subjective:* Information about the condition from patient or family member
- *Objective:* Measurement a clinician obtains during the physical examination
- *Assessment:* Analysis of the problem including the long- and short-term goals
- *Plan:* A specific intervention plan for the identified problem

More recently, the patient/client management format is being used by those clinicians familiar with the *Guide to Physical Therapist Practice*.[8] The patient/client management model described in the *Guide to Physical Therapist Practice* has the following components:

- *History:* Information gathered about the patient's history.
- *Systems review:* Information gathered from performing a brief examination or screening of the patient's major systems addressed by physical therapy. Also includes information gathered about the patient's communication, affect, cognition, learning style, and education needs.
- *Tests and measures:* Results from specific tests and measures performed by the PT.
- *Diagnosis:* Includes a discussion of the relationship of the patient's functional deficits to the patient's impairments and/or disability as determined by the PT as well as a discussion of other healthcare professionals to which the PT has referred the patient or believes the patient should be referred.
- *Prognosis:* Includes the predicted level of improvement that the patient will be able to achieve according to the PT and the predicted amount of time to achieve that level of improvement. The prognosis also should include the PT's professional opinion of the patient's rehabilitation potential.
- *Plan of care:* Includes the expected outcomes (long-term goals), anticipated goals (short-term goals), and interventions, including an education plan for the patient or the patient's caregivers or significant others.

The purposes of documentation are as follows:[8]

- To document what the clinician does to manage the individual patient's case.
- To record examination findings, patient status, intervention provided, and the patient's response to treatment.
- To communicate with all other members of the healthcare team; this helps maintain consistency among the services provided and includes communication between the PT and PTA.
- To provide information to third-party payers, such as Medicare and other insurance companies, who make decisions about reimbursement based on the quality and completeness of the physical therapy note.
- To be used for quality assurance and improvement purposes and for issues such as discharge planning.

Key Point The physical therapy documentation is considered a legal document, and it becomes a part of the patient's medical record.

The PTA reads the initial documentation of the examination, evaluation, diagnosis, prognosis, anticipated outcomes and goals, and intervention plan, and is expected to follow the POC as outlined by the PT in the initial patient note.[8] After the patient has been seen by the PTA for a period of time (the time varies according to the policies of each facility or healthcare system and state law), the PTA must write a progress note documenting any changes in the patient's status that have occurred since the PT's initial note was written.[8] Also, after a discussion with the PT about the diagnosis and prognosis, expected outcomes, anticipated goals, and interventions, the PTA rewrites or responds to the previously written expected outcomes and documents the revised POC accordingly.[8] In many facilities (according to the policies of each facility or healthcare system and state law), the PT then cosigns the PTA's notes, indicating agreement with what is documented.[8]

Key Point Students in PT or PTA programs may document when the record is additionally authenticated by the PT or, when permissible by law, documentation by a PTA student may be authenticated by a PTA.

Abbreviations

Medical abbreviations are used throughout the various disciplines in health care to document client status or progression. To avoid miscommunication, it is important to remember that before using abbreviations the PTA must ensure that they are approved for use by the facility. Appendix C outlines some of the more common abbreviations used by orthopaedic physical therapy professionals.

Patient Confidentiality

In the majority of situations, the patient's written authorization is required for the release of medical information. For example, authorization is required:

- For any member of the patient's family (except where a member of the family has received durable power of attorney for healthcare agencies)
- For the patient's attorney or insurance company
- For the patient's employer (unless a worker's compensation claim is involved)

General Medical Assessment

Although it is the PT's responsibility to perform the initial systems review and evaluation of general health, the PTA must be aware of and continually assess a patient for vital signs, response to care, and medical complications/emergencies. Monitoring of the vital signs can provide the PTA with important information as to the health status of the patient. The four so-called vital signs, which are standard in most medical settings, are temperature, heart rate, blood pressure, and respiratory rate. Pain is considered by many to be the fifth vital sign. Based on a patient's medical history, it may be necessary to take vital signs at every session both before and after treatment.

Temperature

Body temperature is one indication of the metabolic state of an individual; measurements provide information concerning basal metabolic state, possible presence or absence of infection, and metabolic response to exercise.[26] In most individuals there is a diurnal (occurring every day) variation in body temperature of 0.5–2 degrees, with the lowest ebb occurring during sleep. "Normal" adult body temperature is 98.6°F (37°C); however, a temperature in the range of 96.5°–99.4°F (35.8–37.4°C) is not at all uncommon. The normal temperature of infants is 98.2°F (36.8°C). The normal temperature of a child or an adolescent is the same as for adults.

Fever or pyrexia is a temperature exceeding 100°F (37.7°C).[27] At this point, physical therapy should be discontinued. *Hyperpyrexia* refers to extreme elevation of temperature (above 106°F or 41.1°C).[26] *Hypothermia* refers to an abnormally low temperature (below 95°F or 35°C).

Key Point Caution should be used when prescribing exercises for a patient who has a fever. Exercise should not be attempted if the patient has a temperature of 99.5°F (37.5°C) or above due to the increased stresses placed on the cardiopulmonary and immune systems.

It is worth remembering that in adults over 75 years of age and in those who are immune-compromised (e.g., transplant recipients, corticosteroid users, persons with chronic renal insufficiency, anyone taking excessive antipyretic medications), fever response may be blunted or absent.[26] Menstruating women have a well-known temperature pattern that reflects the effects of ovulation, with the temperature dropping slightly

before menstruation and then dropping further 24–36 hours prior to ovulation.[27] Coincident with ovulation, the temperature rises and remains at a somewhat higher level until just before the next menses.

Both the degree of temperature change and its duration are relevant to diagnostic processes when elevated body temperature is evident. Although an increase in localized skin temperature as compared to the normal side is to be expected as part of the inflammatory process following an injury, a systemic increase in temperature, which may be a sign of illness or infection, should be communicated to the PT. The testing of skin temperature can also help the PT to differentiate between a venous and an arterial insufficiency. With venous insufficiency, an increase in skin temperature is usually noted in the area of occlusion, and the area also appears bluish in color. Pitting edema, especially around the ankles, sacrum, and hands, also may be present. However, if pitting edema is present and the skin temperature is normal, the lymphatic system may be at fault. With arterial insufficiency, a decrease in skin temperature is usually noted in the area of occlusion, and the area appears whiter. It is also extremely painful.

It is very important to be able to recognize the signs and symptoms of infection so that the PT and the patient's physician can be notified immediately. An infection may cause redness, warmth, and inflammation around the affected area and the area may become stiff, drain pus, and begin to lose range of motion.

Key Point

Infection and inflammation are not to be confused:

- *Infection:* The harmful colonization of a host by an infecting organism
- *Inflammation:* The complex biological response of vascular tissues to harmful stimuli while initiating the healing process for the tissue (see Chapter 5)

The PTA must always exercise vigilance with proper hygiene techniques, especially with regular hand washing in between patients and the cleaning and disinfection of all treatment areas and equipment as per the policy and procedure of the facility (**Table 1-11**).

Heart Rate

In most people, the pulse is an accurate measure of heart rate. The heart rate or pulse is taken to obtain information about the resting state of the cardiovascular system and the system's response to activity or exercise and recovery.[26] It is also used to assess patency of the specific arteries palpated and the presence of any irregularities in the rhythm.[26]

Key Point

- *Normal resting adult heart rate (HR):* 70 beats per minute (bpm) (range = 60–100); a true resting heart rate should be taken prior to the patient getting out of bed in the morning
- *Bradycardia:* Less than 60 bpm; at <60 bpm, the supervising PT should be informed as the patient may need to be monitored carefully
- *Tachycardia:* More than 100 bpm; at 110 bpm, the supervising PT should be informed and the patient should be monitored carefully
- *Normal infant HR:* 120 bpm (range = 70–170)
- *Normal child HR:* 125 bpm (range = 75–140)
- *Normal adolescent HR:* 85 bpm (range = 50–100)

Respiratory Rate

In adults, the normal chest expansion difference between the resting position and the fully inhaled position is 2–4 cm. (It is greater for females than for males.) As per the PT's instructions, the PTA should compare measurements of both the anterior-posterior diameter and the transverse diameter during rest and at full inhalation.

Key Point

- *Normal adult respiratory rate (RR):* 12–18 breaths/min; at 30 breaths/min the supervising PT should be informed and the patient should be monitored carefully
- *Normal infant RR:* 30–50 breaths/min
- *Normal child RR:* 20–40 breaths/min
- *Normal adolescent RR:* 15–22 breaths/min

Blood Pressure

Blood pressure is a measure of vascular resistance to blood flow.[26] Blood pressure values, measured with a sphygmomanometer, are usually given in millimeters of mercury (mm Hg). The values consist of two parts:

- *Systolic pressure:* The pressure exerted on the brachial artery when the heart is contracting[26]
- *Diastolic pressure:* The pressure exerted on the brachial artery during the relaxation phase of the heart contraction[26]

Key Point

The values for resting blood pressure in adults are:

- *Normal:* Systolic blood pressure <120 mm Hg and diastolic blood pressure <80 mm Hg
- *Prehypertension:* Systolic blood pressure 120–139 mm Hg or diastolic blood pressure 80–90 mm Hg
- *Stage 1 hypertension:* Systolic blood pressure 140–159 mm Hg or diastolic blood pressure 90–99 mm Hg
- *Stage 2 hypertension:* Systolic blood pressure ≥160 mm Hg or diastolic blood pressure ≥100 mm Hg

The normal values for resting blood pressure in children are:

- *Systolic:* Birth to 1 month, 60 to 90 mm Hg; up to 3 years of age, 75 to 130 mm Hg; over 3 years of age, 90 to 140 mm Hg
- *Diastolic:* Birth to 1 month, 30 to 60 mm Hg; up to 3 years of age, 45 to 90 mm Hg; over 3 years of age, 50 to 80 mm Hg

TABLE 1-11 Standard Precautions

Handwashing

1. Wash hands after touching blood, body fluids, secretions, excretions, and contaminated items, whether or not gloves are worn.
2. Wash hands immediately after removing gloves, between patient contacts, and when otherwise indicated to reduce transmission of microorganisms.
3. Wash hands between tasks and procedures on the same patient to prevent cross-contamination of different body sites.
4. Use plain (non-antimicrobial) soap for routine handwashing.
5. An antimicrobial agent or a waterless antiseptic agent may be used for specific circumstances (hyperendemic infections), as defined by infection control.

Patient Care Equipment

1. Handle used patient care equipment soiled with blood, body fluids, secretions, or excretions in a manner that prevents skin and mucous membrane exposures, contamination of clothing, and transfer of microorganisms to other patients or environments.
2. Ensure that all equipment, including but not limited to BP equipment, weights, exercise toys, and dumbbells, is not used for the care of another patient until it has been cleaned and reprocessed appropriately.
3. Ensure that single use items are discarded properly.

Gloves

1. Wear gloves (clean, unsterile gloves are adequate) when touching blood, body fluids, secretions, excretions, and contaminated items; put on clean gloves just before touching mucous membranes and nonintact skin.
2. Change gloves between tasks and procedures on the same patient after contact with materials that may contain high concentrations of microorganisms.
3. Remove gloves promptly after use, before touching uncontaminated items and environmental surfaces, and before going on to another patient; wash hands immediately after glove removal to avoid transfer of microorganisms to other patients or environments.

Environmental Control

1. Follow hospital procedures for the routine care, cleaning and disinfection of environmental surfaces, beds, bed rails, bedside equipment, and other frequently touch surfaces.

Linen

1. Handle, transport, and process used linen soiled with blood, body fluids, secretions, and excretion in a manner that prevents skin and mucous membrane exposures and contamination of clothing, and avoids transfer of microorganisms to other patients or environments.

Adapted from Centers for Disease Control, Hospital Infection Control Practices Advisory Committee: Part II Recommendations for Isolation Precautions in Hospitals. February 1997.

Orthostatic (postural) hypotension is a form of hypotension in which a person's blood pressure drops upon standing up, particularly after resting. The decrease is typically greater than 20/10 mm Hg. The symptoms, which can include dizziness, lightheadedness, nausea, headache, blurred or dimmed vision, generalized (or extremity) numbness/tingling, and fainting, are the consequences of insufficient blood pressure and cerebral perfusion (blood supply to the brain).

Key Point White coat hypertension (WCH), also known as the white coat effect or isolated office hypertension, is the presence of higher BP when measured in the physician's office than at other times.[28–30] Whether WCH is a benign phenomenon or carries increased cardiovascular risk is still not known.

Pain

Concomitant with most soft tissue injuries is pain, inflammation, and edema (see Chapter 5). Pain serves as a protective mechanism, allowing an individual to be aware of a situation's potential for producing tissue damage and to minimize further damage. With the exception of constant pain, the presence of pain should not always be viewed negatively by the clinician. After all, its presence helps to determine the location of the injury, and its behavior aids the clinician in determining the stage of healing and the impact it has on the patient's function; for example, whether the pain is worsening, improving, or unchanging provides information on the effectiveness of an intervention. In addition, a gradual increase in the intensity of the symptoms over time

may indicate to the clinician that the condition is worsening or that the condition is nonmusculoskeletal in nature. If pain is present, the PTA's major focus should be to seek methods to help control it throughout each interaction.

Key Point Remember that the location of symptoms for many musculoskeletal conditions is quite separate from the source, especially in those peripheral joints that are more proximal, such as the shoulder and the hip. The term *referred pain* is used to describe symptoms that have their origin at a site other than where the patient feels the pain. The concept of referred pain is often difficult for patients to understand, so an explanation of referred pain can enable the patient to better understand and answer questions about symptoms they might otherwise have felt irrelevant.

Pain may be constant, variable, or intermittent. Variable pain is pain that is perpetual, but that varies in intensity. Variable pain usually indicates the involvement of both a chemical and a mechanical source.

Myofacial pain syndrome (MPS) often manifests with symptoms suggestive of neurologic disorders, including diffuse pain and tenderness, headache, vertigo, visual disturbances, paresthesias, incoordination, and referred pain that often can be clarified by the musculoskeletal and neurologic examination.[31] MPS is characterized by the presence of myofascial trigger points (MTrPs).[32–36] An MTrP is a hyperirritable location, approximately 2 to 5 cm in diameter,[37] within a taut band of muscle fibers that is painful when compressed and that can give rise to characteristic referred pain, tenderness, and tightness.[38] Some confusion exists as to the difference between trigger points and tender points. Although MTrPs can occur in the same sites as the tender points of fibromyalgia, MTrPs can cause referral of pain in a distinct and characteristic area, remote from the trigger point site, not necessarily in a dermatomal distribution.[32]

The mechanical cause of constant pain is less understood than the chemical causes of pain but is thought to be the result of the deformation of collagen, which compresses or stretches the nociceptive free nerve endings, with the excessive forces being perceived as pain.[39] Thus, specific movements or positions should influence pain of a mechanical nature. Chemical, or inflammatory, pain is more constant and is less affected by movements or positions than mechanical pain. Intermittent pain is unlikely to be caused by a chemical irritant. Usually, this type of pain is caused by prolonged postures, a loose intra-articular body, or an impingement of a musculoskeletal structure.

Key Point Constant pain following an injury continues until the healing process has sufficiently reduced the concentration of noxious irritants.

Unfortunately, the source of the pain is not always easy to identify, because most patients present with both mechanical and chemical pain. It is therefore important that the PTA be able to determine the following:

- Any change in the patient's pain since their last PT visit or examination. If the perception of pain has increased since the last visit, further questioning may be needed to determine whether the increase is due to postexercise muscle soreness rather than deterioration in the patient's condition.
- The response of the pain to any of the interventions, or direction of movement of the involved structure (e.g., does the patient complain of more pain with lumbar flexion or with extension?). Musculoskeletal conditions are typically aggravated with movement and alleviated with rest.
- The nature and pattern of the pain. Because pain is variable in its nature, quality, and location, describing pain is often difficult for the patient.
- The intensity of the pain. One of the simplest methods to quantify the intensity of pain is to use an 11-point (0–10) visual analog scale (VAS). The VAS is a numerically continuous scale that requires the pain level be identified by making a mark on a 100-mm line, or by circling the appropriate number in a 0–10 series.[40] The patient is asked to rate his or her present pain compared with the worst pain ever experienced, with 0 representing no pain, 1 representing minimally perceived pain, and 10 representing pain that requires immediate attention.[41]

Several tools are at the clinician's disposal to help to control pain, inflammation, and edema, including the application of electrotherapeutic and physical modalities, gentle ROM exercises, and graded manual techniques (see Chapter 6 and 7). Most episodes of pain resolve on their own, provided that the condition is not exacerbated through constant re-injury and that the injured tissue is allowed to progress through the natural stages of healing. If this natural progression does not occur, chronic pain can result. The prognosis for chronic pain syndromes is generally poor, and often requires a biopsychosocial approach. In these instances, the PTA may need

to discuss with the PT resources that will aid the patient both physically and emotionally. This can include referrals for counseling, pain control, stress management, and self-help groups.

Key Point

Symptom magnification, an exaggerated subjective response to symptoms in the absence of adequate objective findings, is an increasingly common occurrence in the clinic. The patients who display this type of behavior are a difficult population to deal with. The causes of symptom magnification can be categorized into two main patient types:

1. Patients with a psychosomatic overlay and those whose symptoms have a psychogenic cause
2. Patients who are involved in litigation

In either case, the PTA must inform the PT.

Recognizing a Medical Emergency

It is extremely important that the PTA be able to detect malfunctions of the various systems, often referred to as *red flags*, through observation and receiving subjective complaints. Any of the following should cause immediate concern for the PTA and require consultation with the supervising PT or medical personnel:[42]

- *Fatigue:* Complaints of feeling tired or run down are extremely common and therefore often only become significant if the patient reports that tiredness interferes with the ability to carry out typical daily activities and when the fatigue has lasted for 2–4 weeks or longer. Many serious illnesses can cause fatigue.

Key Point

The signs and symptoms of hyperglycemia (high blood sugar of more than 200 mg/dL) include:

- Fatigue and lethargy
- Blurred vision and dry skin
- Extreme thirst and frequent urination
- Dizziness and increased appetite
- Nausea, vomiting, or abdominal pain

Hyperglycemia can result in ketoacidosis and ultimately a diabetic coma. If hyperglycemia is suspected, the PTA should call for medical assistance, monitor the patient until help arrives, and inform the supervising PT. Ideally, to prevent such occurrences, the patient exercise program should be planned in conjunction with food intake, and insulin should be administered and the patient's glucose levels monitored before exercise.

- *Malaise:* A sense of uneasiness or general discomfort that is often associated with conditions that generate fever.
- *Fever/chills/sweats:* These are signs and symptoms that are most often associated with systemic illnesses such as cancer, infections, hypoglycemia, and connective tissue disorders such as rheumatoid arthritis. To qualify as a red flag, the fever should have some longevity (2 weeks or longer).

Key Point

The signs and symptoms of hypoglycemia (low blood sugar of less than 50 mg/dL) include:

- Sweating, unsteadiness, and weakness
- Increased heart rate and lightheadedness
- Headache, fatigue, and impaired vision
- Clumsiness and tingling sensation in the mouth
- Confusion, pallor, and behavior changes

If the PTA suspects hypoglycemia, the patient should be provided with sugar (half a cup of orange juice, a glass of milk, or four or five candies). The supervising PT should be notified. Ideally, to prevent such occurrences, the patient exercise program should be planned in conjunction with food intake and insulin administration, and the patient's glucose levels should be monitored before exercise.

- *Unexpected weight change:* A sensitive but nonspecific finding that can be a normal physiologic response, but also may be associated with depression, cancer, or gastrointestinal disease.
- *Nausea/vomiting:* Persistent vomiting is an uncommon complaint reported to a physical therapist, because the physician will have already been contacted. However, a low-grade nausea can be caused by systemic illness or an adverse drug reaction.
- *Dizziness/lightheadedness:* Dizziness (vertigo) is a nonspecific neurologic symptom that requires a careful diagnostic workup. A report of vertigo, although potentially problematic, is not a contraindication to the continuation of the examination. Differential diagnosis includes primary central nervous system diseases, vestibular and ocular involvement, and, more rarely, metabolic disorders.[43]

Key Point

Dizziness provoked by head movements or head positions could indicate an inner ear dysfunction. Dizziness provoked by certain cervical motions, particularly extension or rotation, may indicate vertebral artery compromise.

- *Paresthesia/numbness/weakness:* Because motor and sensory axons run in the same nerves, disorders of the peripheral nerves (neuropathies) usually affect both motor and sensory functions. Peripheral neuropathies can manifest as abnormal, frequently unpleasant sensations, which are variously described by the patient as numbness, pins and needles, and tingling.[44] When these sensations occur spontaneously without an external sensory

stimulus, they are called *paresthesias*. Patients with paresthesias typically demonstrate a reduction in the perception of cutaneous and proprioceptive sensations.

- *Change in mentation/cognition:* Can be a manifestation of multiple disorders including delirium, dementia, head injury, stroke, infection, fever, and adverse drug reactions. The clinician notes whether the patient's communication level is age appropriate; whether the patient is oriented to person, place, and time; and whether his or her emotional and behavioral responses appear to be appropriate to his or her circumstances.

Medical Emergency Diagnoses

The PTA may encounter a number of diagnoses that are recognized as medical emergencies. A knowledge of these diagnoses is essential because early recognition of these conditions can have a significant impact on the prognosis.

Compartment Syndrome

Compartment syndromes, caused by compression of nerves and blood vessels within a fascial compartment, can be acute or chronic. Chronic compartment syndromes can occur when muscle hypertrophy causes compression. The acute syndrome occurs when fluid accumulation within a closed osseofascial space (compartment) causes neurovascular compression. For example, an acute compartment syndrome can be caused by the application of a tight bandage or plaster cast; a decrease in arterial flow, as in peripheral vascular disease (PVD); or an increase in venous pressure. A number of recognized acute compartment syndromes exist:

- *Gluteal:* A tense, swollen buttock following a mechanism of severe contusion, such as a fall from a height.[45] The swelling in the buttock can result in necrosis of the gluteal muscles or sciatic neuropathy, or both.
- *Thigh:* A pulsating, expanding swelling of the upper thigh.
- *Forearm (Volkmann's ischemic contracture):* Severe pain of the forearm, exacerbated with passive stretch of the forearm muscles.
- *Anterior aspect of the lower leg:* Tenderness along the proximal half of the lower leg, with swelling and tightness over the anterior compartment.
- *Lateral aspect of the lower leg:* Tenderness along the proximal half of the lower leg, with swelling and tightness over the lateral compartment.
- *Posterior aspect of the lower leg:* Acute calf pain with activity that improves with rest.

Key Point An acute compartment syndrome is a medical emergency and requires immediate consultation with the supervising PT. Clinical findings include:[46]

- A swollen and tense tender compartment
- Severe pain, exacerbated with passive stretch of the surrounding muscles or with exercise
- Sensory deficits in the involved area
- Motor weakness or paralysis
- Absence of related peripheral pulses

The clinical signs of compartment syndrome can be remembered using the mnemonic of the five Ps: pain, paralysis, paresthesia, pallor, and pulses. Pain, especially disproportionate pain, is often the earliest sign, but the loss of normal neurologic sensation is the most reliable sign.[47,48]

Deep Vein Thrombosis

A thrombus, or blood clot, is an obstruction of the venous or arterial system. If a thrombus is located in one of the superficial veins, it is usually self-limiting. Venous thromboembolism is a vascular disease that manifests as deep vein thrombosis (DVT) or pulmonary embolism (PE). A DVT most commonly appears in the lower extremity and is typically classified as being either proximal (affecting the popliteal and thigh veins) or distal (affecting the calf veins). Proximal DVT is the more dangerous form of lower extremity DVT because it is more likely to cause life-threatening PE.

DVT is caused by an alteration in the normal coagulation system. This alteration in the fibrinolytic system, which acts as a system of checks and balances, results in a failure to dissolve the clot. If the clot becomes dislodged, it enters into the circulatory system through which it can travel to become lodged in the lungs (PE), obstructing the pulmonary artery or branches that supply the lungs with blood. If the clot is large and completely blocks a vessel, it can cause sudden death.

Certain patients are at increased risk for DVT:[49–53]

- Strong risk factors include fracture (e.g., pelvis, femur, tibia), hip or knee replacement, major general surgery, major trauma, or spinal cord injury. A recent study indicated that up to 60 percent of patients undergoing total hip replacement surgery may develop a DVT without preventative treatment.[54,55]

- Moderate risk factors include arthroscopic knee surgery, central venous lines, chemotherapy, congestive heart or respiratory failure, hormone replacement therapy, malignancy, oral contraceptive therapy, cerebrovascular accident, pregnancy/postpartum, previous venous thromboembolism, and thrombophilia.
- Weak risk factors include bed rest for more than 3 days, immobility due to sitting (e.g., prolonged air travel), increasing age, laparoscopic surgery, obesity, pregnancy/antepartum, and varicose veins.

Key Point Two-thirds of the fatalities resulting from DVT occur within 30 minutes of the initial symptoms.[56–58] Both DVT and PE can be symptomatic or asymptomatic. Clinical signs of a DVT have traditionally been described as including swelling of the extremity, tenderness or a feeling of cramping of the calf muscles that increases with weight bearing, vascular prominence, elevated temperature in the region of the clot, tachycardia, and inflammation and discoloration or redness of the extremity. However, a purely clinical diagnosis is fraught with a high incidence of false positives and negatives.

The traditional test used to detect a DVT was the Homan's sign—the gentle passive stretching of the ankle into full dorsiflexion. The test is considered positive if the symptoms increase when the ankle is dorsiflexed. However, a positive Homan's sign has been found to be insensitive, nonspecific, and is present in fewer than 30 percent of documented cases of DVT,[58,59] and the performance of the test may increase the risk of producing a PE. The most commonly used method to predict clinical probability, the Wells score, is a clinical prediction rule (Table 1-12).

Prevention is the key with DVT. Methods of prevention may be classified as pharmacologic and nonpharmacologic:

- *Pharmacologic:* Includes anticoagulant drugs such as low-dose Coumadin (warfarin), low molecular weight heparin, adjusted-dose heparin, and heparin-antithrombin III combination; these drugs work by altering the body's normal blood-clotting process
- *Nonpharmacologic:* Attempts to counteract the effects of immobility through early mobilization, calf and foot/ankle exercises, and compression stockings

Edema

Edema is an observable swelling from fluid accumulation in the tissue spaces of the body. The swelling occurs as a result of changes in the local circulation and an inability of the lymphatic system to maintain equilibrium, which causes an accumulation of excess fluid under the skin in the interstitial spaces or compartments within the tissues that are outside of the blood vessels. Edema can be generalized or localized. Generalized edema is diffused over a larger area and most commonly occurs due to a systemic disorder (e.g., congestive heart failure, renal disease); if it occurs in the feet and legs, it is referred to as peripheral edema.

Key Point The more serious reasons for swelling include fracture, tumor, congestive heart failure, compartment syndrome, and deep vein thrombosis.

Injury or trauma to musculoskeletal tissue typically results in localized edema at the site of an injury. In general, the amount of swelling is related

TABLE 1-12 The Wells Score

Criteria	Scoring	Traditional Interpretation	Alternate Interpretation
Clinically suspected DVT	3.0 points	Score >6.0: High probability	Score >4: PE likely; consider diagnostic imaging.
Alternative diagnosis is less likely than PE	3.0 points	Score 2.0 to 6.0: Moderate probability	Score 4 or less: PE unlikely; consider D-dimer to rule out PE.
Tachycardia	1.5 points	Score <2.0: Low probability	
Immobilization/surgery in previous 4 weeks	1.5 points		
History of DVT or PE	1.5 points		
Hemoptysis	1.0 point		
Malignancy (treatment for within 6 months, palliative)	1.0 point		

Data from Wells P, Anderson D, Rodger M, et al: Derivation of a simple clinical model to categorize patients' probability of pulmonary embolism: Increasing the model's utility with the SimpliRED D-dimer. Thromb Haemost 83(3):416-420, 2000

to the severity of the condition. Assessment of edema by a PTA involves measurement of the edematous part or extremity. The measurement can occur in one of two ways:

- *Volumetric measurement:* Involves immersing the limb into a specially designed container of fluid, a volumeter, and measuring the amount of water displaced
- *Tape measurement:* Uses a tape measure to obtain circumferential measurements using recognized landmarks of the involved region (**Table 1-13**).

Petersen et al. performed a study to determine the interrater and intrarater reliability of water volumetry and the figure-of-eight method (shown in Figure 1-1) on subjects with ankle joint swelling, and found high interrater reliability for both the water volumetry (intraclass correlation coefficient [ICC] = 0.99) and the figure-of-eight method (ICC = 0.98). Additionally, intrarater reliability was high (ICCs = 0.98–0.99). The authors concluded that both methods are reliable measures of ankle swelling, although they recommended the figure-of-eight method because of its ease of use, time efficiency, and cost effectiveness. However, water volumetry may be more appropriate when measuring diffuse lower extremity swelling. Edema can also be assessed based on its quality (**Table 1-14**).

Figure 1-1 Figure-of-eight measurement for ankle swelling.

TABLE 1-13 Examples of Common Tape Measurement Methods for Edema

Body Region	Method
Elbow	A circumferential measurement is made 4 inches above the elbow, 2 inches above the elbow, at the elbow (from the cubital fossa around the elbow, crossing the olecranon process), 2 inches below the elbow, and 4 inches below the elbow.
Ankle	Figure-of-eight method: The clinician places a tape measure midway between the tibialis anterior tendon and lateral malleolus. The tape is then drawn medially and is placed just distal to the navicular tuberosity. The tape is then pulled across the arch and just proximal to the fifth metatarsal. The tape is then pulled across the tibialis anterior tendon and around the ankle to a point just distal to the medial malleolus, before being finally pulled across the Achilles tendon and placed just distal to the lateral malleolus and across the start of the tape.

Integumentary Changes

The integumentary system includes the skin, hair, and nails. Changes in the integumentary system may be manifestations of systemic disorders. Cyanosis in the nails, hands, and feet may be a sign of a central dysfunction (advanced lung disease, pulmonary edema, congenital heart disease, or low hemoglobin level) or peripheral dysfunction (pulmonary edema, or venous obstruction).[26] Palpation of the skin in

TABLE 1-14 Quality Descriptors of Edema

Descriptor	Characteristics
Pitting	Formation of a sustained indentation when the swollen area is compressed. Can be quantified using the following scale: 1+ = slight pitting/2 mm, disappears rapidly 2+ = somewhat deeper pit/4 mm, disappears in 10–15 seconds 3+ = deep pit/6 mm, may last >1 minute; dependent extremity is swollen 4+ = very deep pit/8 mm, lasts 2–5 minutes, dependent extremity is grossly distorted
Brawny/ nonpitting	Feels tough, thick, or leathery
Dependent	The fluid shifts in response to gravity. For example, if the patient is lying down, the fluid accumulates on the side of the body in contact with the bed.

general should include assessment of temperature, texture, moistness, mobility, and turgor (degree of fluid loss or dehydration).[26] Skin mobility may be decreased in areas of edema or in scleroderma.

Key Point Skin temperature is best felt over large areas using the back of the clinician's hand.

Viscerogenic Symptoms

Visceral symptoms can be produced by chemical damage, ischemia, or spasm of the smooth muscles. Although not evoked from all viscera, the symptoms are generally described as diffuse and poorly localized and are often accompanied by autonomic reflexes, such as nausea and vomiting. Symptoms arising from problems in the peritoneum, pleura, or pericardium differ from those of other visceral impairments because of the innervation of these structures.

Key Point A visceral source of the symptoms should always be suspected if the symptoms are not altered with movement or position changes.

Palpatory findings of tenderness, gross abnormal masses, or abnormal pulsations are indicative of a broad range of abdominal pathologies, including tumor, obstruction, infection, and abdominal aortic aneurysm.[60] Any of these findings warrant a call to the physician.

Key Point The clinician should always be alert for the presence of cancer. The most common signs and symptoms of cancer include:

- Unexplained weight loss
- Fever
- Constant pain
- Night pain
- Fatigue
- Changes in bowel and/or bladder function
- Unexplained skin changes

Vasculogenic Symptoms

Vasculogenic symptoms tend to result from venous congestion or arterial deprivation to the musculoskeletal areas. Vasculogenic pain may mimic a wide variety of musculoskeletal, neurologic, and arthritic disorders because this type of pain is often worsened by activity.

Key Point Clinical evidence of arterial insufficiency includes lower calf pain with walking, extremity asymmetry, skin condition changes, skin temperature and color changes, and diminishing pulses. Venous insufficiency is characterized by leg aching, swelling, cramping, heaviness, and soreness, which are improved by walking or by elevating the legs.

The term *intermittent claudication* is used to describe activity-related discomfort associated with peripheral artery disease (PAD). Patients suffering from intermittent claudication often experience effort-related cramp in the calves, thighs, and buttocks, which disappears at rest.

Key Point Unlike the pain from spinal stenosis, the pain from PVD is not relieved by trunk flexion or aggravated with sustained trunk extension

Pain may occur at more regular intervals as the disease process continues to its end stage—critical limb ischemia—until finally it occurs when the patient is at rest (rest pain). At this stage, rest pain is usually worse when the legs are elevated and during sleep, with the patient gaining relief by hanging the foot over the side of the bed. The development of nonhealing wounds or gangrene (tissue death) may occur at this stage. Any significant changes in the resting vascular signs and symptoms or during exercise must be reported to the PT or physician. **Table 1-15** outlines the general signs and symptoms that warrant the discontinuation of a physical therapy intervention.

TABLE 1-15 The General Signs and Symptoms that Warrant the Discontinuation of a Physical Therapy Intervention

Temperature	>100°F
Systolic BP	>240 mm Hg
Diastolic BP	>110 mm Hg
Fall in systolic BP	More than 20 mm Hg
Rise in HR	More than 220 – age
Resting HR	More than 130 bpm or less than 40 bpm
Oxygen saturation (the percentage of hemoglobin binding sites in the bloodstream occupied by oxygen)	Less than 90%. At low partial pressures of oxygen, most hemoglobin is deoxygenated. An Sa_{O_2} (arterial oxygen saturation) value below 90% causes hypoxemia.
Blood glucose	More than 250 mg/dL

Data from Dreeben O: Introduction to physical therapy for physical therapist assistants. Sudbury, MA, Jones & Bartlett Learning, 2007

Evidence-Based Practice

Evidence-based practice (EBP) involves the integration of three key elements: best research evidence from systematic research, clinical expertise, and patient values.[61] Judging the strength of the evidence becomes an important part of the decision-making process. One of the major problems in evaluating studies is that the volume of literature makes it difficult for the busy clinician to obtain and analyze all of the evidence necessary. In addition, an understanding of how to appraise the quality of the evidence offered by clinical studies and deciding whether the results from the literature are definite enough to indicate an effect other than chance is important.[62] Judging the strength of the evidence becomes an important part of the decision-making process.

Key Point Clinical prediction rules (CPRs) are tools designed to assist clinicians in decision making when caring for patients. However, although there is a growing trend toward producing more CPRs in the field of physical therapy, few reliable and valid CPRs presently exist.

The efficacy of a test or intervention is determined by clinical trials, that is, prospective studies assessing the effect and value of a test or intervention against a control in human subjects.[63] Unfortunately, many of the experimental studies that deal with physical therapy topics are not clinical trials, because there is no control to judge the efficacy of the test or intervention, and there are no tests or interventions from which to draw comparisons.[64] The best evidence comes from randomized controlled trials, systematic reviews, and evidence-based clinical practice guidelines.[65] The ideal clinical trial includes a blinded, randomized design and a control group. A hierarchy of evidence grading is outlined in **Table 1-16**, with Grade A representing the best evidence. Two terms used in the table, and throughout this text, are:

- *Sensitivity:* This represents the proportion of patients with the target disorder who test positive with the diagnostic test. A test that can correctly identify every person who has the target disorder has a sensitivity of 1.0.
- *Specificity:* This represents the proportion of the study population without the target disorder who test negative.[66] A test that can correctly identify every person who does not have the target disorder has a specificity of 1.0.

Key Point A test with a very high sensitivity but low specificity, and vice versa, is of little value. The acceptable levels for each are generally set at between 50% (unacceptable test) and 100% (perfect test), with an arbitrary cut-off of about 80 percent.[66]

It may be possible to discriminate between high- and low-quality trials by asking three simple questions:[65]

- *Were subjects randomly allocated to conditions?* Random allocation implies that a non-systematic, unpredictable procedure was used to allocate subjects to conditions.
- *Was there blinding of assessors and patients?* Blinding (the people are unaware of which subjects have been assigned to which group) of assessors and patients minimizes the risk of the placebo effect and the "Hawthorne effect," an experimental artifact that is of no clinical utility, where patients report better outcomes than they really experienced because they perceive that this is what is expected from them.[67]
- *Was there adequate follow-up?* Ideally, all subjects who enter the trial should subsequently be followed up to avoid bias. In practice this rarely happens. As a general rule, losses to follow-up of less than 10 percent avoid serious bias, but losses to follow-up of more than 20 percent cause potential for serious bias.

TABLE 1-16 A Hierarchy of Evidence Grading

Level of Evidence Grading = A	Level of Evidence Grading = B	Level of Evidence Grading = C	Level of Evidence Grading = D	Level of Evidence Grading = E
Randomized clinical trial	Cohort study	Nonrandomized trial with concurrent or historical controls Case study Study of the sensitivity and specificity of a diagnostic test Population-based descriptive study	Cross-sectional study Case series Case report	Expert consensus Clinical experience

Laboratory Values

Although PTAs are not involved in the administration or interpretation of laboratory values, an understanding of normal lab values is essential when reviewing medical charts and other documentation. Laboratory tests can be used for screening, diagnosing, and monitoring patient health and disease. A laboratory test result is interpreted using a reference range appropriate for the age and sex of the patient; the range is the interval between and including the lower and upper reference limits. Reference ranges of the more common laboratory values are provided in Appendix D. The traditional reference range for a quantitative test is the range of values of the central 95 percent of the healthy population.[68]

Musculoskeletal Pharmacology

A drug is any substance that can be used to modify a chemical process or processes in the body, for example, to treat an illness, relieve a symptom, enhance performance or an ability, or alter states of mind. Drug therapy (**Table 1-17**) is one of the mainstays of modern treatments, and PTAs often encounter patients who are taking various medications. These medications may be administered to treat preexisting conditions that are not directly related to the condition being treated with physical therapy, but they can nonetheless have an impact on the patient's response to rehabilitation.[69] As PTAs monitor the effects of their interventions, they must also understand the effect and potential interactions of all available and reasonable resources, including

TABLE 1-17 Pharmacology Terms and Definitions

Term	Definition
Pharmacology	The science of studying both the mechanisms and the actions of drugs, usually in animal models of disease, to evaluate their potential therapeutic value
Pharmacy	The mixing and dispensing of drugs The monitoring of drug prescriptions for appropriateness and the monitoring of patients for adverse drug interactions
Pharmacotherapeutics	The use of chemical agents to prevent, diagnose, and cure disease
Pharmacokinetics	The study of how the body absorbs, distributes, metabolizes, and eliminates a drug
Pharmacodynamics	The study of the biochemical and physiologic effects of drugs and their mechanisms of action at the cellular or organ level
Pharmacotherapy	The treatment of a disease or condition with drugs
Pharmacogenetics	The study of how variation in human genes leads to variations in our response to drugs; helps direct therapeutics according to a person's genotype
Toxicology	A study of the negative effects of chemicals on living things, including cells, plants, animals, and humans

TABLE 1-18 Controlled Substances

Schedule	Description
I	These drugs are available only for research. They have a high abuse potential, leading to dependence without any acceptable medical indication. Examples include heroin, LSD, and marijuana.
II	These drugs also have a high abuse potential but also have accepted medical uses. Examples include amphetamines, morphine, and oxycodone.
III	Although these drugs have a lower abuse potential and dosing schedule than I or II, they also may be abused and can result in some physical and psychological dependence. Examples include mild to moderately strong opioids, barbiturates, and steroids.
IV	These drugs have less of an abuse potential. No more than five refills within 6 months are allowed under one prescription. Examples include opioids, benzodiazepines, and some stimulants.
V	These drugs have the lowest abuse potential and often are available without prescription. Examples include various cold and cough medicines containing codeine.

pharmacologic interventions, offered by other members of the healthcare team.

Controlled substances are drugs classified according to their potential for abuse. These drugs are regulated under the Controlled Substances Act, which classifies these compounds into schedules from I to V (**Table 1-18**).[1] A black box warning (also sometimes called a black label warning or boxed warning), named for the black border that usually surrounds the text of the warning, appears on the package insert for prescription drugs that carry a significant risk of serious or even life-threatening adverse effects. The U.S. Food and Drug Administration (FDA) can require a pharmaceutical company to place a black box warning on the labeling of a prescription drug, or in literature describing it. It is the strongest warning that the FDA requires.

Drugs are widely used in the management of infection, both acute and chronic pain, and inflammation. The following discussion emphasizes those drugs that are prescribed to control infection, pain, and/or inflammation.

Key Point In the absence of data supporting a therapeutic benefit, toxicity can be associated with any drug, including herbal supplements.

Antibacterial Drugs

Bacteria are unicellular organisms that consist of a cell wall, sometimes a membrane, DNA without a nuclear envelope, and protoplasm containing metabolites and enzymes. Drugs that affect these microorganisms are called antibacterial or antibiotic drugs and are relatively specific for bacteria only. Most antibacterial drugs have five major sites of action as follows:

1. Inhibition of synthesis and/or damage to the bacterial cell wall
2. Inhibition of synthesis and/or damage to the cytoplasmic membrane
3. Modification of synthesis and/or metabolism of microbial nucleic acids
4. Inhibition or modification of microbial protein synthesis by disrupting ribosomal function
5. Inhibition or modification of microbial cell metabolism

Antibacterials/antibiotics are among the most frequently prescribed medications in modern medicine. Although there are well over 100 antibiotics, the majority come from only a few types of drugs. The main classes of antibiotics are outlined in **Table 1-19**. In orthopaedics, antibiotics are commonly used to treat general bone infections (e.g., osteomyelitis) and joint infections (e.g., septic arthritis), for preoperative surgical prophylaxis, and for fracture management with internal fixation.

Key Point Despite excellent antibiotics and preventative treatments, patients who undergo a joint replacement can develop an infection, which will often require removal of the implanted joint in order to treat the infection effectively.

In general, antibacterial drugs can cause nausea, vomiting, allergic reactions, and superinfections.

Key Point Healthcare professionals have been shown to be a primary source of spreading infections. These are referred to as *nosocomial infections*. Between patients, gloves worn by the PTA should be discarded, hands should be washed with soap for at least 15 to 30 seconds, or disinfective solutions should be used to minimize the spread of infection.

TABLE 1-19 Antibiotics

Type	Action	Examples	Implications for Physical Therapy
Penicillin	Bactericidal agent; acts by inhibiting cell membrane synthesis.	Penicillin and amoxicillin	Advise patients to follow prescription schedule strictly and to continue taking drugs even if clinical signs or symptoms have subsided.
Cephalosporin	Bactericidal agent; mainly used to counter staphylococcal organisms	Cephalexin (Keflex)	Adhere to drug warnings that tetracyclines and quinolones must be taken as prescribed because their use with food or antacids can render them ineffective.
Aminoglycosides	Bactericidal agent; generally effective against aerobic gram-negative bacteria (*Klebsiella, Pseudomonas, Escherichia coli*)		
Macrolide	Bacteriostatic agent; inhibits organism replication and is used to counter organisms such as *Chlamydia, Clostridium, Staphylococcus aureus*, and *Bacteroides*	Erythromycin (E-Mycin), clarithromycin (Biaxin), and azithromycin (Zithromax)	Notify supervising PT if patient exhibits an unexplained rash or abdominal discomfort.
Quinolone	Bacteriostatic agent; broadly effective against all gram-negative rods (e.g., *E. coli*, salmonella, and *Pseudomonas*)	Ciprofloxacin (Cipro), levofloxacin (Levaquin), and ofloxacin (Floxin)	Advise the patient to avoid exposure to sunlight because these drugs can cause photosensitization.
Sulfonamide	Bacteriostatic agent; prescribed for the treatment of certain urinary tract infections but also for other (non-orthopedic-related) infections	Co-trimoxazole (Bactrim) and trimethoprim (Proloprim)	
Tetracycline	Bacteriostatic agent; rarely used in the treatment of orthopedic infections	Tetracycline (Sumycin, Panmycin) and doxycycline (Vibramycin)	

Opioid Analgesics

Most of the narcotics used in medicine are referred to as opioids, because they are derived directly from opium or are synthetic opiates. Examples of these opioids include codeine, Darvon (propoxyphene hydrochloride), morphine, and Demerol (meperidine).

Nonopioid Analgesics

Cyclooxygenase (COX) is an enzyme responsible for the formation of important biological mediators called prostanoids, including prostaglandins, prostacyclin, and thromboxane. Pharmacologic inhibition of COX can provide relief from the symptoms of inflammation and pain. The main COX inhibitors are the nonsteroidal anti-inflammatory drugs (NSAIDs), including Voltaren (diclofenac), Relafen (nabumetone), Naprosyn (naproxen), Motrin (ibuprofen), Indocin (indomethacin), Feldene (piroxicam), Lodine (etodolac), Celebrex (celecoxib), and many others.

Key Point Different tissues express varying levels of COX-1 and COX-2. Although both enzymes act basically in the same fashion, selective inhibition can make a difference in terms of side effects.

The NSAIDs are not selective and inhibit all types of COX. The resulting inhibition of prostaglandin and thromboxane synthesis has the effect of reducing inflammation as well as causing antipyretic, antithrombotic, and analgesic effects. The most frequent adverse effect of this class of medication is an irritation of the gastric mucosa, a direct effect of inhibition of prostaglandin synthesis, which normally has a protective role in the gastrointestinal tract.

Key Point NSAIDs currently are the medication of choice to help control the inflammatory process at initial presentation. It has not been proven that these agents have a specific effect on fibroblast function or on connective tissue healing.[13,70] However, the analgesic effects of the anti-inflammatory medications make it easier to rehabilitate injured structures, as well as the muscles in the surrounding kinematic chain, and can help curb further inflammatory response as patients increase their activity level.[71,72]

NSAIDs also may alter kidney blood flow by interfering with the synthesis of prostaglandins in the kidneys involved in the autoregulation of blood flow and glomerular filtration.[73]

Because COX-2 is usually specific to inflamed tissue, there is much less gastric irritation associated with COX-2 inhibitors, with a decreased risk of peptic ulceration. (Currently the only COX-2 inhibitor available in the United States is celecoxib [Celebrex].) The selectivity of COX-2 does not seem to negate other side effects of NSAIDs, most notably an increased risk of renal failure, and there is evidence that indicates an increase in the risk for heart attack, thrombosis, and stroke through an increase of thromboxane unbalanced by prostacyclin (which is reduced by COX-2 inhibition).

Key Point Acetaminophen (paracetamol) is not an NSAID and acts via different mechanisms. Although acetaminophen has the analgesic and antipyretic properties of the NSAIDs, it lacks the anti-inflammatory or antithrombotic properties. An example of acetaminophen is Tylenol.

Acetaminophen is broken down in the body by the liver, unlike NSAIDs, which are removed via the kidneys and have very different side effects.

Corticosteroids

Corticosteroids are natural anti-inflammatory hormones produced by the adrenal glands under the control of the hypothalamus. An injection of corticosteroids can be used to decrease pain at the site of inflammation, at least temporarily.

Key Point Leadbetter[74] reviewed the literature on the use of injections of corticosteroids to treat sports-related injuries. He concluded that such intervention should remain a form of adjunctive therapy and not the sole means of intervention.

Synthetic corticosteroids (cortisone, dexamethasone) are commonly used to treat a wide range of immunological and inflammatory musculoskeletal conditions. Corticosteroids exert their anti-inflammatory effects by binding to a high-affinity intracellular cytoplasmic receptor present in all human cells.[75] As a result, these agents are capable of producing undesirable and sometimes severe systemic adverse effects that may offset clinical gains in many patients. The side effects from corticosteroids emulate those from exogenous hypercortisolism, which is similar to the clinical syndrome of Cushing's disease. These side effects include:[76]

- *Cutaneous manifestations:* Cutaneous manifestations of hypercortisolism include delayed wound healing, acanthosis nigricans (a velvety, thickened, hyperpigmented plaque that usually occurs on the neck or in the axillary region), acne, ecchymoses after minor trauma, hyperpigmentation, hirsutism, petechia, and striae.
- *Hypokalemia:* Hypokalemia is a well-recognized side effect of corticosteroid therapy and is probably related to the mineralocorticoid effect of hydrocortisone, prednisone, and prednisolone. Dexamethasone has no mineralocorticoid effect.
- *Myopathy:* There are two recognized forms of corticosteroid-induced myopathy: acute and chronic. Acute myopathy may in part be caused by hypokalemia, although corticosteroids (especially massive dosages) may have a direct effect on skeletal muscle. Both proximal and distal muscle weakness occur acutely, usually with an associated and significant elevation in serum creatinine phosphokinase, which is indicative of focal and diffuse muscle necrosis. In the more chronic form of myopathy, weakness is more insidious in onset and primarily involves proximal muscle groups.
- *Hyperglycemia:* Although it is not clear how corticosteroid use causes it, hyperglycemia, especially when combined with the immunosuppressive effect of corticosteroids, may significantly increase the risk for infection.
- *Neurological impairments:* These can include vertigo, headache, convulsions, and benign intracranial hypertension.
- *Osteoporosis:* Corticosteroids inhibit bone formation directly via inhibition of osteoblast differentiation and type I collagen synthesis and indirectly by inhibition of calcium absorption and enhancement of urinary calcium excretion.
- *Ophthalmologic side effects:* Corticosteroids increase the risk of glaucoma by increasing intraocular pressure, regardless of whether administered intranasally, topically, periocularly, or systemically.

- *Growth suppression:* Corticosteroids interfere with bone formation, nitrogen retention, and collagen formation, all of which are necessary for anabolism and growth.

Key Point Both iontophoresis and phonophoresis can be used to deliver corticosteroids, without the potential for systemic effects.

Key Point Pain medications and nonsteroidal anti-inflammatory drugs including corticosteroids can mask signs and symptoms, thereby affecting examination findings and increasing the potential for injury during the performance of prescribed exercises.[77] However, if the patient has a significant amount of pain, appropriate use of these medications may enhance treatment, allowing a more rapid progression than would otherwise be possible. However, as the patient improves, the need for this medication should lessen.

Muscle Relaxants

Muscle relaxants, such as Robaxin and Soma, are thought to decrease muscle tone without impairment in motor function by acting centrally to depress polysynaptic reflexes. Because muscle guarding and spasm accompanies many musculoskeletal injuries, it was originally thought that these drugs, by eliminating the spasm and guarding, would facilitate the progression of a rehabilitation program. However, other drugs with sedative properties, such as barbiturates, also depress polysynaptic reflexes, making it difficult to assess if centrally acting skeletal muscle relaxants actually are muscle relaxants as opposed to nonspecific sedatives.[78]

A description of most common drugs, their indications, and their implications to physical therapy is provided in **Table 1-20**.

TABLE 1-20 The Most Common Drugs, Their Indications, Mechanism of Action, and Implications to Physical Therapy

Drug	Indications	Mechanism of Action	Implications
ACE inhibitors	Hypertension Congestive heart failure Diabetic nephropathy Migraine headaches	Inhibit ACE (angiotensin-converting enzyme), which causes less stimulation of angiotensin receptors, blood vessel dilation, and a fall in blood pressure	Advise patients to change positions and get up slowly because orthostatic hypotension may occur. Notify the physician if the patient complains of a sore throat (early warning sign of agranulocytosis).
α agonists	Nasal congestion Allergic conditions Bronchoconstriction	Stimulate α agonist receptors resulting in constriction of blood vessels (with increased peripheral resistance and increased blood pressure), and prevent urinary outflow	Some of these drugs are available OTC, and patients often assume that OTC drugs are safe. Advise older men that use of OTC α agonists can lead to urinary hesitancy or even retention in the presence of benign prostatic hyperplasia. Inquire about the use of OTC medications that contain α agonists if you notice that blood pressure has increased in a patient.
α blockers	Hypertension Benign prostatic hyperplasia	Block α agonist receptors resulting in dilation of blood vessels (with decreased peripheral resistance and decreased blood pressure), and increased urinary outflow	Advise patients to change positions and get up slowly because orthostatic hypotension may occur. Monitor patients after strenuous exercise because of risk of hypotensive episode.
Antiarrhythmic drugs	Arrhythmias/dysrhythmias	These drugs can affect the movement of electrical and muscular activity of the heart. There are four major classes: • Sodium channel blockers • β blockers • Drugs that slow the efflux of potassium • Calcium channel blockers	Advise patients to strictly adhere to the prescribed dosing, and avoid caffeine. Monitor patients for peripheral edema or dyspnea. Advise patients to change positions and get up slowly because orthostatic hypotension may occur.

(*continued*)

TABLE 1-20 The Most Common Drugs, Their Indications, Mechanism of Action, and Implications to Physical Therapy (continued)

Drug	Indications	Mechanism of Action	Implications
Anticholinergics	Arrhythmias Peptic ulcer and irritable bowel syndrome Urinary bladder hypermotility Asthma Parkinson's disease	Inhibit muscarinic (M) cholinergic receptors, thereby reducing the action of acetylcholine resulting in increased heart rate and contractility, dilation of bronchial muscles, and decreased gut and bladder activity	Expect some increases in heart rate in all patients, and some mental confusion in older patients. Keep the exercise environment cool because these patients have a decreased ability to sweat and lose heat.
β blockers	Angina pectoris Hypertension Arrhythmias	Bronchial constriction, blood vessel constriction, decreased heart rate, and decreased systolic blood pressure	When exercising a patient, be aware that because the heart rate will be reduced by the drug, the use of target heart rate needs to be altered accordingly.
Corticosteroids	Inflammation Adrenocortical insufficiency	Multiple metabolic effects on glucose, carbohydrate, and lipid metabolism as well as on inflammatory processes	Observe standard precautions with patients on long-term, high-dose steroid therapy due to the likelihood of a weakened immune system. Be aware of the association between osteoporosis and long-term, high-dose steroid therapy. Be aware that steroid injections can weaken ligaments and tendons. Monitor blood pressure in these patients because hypertension can be a side effect.
Nonsteroidal anti-inflammatory drugs (NSAIDs)	General inflammation Dysmenorrhea Fever Ocular inflammation	See text	Advise the patient that these drugs must be used with caution. NSAIDs may mask pain during exercises. Notify supervising PT if the patient complains about stomach problems, upper respiratory infection, muscle aching, a rash with blisters, or any indications of dermatitis.
Opioid analgesics	Moderate to severe pain Therapy for opioid dependence and withdrawal	Stimulation of opioid receptors in the CNS, which can prevent pain impulses from reaching their final destination	Analgesics may mask pain during exercises. Monitor patients for drowsiness and respiratory depression. Advise patients to change positions and get up slowly because orthostatic hypotension may occur.
Skeletal muscle relaxants	Spasticity Spasm Malignant hyperthermia/tetanus/seizures/neuralgia/cosmetic purposes (Botox)	Enhance the action of the inhibitory GABA system and reduce muscle tone Suppress polysynaptic reflex activity Suppress calcium release from the sarcoplasmic reticulum in skeletal muscles	Monitor patients who have previously used extensor spasticity to maintain balance. Monitor all patients when walking or getting up because drowsiness and muscle weakness can cause falls.

Data from Vogel W: Introduction to pharmacology, in Sueki D, Brechter J (eds): Orthopedic Rehabilitation Clinical Advisor. St Louis, MO, Mosby, 2010, pp 873–922

Imaging Studies

For healthcare professionals involved in the primary management of neuromusculoskeletal disorders, diagnostic imaging is an essential tool. The availability of diagnostic images varies greatly depending on the practice setting. Although the interpretation of diagnostic images is always the responsibility of the radiologist, it is important for the clinician to know what importance to attach to these reports, and the strengths and weaknesses of the various techniques that image bone and soft tissues, such as muscle, fat, tendon, cartilage, and ligament. In general, imaging tests have a high sensitivity (few false negatives) but low specificity (high false-positive rate), so they are not used in isolation.

Conventional (Plain Film) Radiography

Tissues of greater density allow less penetration of the x-rays and therefore appear lighter on the film. The following structures are listed in order of descending density: metal, bone, soft tissue, water or body fluid, fat, and air. Metal structures (total joint components) are denser than bone and therefore appear as the lightest structures. In contrast, because air is the least dense material in the body, it absorbs the least amount of x-ray particles, thereby appearing as the darkest structure on the film. When studying radiographs, a systematic approach such as the mnemonic ABCS is recommended:[79]

- *A: Architecture or alignment.* The entire radiograph is scanned from top to bottom, side to side, and in each corner to check for the normal shape and alignment of each bone. The outline of each bone should be smooth and continuous. Breaks in continuity usually represent fractures. Malalignments may indicate subluxations or dislocations, or in the case of the spine, scoliosis. Malalignment in a setting of trauma must be considered traumatic rather than degenerative until proven otherwise.[80]
- *B: Bone density.* The clinician should assess both general bone density and local bone density. The cortex of the bone should appear denser than the remainder of the bone. Subchondral bone becomes sclerosed in the presence of stress in accordance with Wolff's law[81] (see Chapter 5) and increases its density. This is a radiographic hallmark of osteoarthritis.
- *C: Cartilage spaces.* Each joint should have a well-preserved joint space between the articulating surfaces. A decreased joint space typically indicates that the articular cartilage is thinned from a degenerative process such as osteoarthritis.
- *S: Soft tissue evaluation.* Trauma to soft tissues produces abnormal images resulting from effusion, bleeding, and distension.

Arthrography

Arthrography is the study of structures within an encapsulated joint using a contrast medium with or without air that is injected into the joint space. The contrast medium distends the joint capsule. This type of radiograph is called an *arthrogram*. An arthrogram outlines the soft tissue structures of a joint that would otherwise not be visible with a plain-film radiograph. This procedure is commonly performed on patients with injuries involving the shoulder or the knee.

Myelography

Myelography is the radiographic study of the spinal cord, nerve roots, dura mater, and spinal canal. The contrast medium is injected into the subarachnoid space, and a radiograph is taken. This type of radiograph is called a *myelogram*. Myelography is used frequently to diagnose intervertebral disk herniations, spinal cord compression, stenosis, nerve root injury, or tumors. The nerve root and its sleeve can be observed clearly on direct myelograms.

Diskography

Diskography is the radiographic study of the intervertebral disk. A radiopaque dye is injected into the disk space between two vertebrae. A radiograph is then taken. This type of radiograph is called a *diskogram*. An abnormal dye pattern between the intervertebral disks indicates a rupture of the disk.

Angiography

Angiography is the radiographic study of the vascular system. A water-soluble radiopaque dye is injected either intra-arterially (arteriogram) or intravenously (venogram). A rapid series of radiographs is then taken to follow the course of the contrast medium as it travels through the blood vessels. Angiography is used to help detect injury to or partial blockage of blood vessels.

Computed Tomography

A CT scanner system, also known as computerized axial tomography (CAT) and computerized transaxial tomography (CT), consists of a scanning gantry that holds the x-ray tube and detectors (moving parts), a moving table or couch for the patient, an x-ray generator, a computer processing unit, and a display

console or workstation.[82] Images are obtained in the transverse (axial) plane of the patient's body by rotating the x-ray tube 360 degrees. The x-rays are absorbed in part by the patient's body. The amount of x-rays transmitted through the body is detected in the opposite side of the gantry by an array of detectors. The quality of the image is dependent on variables selected by the operator. Two parameters are used to determine image quality:[82]

- *Spatial resolution:* The ability of the system to distinguish between two closely spaced objects.
- *Contrast resolution:* The ability of the system to discriminate between two adjacent areas. The contrast resolution of CT is dramatically better than conventional radiography, providing the operator with greater soft tissue detail compared with plain films.[80]

As with plain radiographs, air appears as the darkest portion of the film, and bone appears white.

CT Myelogram (CTM)

CTM is a diagnostic tool that uses radiographic contrast media (dye) that is injected into the subarachnoid space (cerebrospinal fluid, CSF). After the dye is injected, the contrast medium serves to illuminate the spinal canal, cord, and nerve roots during imaging. The low viscosity of the water-soluble contrast permits filling of the nerve roots and better visualization.[80]

Magnetic Resonance Imaging (MRI)

Unlike CT, which depends upon multiple thin slices of radiation that are "backplotted" through Fourier transformers, MRI is the result of the interaction among magnetic fields, radiofrequency (RF) waves, and complex image reconstruction techniques. Normally, the axes of protons in the body have a random orientation. However, if the body or body part is placed within a high magnetic field, the protons align themselves parallel with or perpendicular to the direction of the magnetic field. The protons, now spinning synchronously at an angle within the magnetic field, induce a current in a nearby transmitter-receiver coil or antenna. This small nuclear signal is then recorded, amplified, measured, and localized (linked to the exact location in the body where the MRI signal is coming from), producing a high contrast, clinically useful MR image.

Radionucleotide Scanning

Radionucleotide scanning involves the introduction of bone-seeking isotopes that are administered to the patient orally or intravenously and allowed to localize to the skeleton. The photon energy emitted by the isotopes is then recorded using a gamma camera 2–4 hours later. The pathophysiologic basis of the technique is complex but depends on localized differences in blood flow, capillary permeability, and metabolic activity that accompany any injury, infection, repair process, or growth of bone tissue.[83] The most common radionuclide scanning test is the bone scan. This test is used to detect particular areas of abnormal metabolic activity within a bone. The abnormality shows up as a so-called hot spot, which is darker in appearance than normal tissue.

Summary

The role of the PTA in the orthopaedic setting continues to evolve, and the responsibilities placed on the PTA continue to increase. With this increased responsibility comes the need to be fully prepared by having a sound knowledge base from which to work from. However, what has not changed is the importance of communication among the PTA, the PT, the patient, and other members of the healthcare team.

REVIEW Questions

1. A PT asks you to perform a joint mobilization. Whether you can perform the mobilization depends upon:
   - **a.** Ethical principles
   - **b.** State licensure laws
   - **c.** Departmental procedures
   - **d.** Whether the patient has medical insurance
2. What was developed to "encourage a uniform approach to physical therapist practice and to explain to the world the nature of that practice"?
   - **a.** State licensure laws
   - **b.** *Guide to Physical Therapist Practice*
   - **c.** National Physical Therapy Examination
   - **d.** Medicare Act of 1973
3. What is the function of the Commission on Accreditation in Physical Therapy Education (CAPTE)?
   - **a.** To design policies and procedures with regard to physical therapy
   - **b.** To make autonomous decisions concerning the accreditation status of continuing

education programs for physical therapists and physical therapist assistants
   c. To design questions for the National Physical Therapy Examination
   d. To oversee state licensing laws

4. A loss or abnormality of anatomic, physiologic, or psychologic structure or function is a description of which category of the disablement model?
   a. Impairment
   b. Functional limitation
   c. Disability
   d. None of the above

5. Which element of patient/client management includes gathering information from the chart, other caregivers, the patient, the patient's family, caregiver, and friends in order to identify and define the patient's problem(s)?
   a. Evaluation
   b. Intervention
   c. Examination
   d. Tests and measures

6. Which component of the examination includes an analysis of posture, structural alignment or deformity, scars, crepitus, color changes, swelling, and muscle atrophy?
   a. Palpation
   b. Observation
   c. Patient history
   d. None of the above

7. Which of the elements of patient/client management attempts to identify a relationship between the symptoms reported and the signs of disturbed function?
   a. Tests and measures
   b. Patient history
   c. Examination
   d. None of the above

8. Which of the elements of patient/client management determines the predicted level of function that the patient will attain and identifies the barriers that may impact the achievement of optimal improvement—age, medication(s), socioeconomic status, comorbidities, cognitive status, nutrition, social support, and environment—within a certain time frame?
   a. Evaluation
   b. Examination
   c. Prognosis
   d. Diagnosis

9. Which of the following statements is true about the plan of care?
   a. It is based on the examination, evaluation, diagnosis, and prognosis, including the predicted level of optimal improvement.
   b. It describes the specific interventions to be used, and the proposed frequency and duration of the interventions that are required to reach the anticipated goals and expected outcomes.
   c. It includes plans for discharge of the patient/client, taking into consideration achievement of anticipated goals and expected outcomes, and provides for appropriate follow-up or referral.
   d. All of the above.

10. Which of the elements of patient/client management can be defined as "the purposeful and skilled interaction of the PTA and the patient/client and, when appropriate, other individuals involved in the patient/client care, using various physical therapy procedures and techniques to produce changes in the condition consistent with the diagnosis and prognosis."
   a. Examination
   b. Prognosis
   c. Intervention
   d. Evaluation

11. What are the four components of the traditional SOAP note?

12. True or false: Correction fluid/tape can be used to correct text when documenting in medical records.

13. True or false: A PTA may modify an intervention only in accordance with changes in patient status and within the established plan of care developed by the physical therapist.

14. Which of the following duties cannot be performed legally by a physical therapist assistant?
   a. Call a physician about a patient's status
   b. Add 3 pounds to a patient's current exercise protocol
   c. Allow a patient to increase in frequency from 2 times a week to 3 times a week
   d. Perform an ultrasound on a patient

15. A PTA is performing a chart review and discovers that lab results reveal that the patient has malignant cancer. When later treating the patient, the PTA is asked by the patient, "Did

my lab results come back?" The appropriate response for the physical therapist assistant is:
   a. To inform the patient about the results and contact the social worker to assist in consultation of the family
   b. To inform the patient that it would be inappropriate for you to comment on the lab results before the physician has assessed the lab results and spoken to the patient
   c. To inform the patient that he or she has a malignant cancer
   d. To tell the patient the results are in, but that PTAs are not allowed to comment on the results

16. You are completing documentation using a SOAP note. Where should "The patient reports wanting to return to playing soccer in 5 weeks" be placed in a SOAP note?
   a. Subjective
   b. Objective
   c. Assessment
   d. Plan

17. A physical therapist assistant checks the vital signs of a 40 year-old patient who has a history of cardiac disease. The heart rate is steady at 65 beats per minute; respiratory rate is 8 breaths per minute; blood pressure is 120/72 mm Hg; and the oral temperature is 98.6°F. The vital sign that presents the most concern at this time is the patient's:
   a. Respiratory rate
   b. Heart rate
   c. Blood pressure
   d. Temperature

18. A patient with hepatitis B receives a bleeding skin tear on the right forearm during a treatment session. To prevent transmission of the disease while cleaning up, the physical therapist assistant should:
   a. Wear disposable gloves
   b. Wash both hands before and after cleaning up
   c. Wipe up the blood with gauze and dispose in a trash container
   d. Wear a mask with a splash guard

19. You are working with a patient who begins to exhibit signs and symptoms of unresponsiveness. You should:
   a. Activate emergency protocols and check for vital signs
   b. Sit the patient down and monitor blood pressure and pulse rate
   c. Administer chest compressions
   d. Allow the patient to rest, then resume exercise activities at a lighter pace

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