CHAPTER 1

Therapeutic Exercise: Foundational Concepts

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Health-care consumers typically seek out or are referred to physical therapy because of physical impairments associated with movement performance caused by injury, disease, or health conditions that restrict their ability to participate in activities that are necessary or important to them. A therapeutic exercise program is almost always an appropriate intervention for individuals with movement dysfunctions. The ultimate goal of designing an individualized therapeutic exercise program is to remediate or prevent impairments of body functions and structures, enhance activities and participation, reduce risk, optimize overall health, and improve fitness and well-being.[5]

A *patient* is an individual with impairments and functional deficits that result in diminished movement performance who is receiving physical therapy services to improve function and prevent disability. A *client* is an individual, business, school, or other organization who seeks the physical therapist's expertise for consultation, advice, fitness, wellness, or prevention services.[5] Because the main focus of this textbook is on the management of individuals with movement system deficits, the authors have chosen to use the term "patient," rather than "client" or "patient/client," throughout this text.

The purpose of this foundational chapter is to present an overview of the scope of therapeutic exercise interventions used in physical therapy practice. This chapter also explores the evolution of several models of disability and the language used to classify disability, health, and function. A physical therapist must understand the interrelationship between health, disability, and physical function to provide effective patient care. A comprehensive approach to patient management is discussed as a means to guide the practitioner in the development and implementation of therapeutic exercise programs from initial examination to discharge. The chapter concludes with a discussion of methods and strategies for teaching and progressing exercises and functional motor skills based on principles of motor learning.

Therapeutic Exercise: Influence on Physical Function

Of the many procedures used by physical therapists in the continuum of care, therapeutic exercise takes its place at the center of programs designed to improve or restore an

individual's participation in meaningful activities.[5,126] All individuals receiving physical therapy services should be active participants in the rehabilitation process, from initial assessment to discharge, and should learn to self-manage their health needs. Movement and physical activity have been repeatedly shown to be related to lifestyle; and routine exercise contributes to both overall health and functional movement.[36,51,150] The beneficial effects of therapeutic exercise for individuals with a wide variety of health conditions and related physical impairments are documented extensively in the scientific literature.[36,130,132,173]

The Human Movement System

When the American Physical Therapy Association (APTA) adopted the 2013 vision statement, the human movement system became the focus for achieving universal identification of the physical therapy profession. The vision statement is compelling and clearly speaks to human movement and the role of physical therapy: "Transforming society by optimizing movement to improve the human experience."[8] The challenge undertaken by the profession was to define human movement *as a system* and to integrate the concepts of that system into research, education, and practice.[9,150] The intent is to create a professional identity for physical therapy providers as movement system experts in the minds of the public, clients, patients, and legislators.[152]

The role of physical therapists has evolved over the past century from providing technical care to becoming primary caregivers. Historically, physical therapists have been identified by what they do, rather than what they know as professionals. The profession of physical therapy was recognized as an essential service in the health-care environment under the Affordable Care Act of 2014, but the unique expertise of physical therapy providers is not universally recognized by the community.[151] It has been proposed that physical therapy providers identify with a specific body system rather than with a type of intervention in order to gain professional recognition for content expertise.[9,150] Such a shift will allow the profession to be identified by a comprehensive knowledge base of physiology, anatomy, kinesiology, pathology, and the behavioral sciences used for critical thinking and problem-solving rather than by the treatments that are performed.[151] In response to several decades of research and dialogue by physical therapy leaders, the APTA in 2015 defined the *human movement system* and called for this system to be the "core of physical therapy practice, education and research."[9] The movement system is defined as "... the collection of systems (cardiovascular, pulmonary, endocrine, integumentary, nervous, and musculoskeletal) that interact to move the body or its component parts" (Fig. 1.1).

As part of the definition, the APTA also provided a description of the relationship of the movement system to physical therapy training in diagnosis and management of movement system disorders (Box 1.1). The physical therapists' education is unique in that it includes knowledge of the component systems of movement with a focus on analysis of human movement. This identity with the movement system defines the expertise of the physical therapist to recognize movement behaviors that influence an individual's ability to perform activities and tasks.[9] Impairment of any one or more of the body systems and subsequent impairment of any aspect of the human movement system, separately or jointly, can limit or restrict an individual's ability to carry out or participate in daily activities.[58] Disorders of the movement system may be the cause of the patient's inability to perform activities or they may be the result of an underlying health condition.[58] In 2013 Painter and Marcus described the low levels of physical functioning experienced by patients with chronic kidney disease.[130] They identified the need for nephrologists to provide their dialysis patients with referrals to a specialist for physical activity and exercise to prevent deterioration of

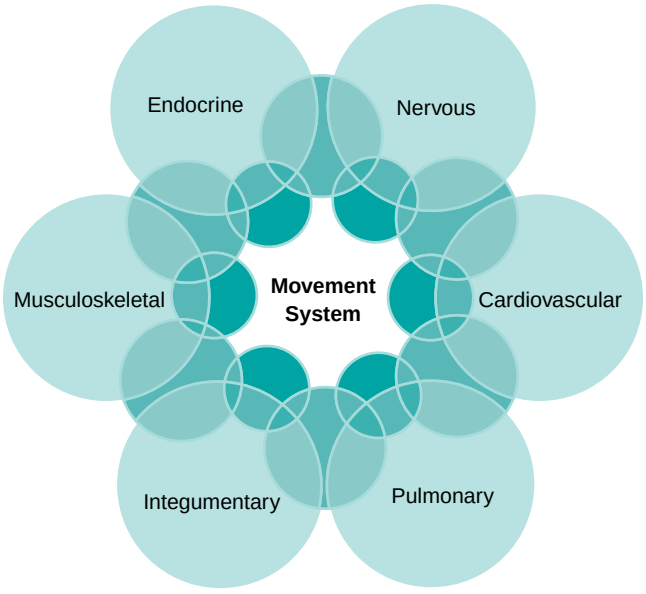

FIGURE 1.1 Movement System

BOX 1.1 Relationship of the Movement System to PT Practice

- Physical therapists provide a unique perspective on purposeful, precise, and efficient movement across the life span based upon the synthesis of their distinctive knowledge of the movement system and expertise in mobility and locomotion.
- Physical therapists examine and evaluate the movement system (including diagnosis and prognosis) to provide a customized and integrated plan of care to achieve the individual's goal-directed outcomes.
- Physical therapists maximize an individual's ability to engage with and respond to his or her environment using movement-related interventions to optimize functional capacity and performance.

physical function, mobility, and performance of activities of daily living (ADLs) and instrumental activities of daily living (IADLs).[130] This demonstrates that physical therapists do not "own" the human movement system, but that by identifying physical therapists as the specialists in diagnosis and treatment of movement system disorders, physical therapists are essential contributors to the overall health of individuals throughout their lifespan as they encounter health-care challenges.

As a movement system practitioner, the physical therapist is uniquely educated and qualified to recognize, diagnose, and provide interventions for movement dysfunctions in the context of functional performance and participation in life roles.[151] The basic requirements of a movement system practitioner as described by the APTA in the 2015 White Paper are:[9]

1. In-depth, integrative knowledge of the movement system and its component elements (anatomical structures and physiological functions)
2. The ability to evaluate and diagnose movement dysfunction in the clinical setting (using observation, instruments, or both)
3. The ability to identify physical impairments across various body systems (e.g., integumentary, musculoskeletal, cardiorespiratory, neurological, endocrine, genitourinary) that may be contributing to dysfunctional movement, such as muscle weakness, limited joint range of motion, limited oxygen exchange, or impaired motor control
4. The ability to design an intervention program to address underlying impairments as well as the movement dysfunction itself.

Components of Physical Function Related to Human Movement: Definition of Key Terms

The ability to function independently at home, in the workplace, within the community, or during leisure and recreational activities relies on the interrelationship of physical, psychological, environmental, personal, and social influences.[73,130,175] But this discussion as it relates to therapeutic exercise targets primarily physical function. Physical function is the ability to perform both basic and instrumental activities of daily living.[51] The diverse yet interrelated components of physical function influenced by therapeutic exercise are depicted in Figure 1.2 and are characterized by the following definitions.

Balance. The ability to align body segments against gravity to maintain or move the body within the available base of support without falling; the ability to move the body in equilibrium with gravity via interaction of the sensory and motor systems.[43,88,121,157,161,162]

Cardiopulmonary endurance. The ability to perform moderate-intensity, repetitive, total body movements (walking, jogging, cycling, swimming, etc.) over an extended period of time.[2,110] A synonymous term is cardiopulmonary fitness.

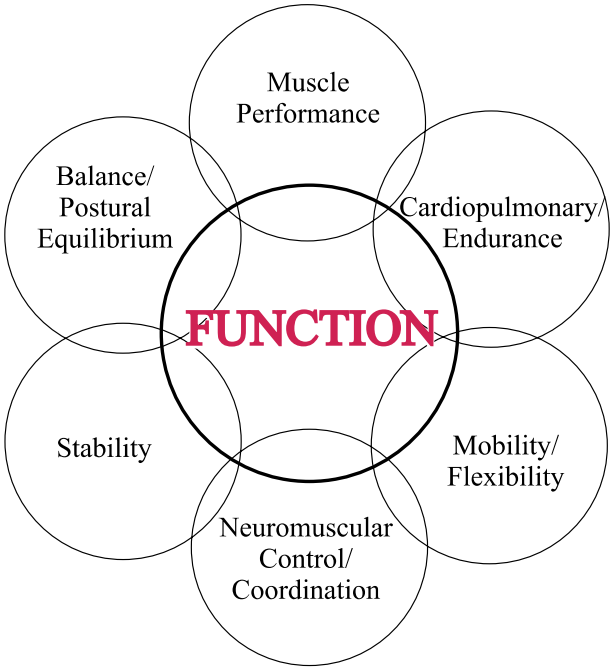

FIGURE 1.2 Interrelated components of physical function.

Coordination. The correct timing and sequencing of muscle firing combined with the appropriate intensity of muscular contraction leading to the effective initiation, guiding, and grading of movement. Coordination is the basis of smooth, accurate, efficient movement and occurs at a conscious or automatic level.[134,156]

Flexibility. The ability to move freely, without restriction; used interchangeably with mobility.

Mobility. The ability of structures or segments of the body to move or be moved in order to achieve the range of motion (ROM) needed for functional activities (functional ROM).[4,168] Passive mobility is dependent on soft tissue (contractile and noncontractile) extensibility; in addition, active mobility requires neuromuscular activation.

Muscle performance. The capacity of muscle to produce tension and do physical work. Muscle performance encompasses strength, power, and muscular endurance.[5,132]

Neuromuscular control. Interaction of the sensory and motor systems that enables synergists, agonists, and antagonists, as well as stabilizers and neutralizers, to anticipate or respond to proprioceptive and kinesthetic information and, subsequently, to work in correct sequence and magnitude to create coordinated movement.[96]

Postural control, postural stability, and equilibrium. Used interchangeably with static or dynamic balance.[70,157,161]

Stability. The ability of the neuromuscular system through synergistic muscle actions to hold a proximal or distal body

segment in a stationary position or to control a stable base during superimposed movement.[70,161,168] Joint stability is the maintenance of proper alignment of bony partners of a joint by means of passive and dynamic components.[118]

The human movement system as depicted in Figure 1.1 reacts, adapts, and develops over the lifetime of an individual in response to forces and physical stresses (stress = force / area) placed upon tissues and structures that make up the component parts of movement.[110,117,150] Gravity, for example, is a constant force that affects the musculoskeletal, neuromuscular, and circulatory systems. Additional forces occurring during routine physical activities help the body maintain a functional level of strength, cardiopulmonary fitness, and mobility. Imposed forces and physical stresses that are excessive can cause acute injuries, such as sprains and fractures, or chronic conditions, such as repetitive stress disorders.[117] The absence of typical forces on the body also can cause degeneration, degradation, or deformity. For example, the absence of normal weight-bearing associated with prolonged bedrest or immobilization weakens muscle and bone.[2,3,19,117] Prolonged inactivity also leads to decreased efficiency of the circulatory and pulmonary systems.[2]

Definition of Therapeutic Exercise

Therapeutic exercise[5] is the systematic, planned performance of physical movements, postures, or activities intended to provide a patient with the means to:

- Remediate or prevent impairments of body functions and structures.
- Improve, restore, or enhance activities and participation.
- Prevent or reduce health-related risk factors.
- Optimize overall health, fitness, or sense of well-being.

Therapeutic exercise programs designed by physical therapists are *individualized* to the unique needs of each patient. Physical therapists use critical thinking, assessment of movement patterns, and knowledge of how to apply forces at appropriate tolerance levels to design therapeutic exercise programs that will optimize movement of the patient.[150] The unique ability of the physical therapist to prescribe and progress exercise intervention to effectively influence human movement is discussed further in a later section of this chapter.

Types of Therapeutic Exercise Interventions

Therapeutic exercise embodies a wide variety of activities, movements, and techniques. The development of an individualized therapeutic exercise program is based on the therapist's determination of the specific cause of impairments in body function or structure, activity limitations, or participation restrictions as identified in the patient examination.[5] The types of therapeutic exercise interventions presented in this textbook are listed in Box 1.2.

BOX 1.2 Therapeutic Exercise Interventions

- Aerobic conditioning and reconditioning
- Range of motion exercises
- Muscle performance exercises: strength, power, and endurance training
- Stretching techniques including muscle-lengthening procedures and joint or soft tissue mobilization/manipulation techniques
- Neuromuscular control, inhibition, and facilitation techniques and posture awareness training
- Postural control, body mechanics, and stabilization exercises
- Balance exercises and agility training
- Relaxation exercises
- Breathing exercises and ventilatory muscle training
- Task-specific functional training
- Plyometric training

Exercise Safety

Many factors can influence a patient's safety during exercise. Before engaging in exercise, a patient's health history and current health status must be explored. A patient with a known or an undiagnosed health condition may be at risk for adverse effects from exercise especially if they are unaccustomed to physical exertion. Medications can adversely affect a patient's balance and coordination during exercise or cardiopulmonary response to exercise. Therefore, risk factors must be identified and weighed carefully before an exercise program is initiated. Medical clearance from a patient's physician may be indicated before beginning an exercise program.

The environment in which exercises are performed also affects patient safety. Adequate space and a proper support surface for exercise are necessary. If exercise equipment is used in the clinical setting or at home, the equipment must be well maintained and in good working condition, must fit the patient, and must be applied and used properly.

During patient instruction careful consideration should be given to the accuracy with which a patient performs each exercise including proper posture or alignment of the body, execution of the correct movement patterns, and performance of each exercise with the appropriate intensity, speed, and duration. A patient must be informed of the signs of fatigue, the relationship of fatigue to the risk of injury, and the importance of rest for recovery during and after an exercise routine. When a patient is being directly supervised in a clinical or home setting while learning an exercise program, the therapist can control these variables. However, when a patient is carrying out a prescribed exercise program independently at home or at a community fitness facility, patient safety can be enhanced and the risk of injury or reinjury minimized by effective exercise instruction and patient education. Suggestions for effective exercise instruction and patient education using principles of motor learning are discussed in a later section of this chapter.

The therapist's safety also must be considered, particularly when the therapist is directly involved in the application of an exercise procedure or manual technique. For example, when a therapist is using manual resistance during an exercise designed to improve a patient's strength or is applying a stretch force manually to improve a patient's ROM, the therapist must incorporate principles of proper body mechanics and joint protection to minimize his or her own risk of injury.

Throughout each of the chapters of this textbook, precautions, contraindications, and safety considerations are addressed for the use and progression of specific therapeutic exercise interventions.

Classification of Health Status, Functioning, and Disability—Evolution of Models and Related Terminology

Background and Rationale for Classification Systems

Describing a person's ability to function in the presence or absence of a health condition is a complex task that is best communicated and understood when practitioners, researchers, educators, policy makers, and legislators use the same terminology and classification system.[143,167,186]

Disablement refers to the functional consequence of acute or chronic conditions, such as disease, injury, and congenital or developmental abnormalities, that compromise basic human performance and an individual's ability to meet necessary, customary, expected, and desired societal functions and roles.[79,119,180] Disability is an individual response to a health condition that results in a range of activity limitations or participation restrictions that might be either temporary or permanent.[73,186] The *disabling process* depends on countless contextual factors, which include access to quality care, severity and duration of the condition, motivation and attitude of the patient, and support from family and society. Depending on individual variables and social support, the disabling course is altered and levels of functioning vary among patients with the same medical diagnosis or health condition.[79,119,167,180]

Models of Functioning and Disability—Past and Present

Early Models

Several models that describe disability have been developed worldwide over the past several decades. Two early theories were the Nagi model developed in the 1960s[119,120] and the International Classification of Impairments, Disabilities, and Handicaps (ICIDH) model introduced by the World Health Organization (WHO) in the 1980s.[65,72] The Institute of Medicine (IOM) and the National Center for Medical Rehabilitation Research (NCMRR) proposed additional models in the 1990s that introduced individual risk factors for disability based on both physical and social risks.[122]

The conceptual frameworks of the Nagi, ICIDH, IOM, and NCMRR models, although applied widely in clinical practice and research, were all criticized internationally for their perceived focus on pathology.[40] These early models imply a *unidirectional* path toward disability that is the direct result of response to disease or pathology based on a medical-biological description without consideration of environmental or social influences.[40,167] In response to these criticisms, the WHO undertook a broad revision of its ICIDH model, and in 2001 the International Classification of Functioning, Disability and Health (ICF) was introduced and characterized as a more appropriate *biopsychosocial model.* Functioning and disability are classified as a bidirectional interaction of health conditions and environmental and personal factors (Fig. 1.3).[73,164,165,166]

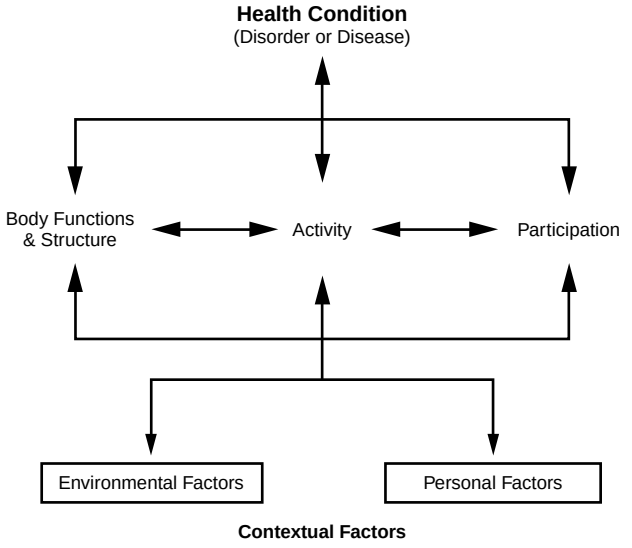

FIGURE 1.3 The ICF Framework.

The ICF—An Overview of the Model

Unlike previous models, the ICF does not define disability as a problem of the person resulting from a medical condition or disease. It also does not view disability as a condition created by society because of a lack of environmental or social modifications. ICF provides a classification system intended to define both functioning and disability as interactive situations in which individuals respond to health conditions and to the environmental and personal factors that influence how people live and participate in society.[40,73,186] The ICF classification and coding methodology is unique from the other models in its unit of measure. The *individual* is not placed in a classification, but rather the *situation* is coded to describe

various health and health-related states that are experienced by all people, not only people with disabilities.[1,40,73,165,166]

As shown in Table 1.1, the ICF model organizes information about health into two basic parts. Part 1*: Functioning and Disability,* is subdivided into two components: (1) Body Functions and Structures and (2) Activities and Participation. *Functioning* is characterized by positive interactions from the integrity of body functions and structures and the ability to perform activities and participate in life situations. In contrast, *disability* is characterized by the negative interactions of situations defined as impairments in body functions and structures, activity limitations, and participation restrictions.[73] Part 2: *Contextual Factors,* is also subdivided into two components: (1) Environmental Factors and (2) Personal Factors. Contextual factors represent the complete background of an individual's life and living situation.[73] Environmental factors make up the physical, social, and attitudinal circumstances in which the individual lives either with or without a health problem.[73] Although external to the individual, environmental factors have either facilitating or hindering influences on performance levels described by functioning and disability. For this reason, Part 1 of the model is not classified separately from Part 2 because the coding of the ICF represents the biopsychosocial paradigm of a person's health condition at any given point in time, not just when they are experiencing disability.[1,73,136] Definitions of key terms of the model are summarized in Box 1.3.[73,176]

BOX 1.3 Definition of Key Terms in the ICF

- **Impairments in body function:** Problems associated with the physiology of the body systems (including psychological functions).
- **Impairments in body structure:** Problems with the anatomical features of the body.
- **Activity limitations:** Difficulties an individual may have in executing actions, tasks, and activities.
- **Participation restrictions:** Problems an individual may experience with involvement in life situations, including difficulties participating in self-care; responsibilities in the home, workplace, or the community; and recreational, leisure, and social activities.
- **Contextual factors:** The entire background of an individual's life and living situation, composed of:
  - **Environmental factors:** Factors associated with the physical, social, and attitudinal environment in which people conduct their lives; factors may facilitate functioning (facilitators) or hinder functioning and contribute to disability (barriers).
  - **Personal factors:** Features of the individual that are not part of the health condition or health state; includes age, gender, race, lifestyle habits, coping skills, character, affect, cultural and social background, education, etc.

TABLE 1.1 An Overview of the International Classification of Functioning, Disability and Health (ICF)*

	Part 1: Functioning and Disability		Part 2: Contextual Factors	
Components	***Body Functions and Structures***	***Activities and Participation***	***Environmental Factors***	***Personal Factors***
Domains	Body functions Body structures	Life areas (tasks, actions)	External influences on functioning and disability	Internal influences on functioning and disability
Constructs	Changes in body functions (*physiological*) Changes in body structures (*anatomical*)	*Capacity:* Executing tasks in a standard environment *Performance:* Executing tasks in the current environment	Facilitating or hindering impact of features of the physical, social, and attitudinal world	Impact of attitudes of the person
Functioning				
Positive aspect	Functional and structural integrity	Activities Participation	Facilitators	Not applicable
Disability				
Negative aspect	Functional and/or structural Impairment	Activity limitation Participation restriction	Barriers Hindrances	Not applicable

*From *International Classification of Functioning, Disability and Health: ICF.* Geneva: World Health Organization, 2008, p 13, with permission.

Components of the ICF and Applications in Physical Therapy

Background

During the 1990s, the physical therapy profession began to explore the potential use of disablement models and related terminology as a framework for clinical decision-making in practice and research.[61,78,153] In addition, practitioners and researchers suggested that adoption of disablement-related vocabulary could be a mechanism to standardize terminology for documentation and communication in the clinical and research settings.[62] The APTA subsequently incorporated an extension of the Nagi disablement model and related terminology in its consensus document, the *Guide to Physical Therapist Practice*[4] (the *Guide*) in both its first edition in 1997 and second edition in 2001. Within the profession, this created a unifying force for documentation, communication, clinical practice, and research by designating a disablement framework for organizing and prioritizing clinical decisions made during the continuum of physical therapy care.

As the physical therapy profession evolved through education and research, the scope of practice included promoting the well-being of healthy individuals and preventing or reducing risk factors associated with external environmental and internal personal factors that might individually influence each person's response to a health condition. In 2008, the APTA officially endorsed the biopsychosocial framework, vocabulary, and classification system of the ICF. This began a continuing initiative to integrate this new framework and vocabulary into research, clinical practice and documentation, education, policy making, and legislation.[5,73,133,136] In 2013, the third edition of the *Guide* included the integration of ICF as the adopted framework for defining the realm of functioning and disability.[5] This also coincided with the adoption of a new vision statement "transforming society by optimizing movement to improve the human experience."[8]

Use of ICF language for documentation in the clinical setting is encouraged to improve both communication and reimbursement.[18, 89,133] Globally, researchers have found that since the introduction of ICF as a common language for patient assessment, both measurement tools and worldwide statistics for functioning and disability have improved.[10,103] Another noteworthy application of the ICF can be found in a series of clinical practice guidelines (CPGs) developed and published by the specialty sections and academies of the APTA. These guidelines use the universal language of the ICF as the template for describing and classifying care provided by physical therapists.[54] Information from the CPGs addressing the efficacy of therapeutic exercise interventions for health conditions and associated impairments commonly seen in physical therapy practice is discussed in the regional chapters of this textbook.

Health Conditions

Health conditions are acute or chronic diseases, disorders, injuries, or circumstances (i.e., aging, pregnancy, or stress) that have an impact on a person's level of function (see Fig. 1.3).[73] Health conditions are the basis of a medical diagnosis and are coded using the WHO's companion diagnostic classification system, the International Classification of Disease (ICD).[73] The ICD and ICF are complementary WHO international classifications, and together they provide information about health and health care across the world.[73]

Knowledge of the medical diagnosis is important background information, but it does not inform the therapist about the movement dysfunction that may cause or be the result of impairments in body function or structure or how a movement dysfunction may limit activities or restrict participation. Despite an accurate medical diagnosis and a therapist's thorough knowledge of specific health conditions, the experienced therapist knows that two patients with the same medical diagnosis, such as rheumatoid arthritis, and the same extent of joint destruction (confirmed radiologically) may have very different levels of functioning. This emphasizes the interrelationship of health, functioning, disability, and contextual factors that must be considered when designing interventions to improve patient activities and participation.

Body Functions and Body Structures

Body functions are the physiological functions of systems of the body, whereas body structures are the anatomical parts of the body including organs, limbs, and their components. These domains of classification occur at the cellular, tissue, or body system level (see Table 1.1).

The loss of integrity of body functions and/or structures is defined as impairment and is a partial reflection of a person's health status. Some representative examples of impairments of body function and structures are noted in Box 1.4.

In a biopsychosocial model, like the ICF, impairments are identified and documented as a first step to investigating the affect that a health condition has on activities and participation within the specific environment of the patient.

Types of Impairments

Primary impairments. Primary impairments arise directly from the health condition (*direct/primary*). A patient, for example, with a medical diagnosis of tendonitis of the rotator cuff may exhibit primary impairments of body function, such as pain and limited ROM of the shoulder during the physical therapy examination (Fig. 1.4 A and B).

Secondary impairments. Secondary impairments occur as a sequela to the primary impairments, or occur in other body systems (*indirect/secondary*). This same patient may also present to therapy with upper quarter postural impairments and faulty movement patterns of the head and upper extremity that are not a direct result of the tendonitis but occur secondarily due to the pain or limited ROM.

Composite impairments. When an impairment is the result of multiple underlying causes and arises from a combination of primary or secondary impairments, the term *composite impairment* is sometimes used. For example, a

BOX 1.4 Common Impairments Managed With Therapeutic Exercise

Musculoskeletal
- Pain
- Muscle weakness/reduced torque production
- Decreased muscular endurance
- Limited range of motion due to:
  - Restriction of the joint capsule
  - Restriction of periarticular connective tissue
  - Decreased muscle length
- Joint hypermobility/hypomobility
- Faulty posture
- Muscle length/strength imbalances

Neuromuscular
- Pain
- Impaired balance, postural stability, or control
- Incoordination, faulty timing
- Delayed motor development
- Abnormal tone (hypotonia, hypertonia, and dystonia)
- Ineffective/inefficient functional movement strategies

Cardiovascular/Pulmonary
- Decreased aerobic capacity (cardiopulmonary endurance)
- Impaired circulation (lymphatic, venous, and arterial)
- Pain with sustained physical activity (intermittent claudication)

Integumentary
- Skin hypomobility (e.g., immobile or adherent scarring)

patient who sustained a severe inversion sprain of the ankle resulting in a tear of the talofibular ligament and whose ankle was immobilized for several weeks is likely to exhibit a balance impairment of the involved lower extremity after the immobilizer is removed. This composite impairment could be the result of chronic ligamentous laxity (body structure impairment) combined with impaired ankle proprioception or muscle weakness (body function impairments) due to immobilization and disuse.

A

FIGURE 1.4 (A) Impingement syndrome of the shoulder and associated tendonitis of the rotator cuff (health condition/pathology) leading to

B

FIGURE 1.4 (B) limited range of shoulder elevation (impairment of body function) are identified during the examination.

An important key to effective patient management is to identify *functionally relevant impairments*, in other words, impairments that directly contribute to current or future activity limitations and participation restrictions in a patient's daily life or impairments that can predispose a patient to secondary health conditions. Equally important is the identification of the *underlying causes* of body function or body structure impairments that result in activity limitations or participation restrictions, particularly as they relate to impaired movement.[132,148,149,150]

Activities and Participation

The second component of Part 1 of the ICF is Activities and Participation (see Table 1.1). *Activity* is defined as the execution of a task or action by an individual, whereas *participation* is the involvement of the individual in a life situation. Every task, especially if executed within a social environment, might be considered participation and participation always involves multiple tasks or actions.[187] For this reason the ICF structure of classification for this component is based on one single list of nine domains of overlapping activities and life areas.[73,187] Because of variable environmental and personal influences (contextual factors), there is not a clear distinction between an individual's ability to perform a task and participation. There has been extensive research to determine whether these two components of functioning (activities and participation) are distinct or interrelated.[1,26,81,82,83,130,136] The therapist is encouraged to differentiate activity limitations from participation restrictions on a case-by-case basis.[187] Two qualifiers are used to code activities and participation when using the ICF. The ***performance*** qualifier describes how the individual performs the activity or participates in their actual environment as defined by their real-life setting. The ***capacity*** qualifier describes functional ability in a standardized or manipulated environment,

Diagnostic Process

Physical therapists use a systematic process, sometimes referred to as differential diagnosis, to rule out other possible causes for the patient's sign or symptoms. The diagnostic process is a complex *sequence* of actions and decisions that includes (1) the collection of data (examination); (2) the analysis and interpretation of all relevant data collected, leading to the generation of working hypotheses (evaluation); and (3) organization of data, recognition of clustering of data (a pattern of findings), formation of a diagnostic hypothesis, and subsequent classification of data into categories.[5,42,55,140,149,174,189] Through the diagnostic process a physical therapist uses movement analysis and problem-solving to identify impairments of body structure and function that specifically affect the human movement system, whereas a medical diagnosis identifies disease or pathology.[55,78,91,101,102,125,140,178]

Diagnostic Category

A diagnostic category or label identifies and describes patterns or clusters of findings from the examination and conclusions from the evaluation. The purpose of this label is to guide the therapist in the development of a prognosis, plan of care, and interventions.[5] Assigning a diagnostic label to the condition being treated also helps improve communication between practitioners and facilitates reimbursement for interventions.[101] A diagnostic category used in physical therapy should describe the affect of a health condition or disease on function of the human movement system at the level of the whole person.[5]

The following are guidelines listed in the *Guide* for choosing or developing a classification scheme that is relevant for the therapist to assign a diagnosis:[5]

- The classification system must be within the legal boundaries placed on the profession and within societal approval.
- The health professional must use acceptable tests and measures to confirm the diagnostic decision.
- The diagnostic label must describe a condition or problem that is within the scope of intervention legally allowed by the clinician making the diagnosis.

As the profession of physical therapy has advanced to a doctoral level and the position as a primary care provider has evolved, the role of diagnostician has become the focus of both research and practice.[5,35,116,125,150] The exclusive use of ICD diagnostic categories does not always identify a problem within the scope of physical therapy intervention because this classification focuses primarily on the diagnosis of pathology. The impairment/function-based diagnoses in the CPGs developed by multiple practice sections/academies of the APTA are currently based on the classification and coding system described in the ICF combined, as appropriate, with the ICD as recommended by the WHO. The diagnostic classifications in these approved CPGs are linked to recommendations for physical therapy interventions based on "best evidence" from the scientific literature.[29,33,34,98,99,113] However, research shows that there continues to be a gap between the use of diagnostic classification systems and the selection of interventions that are directly related to the diagnostic label used by clinicians in practice.[101,116]

In 2015 the APTA HOD passed a resolution to endorse the "development of diagnostic labels and/or classification systems that reflect and contribute to the physical therapist's ability to properly and effectively manage disorders of the movement system."[6] A diagnostic classification system developed by physical therapists is supported by this resolution as a means to delineate the knowledge base and scope of practice of physical therapy.[41,57,78,140,148] There is, however, agreement that development of movement-based diagnosis classification (kinesiopathological) will require interdisciplinary collaboration with therapists, physicians, surgeons, other health-care providers and researchers to adopt nomenclature that is consistent and useful for all providers of care.[102] Because the diagnosis is intended to guide the treatment plan, a universally accepted diagnostic classification scheme would foster clarity of communication in practice and clinical research.[35,48,78,116]

NOTE: In April 2017, the APTA Board of Directors approved the following criteria for use by any stakeholder group developing diagnostic classification systems/labels for use by physical therapists:[6]

- Use recognized movement-related terms to describe the condition or syndrome of the movement system.
- Include, if deemed necessary, the name of the pathology, disease, disorder, anatomical or physiological terms, and stage of recovery associated with the diagnosis.
- Be as succinct and direct as possible to improve clinical usefulness.
- Strive for movement system diagnoses that span all populations, health conditions, and the life span.

Whenever possible, use similar movement-related terms to describe similar movements, regardless of pathology or other characteristics of the patient or client.

A movement system diagnosis template was developed by the APTA movement system task force to create a repository for recommended diagnostic language that meets these criteria. The intent is that this will become a resource for research, education, and clinical practice and allow for ongoing refinement.[6]

Prognosis and Plan of Care

After the initial examination has been completed, data have been evaluated, and a diagnosis has been established, a *prognosis* (see Fig. 1.6), including a plan of care, must be determined before initiating any interventions. A prognosis is a prediction of a patient's optimal level of function expected as the result of a plan for treatment during an episode of care and the anticipated length of time needed to reach specified functional outcomes.[5,91,133] Some factors that influence a patient's prognosis and expected outcomes are noted in Box 1.12.

BOX 1.12 Factors That Influence a Patient's Prognosis/Expected Outcomes

- Complexity, severity, acuity, or chronicity and expected course of the patient's health condition
- Patient's general health status and presence of comorbidities (e.g., hypertension, diabetes, and obesity) and risk factors
- The patient's previous level of functioning or disability
- The patient's living environment
- Patient's and/or family's goals
- Patient's motivation, adherence, and response to previous interventions
- Safety issues and concerns
- Extent of support (physical, emotional, and social)
- Health literacy of the patient

Determining an accurate prognosis is, indeed, challenging even for experienced therapists. The more complex a patient's problems, the more difficult it is to project the patient's optimal level of function, particularly at the onset of treatment. For example, if an otherwise healthy and fit 70-year-old patient who was just discharged from the hospital after a total knee arthroplasty is referred for home-based physical therapy services, it is relatively easy to predict the time frame that will be needed to prepare the patient to return to independence in the home and community. In contrast, it may be possible to predict only incremental levels of functional improvement at various stages of rehabilitation for a patient who has sustained multiple fractures and soft tissue injuries as the result of an automobile accident.

In these two examples, the accuracy of the prognosis is affected in part by the therapist's clinical decision-making ability based on the following[5]:

- Familiarity with the patient's current health condition(s) and the surgical intervention(s) and previous history of diseases or disorders.
- Knowledge of the process and time frames of tissue healing.
- Experience managing patients with similar surgical procedures, pathological conditions, impairments, and functional deficits.
- Knowledge of the efficacy of tests and measures performed, accuracy of the findings, and effectiveness of the physical therapy interventions.

Plan of Care

The *plan of care,* an integral component of the prognosis, is established in coordination with the patient and, if indicated, others involved in the care of the patient. It should include the following components:[5]

- Patient goals that are functionally driven and time limited.
- Expected functional outcomes that are meaningful, sustainable, and measurable.
- Extent of improvement predicted and length of time necessary to reach that level.
- Specific interventions.
- Proposed frequency and duration of interventions.
- Specific discharge plans.

Setting Goals and Outcomes in the Plan of Care

Developing a plan of care involves *collaboration* and *negotiation* between the patient (and, when appropriate, the family) and the therapist.[5,91] The *anticipated goals* and *expected outcomes* documented in the plan of care must be patient centered—that is, the goals and outcomes must be meaningful to the patient.[133] These goals and outcomes also must be measurable and linked to each other. Goals describe the intended affect on functioning established with specific time limits.[4] Outcomes are the overall results from the interventions measured with the specific tests that were initially used to establish a baseline during the examination, and repeated periodically during the episode of care.

Establishing and prioritizing meaningful, functionally relevant goals and determining expected outcomes requires engaging the patient and/or family in the decision-making process from a therapist's first contact with the patient. Knowing what a patient wants to be able to accomplish as the result of treatment and which accomplishments are the most important to the patient helps a therapist develop and prioritize intervention strategies that are patient centered. This, in turn, increases the likelihood of successful outcomes from treatment.[129,133,134] Some key questions a therapist often asks a patient or the patient's extended support system that are critical for establishing anticipated goals and expected outcomes in the plan of care are listed in Box 1.13.[11,91,129,134]

An integral aspect of effective goal and outcome setting is explaining to a patient how the health condition and identified impairments are associated with the patient's activity limitations and participation restrictions and why specific interventions will be used. Discussing an expected time

BOX 1.13 Key Questions to Establish and Prioritize Patient-Centered Goals and Outcomes in the Plan of Care

- What activities are most important to you at home, school, work, in the community, or during your leisure time?
- What activities do you currently need help with that you would like to be able to do independently?
- Of the problems you are having, which ones do you want to try to eliminate or minimize first?
- Can you describe the difficulties you are having with the activities you would like to do on your own?
- What are your goals (what would you like to be able to accomplish) by participating in physical therapy?
- What would make you feel that you were making progress in achieving your goals?
- How soon do you want to reach your goals?

frame for achieving the negotiated goals and outcomes puts the treatment plan and the patient's expectation for progress in a realistic context. This type of information helps the patient and family members set goals that are not just meaningful, but also realistic and attainable. Setting up *short-term* and *long-term goals,* particularly for patients with severe or complex problems, is also a way to help a patient recognize incremental improvement and progress during treatment.

The plan of care also indicates the optimal level of improvement that will be reflected by the functional outcomes as well as how those outcomes will be measured. An outline of the specific interventions, their frequency and duration of use, and how the interventions are directly related to attaining the stated goals and outcomes also must appear in the plan. Periodic reexamination of a patient and reevaluation of a patient's response to treatment may necessitate modification of the initial prognosis and plan of care (see Fig. 1.6).

Finally, the plan of care concludes with the criteria for discharge. Planning for discharge begins early in the rehabilitation process. Criteria for discharge should be discussed with the patient and included in the initial plan of care. Ongoing assessment of outcomes is the mechanism by which a therapist determines when discharge from care is warranted. A patient is discharged from physical therapy services when the anticipated goals and expected outcomes have been attained.[4] The discharge plan often includes some type of home program, appropriate follow-up, or possible referral to community resources.

NOTE: Discontinuation of services is differentiated from discharge.[4] *Discontinuation* refers to the ending of services before the achievement of anticipated goals and expected outcomes. Several factors may necessitate discontinuation of services, which may include a decision by a patient to stop services, a change in a patient's medical status such that progress is no longer possible, or the need for further services cannot be justified to the payor and the patient opts to discontinue.

Intervention

Intervention, as a component of patient management, is the purposeful interaction of the therapist with the patient and with other family members, caregivers, or providers as appropriate.[5] The therapist selects, prescribes, and implements interventions based on the examination, evaluation, diagnosis, prognosis, and goals established for the patient. Interventions are updated, progressed, or discontinued based on patient response, achievement of goals, or results of outcomes (see Fig. 1.6).

The *Guide* describes nine categories of intervention appropriate for use by physical therapists in the care of patients.[5] These categories are listed in Box 1.14. Clinical reasoning, decision-making, clinical practice guidelines, clinical prediction rules, and the use of evidence-based practice are tools that therapists use during the patient management process to assist in the selection of specific, individualized interventions.[37,38,85,89,116]

BOX 1.14 Categories of Intervention Used by Physical Therapists

- Patient or Client Instruction (universally used with all patients)
- Airway Clearance Techniques
- Assistive Technology: Prescription, Application, and as appropriate, Fabrication or Modification
- Biophysical Agents
- Functional Training in Self-Care and in Domestic, Education, Work, Community, Social, and Civic Life
- Integumentary Repair and Protection Techniques
- Manual Therapy Techniques
- Motor Function Training
- Therapeutic Exercise

If interventions are to be considered effective, they must result in the reduction or elimination of body function or structure impairments, activity limitations, and/or participation restrictions and, whenever possible, reduce the risk of future dysfunction. Moreover, the efficacy of each intervention should be supported by sound evidence, preferably based on prospective, randomized, controlled research studies.

Although the intended outcome of therapeutic exercise programs has always been to enhance a patient's functional capabilities or prevent loss of function, until the past few decades the focus of exercise programs in physical therapy was on the resolution of impairments. Success was measured primarily by the reduction of impairments or improvements in specific components of physical performance, such as strength, mobility, or balance as depicted in Figure 1.7.

FIGURE 1.7 Manual resistance exercise, a procedural intervention, is a form of therapeutic exercise used during the early stage of rehabilitation if muscle strength or endurance is impaired.

In the past, it was assumed that if impairments were resolved, improvements in functional abilities would subsequently follow. Physical therapists, as movement system specialists,

now recognize that this assumption is not valid. To improve activity performance and participation in expected roles and to improve a patient's health-related quality of life, not only should interventions be implemented that correct functionally limiting impairments, but whenever possible, exercises should be task specific—that is, they should be performed using movement patterns that closely match a patient's intended or desired functional activities. In Figure 1.8, strengthening exercises are demonstrated using a task-specific lifting pattern.

FIGURE 1.8 Task-specific strengthening exercises are carried out by lifting and lowering a weighted crate in preparation for functional tasks at home or work.

The importance of designing and implementing exercises that closely replicate the desired functional outcomes is demonstrated by the following study:

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Task-specific functional training was investigated in a study of the effects of a resistance exercise program on the stair-climbing ability of ambulatory older women.[39] Rather than having the subjects perform resisted hip and knee extension exercises in nonweight-bearing positions, they trained by ascending and descending stairs while wearing a weighted backpack. This activity not only improved muscle performance (strength and endurance), but also directly enhanced the subjects' efficiency in stair climbing during daily activities.

Another way to use therapeutic exercise interventions effectively to improve functional ability is to integrate safe but progressively more challenging functional activities that utilize incremental improvements in strength, endurance, and mobility into a patient's daily routine as early as possible in the treatment program. With this functionally oriented approach to exercise, the activities in the treatment program are specific to and directly support the activities the patient wants to resume. Selection and use of interventions that target more than one goal or outcome are also appropriate and efficient ways to maximize improvements in a patient's function in the shortest time possible.

Effective intervention must include determining the appropriate *intensity, frequency,* and *duration* of treatment and periodic reexamination of the patient's response. While implementing therapeutic exercise interventions, a patient's response to exercise is continually monitored to decide when and to what extent to increase the difficulty of the exercise program or when to discontinue specific exercises. Each of the chapters of this textbook provides detailed information on factors that influence selection, application, and progression of therapeutic exercise interventions.

Outcomes

Simply stated, outcomes are results. Collection and analysis of outcome data related to health-care services are necessities, not options.[63] Measurement and reporting of outcomes is a means by which quality, efficacy, and cost-effectiveness of services can be communicated. Evaluation of information generated from periodic reexamination and reevaluation of a patient's response to treatment enables a therapist to determine whether the anticipated goals in the plan of care are being met and if the interventions that have been implemented are producing the intended results. It may well be that the goals and expected outcomes or the interventions provided must be adjusted based on the extent of change in a patient's function as determined by the level of the interim outcomes (see Fig. 1.6).

There are several broad areas of outcomes commonly assessed by physical therapists during the continuum of patient care. They are listed in Box 1.15.

BOX 1.15 Broad Areas of Outcomes Assessed by Physical Therapists

- Functional Outcomes: Level of a patient's physical functioning
- Impairment Tests and Measures
- Disability Indices: Perceived disability
- Prevention Measures
- Reduced Risk of Occurrence/Safety Measures (i.e., fall risk assessments)
- Health Related Quality of Life Measures: Patient's general health status or level of well-being and fitness
- Degree of patient satisfaction
- Health literacy/patient/family understanding
- Adherence/compliance with home exercises or instructions

Functional Outcomes

The key to the justification of physical therapy services in today's cost-conscious health-care environment is the identification and documentation of successful patient-centered, functional outcomes that can be directly attributed to interventions.[5,12,30,59,170] Functional outcome reporting allows physical therapists to show the value of physical therapy to consumers and to payors, and allows the profession to have access to data for benchmarking to improve the care provided.

Functional outcomes must be *meaningful, practical,* and *sustainable.*[170] Outcomes that influence a patient's ability to function at work, in the home, or in the community in ways that have been identified as important by the patient, family, significant others, caregivers, or employers are considered *meaningful.* The *practical* aspect of functional outcomes implies that improvements in function have been achieved in an efficient and cost-effective manner. Improvements in function that are maintained over time after discharge from treatment (to the extent possible given the nature of the health condition) are considered *sustainable.*

Measuring Outcomes

The outcomes identified in a physical therapy plan of care must be *measurable.* More specifically, changes in a patient's status over time must be *quantifiable.* As noted in the previous discussion of the examination component of the patient management model, many of the specific tests and measures traditionally used by physical therapists have focused on measurement of impairments (i.e., ROM, muscle performance, joint mobility/stability, and balance). The reduction of impairments may reflect the affect of interventions on the pathological condition but may or may not translate into improvements in a patient's health-related quality of life, such as safety and functional abilities. Hence, there is the need for measurement not only of impairments, but also of a patient's levels of physical functioning and perceived participation ability at initial evaluation and periodically during treatment to accurately assess the effectiveness of physical therapy interventions.

A self-report instrument called OPTIMAL (Outpatient Physical Therapy Improvement in Movement Assessment Log) measures the affect of physical therapy interventions on function and has been tested for validity and reliability.[59] This instrument measures a patient's difficulty with or confidence in performing a series of 22 actions, most of which are related to functional mobility, including moving from lying to sitting and sitting to standing, kneeling, walking, running, climbing stairs, reaching, and lifting. In addition, to assist the therapist with setting goals for the plan of care, the patient is asked to identify three activities that he or she would like to be able to do without difficulty.

A number of studies that have investigated the benefits of exercise programs for individuals with impaired functional abilities reflect the trend in research to include an assessment of changes in a patient's health-related quality of life as the result of interventions.[80,92,145] Assessment of outcomes related to the reduction of risks of future injury or further impairment, prevention of further functional limitations or disability, adherence to a home program, or the use of knowledge that promotes optimal health and fitness may also help determine the effectiveness of the services provided. To substantiate that the use of physical therapy services for prevention is cost-effective, physical therapists are finding that it is important to collect follow-up data that demonstrate a reduced need for future physical therapy services as the result of interventions directed toward prevention and health promotion activities. Further discussion of the role of the physical therapist in prevention and wellness can be found in Chapter 2 of this text.

Patient satisfaction. Another area of outcomes assessment that has become increasingly important in physical therapy practice is that of *patient satisfaction.* An assessment of patient satisfaction during or at the conclusion of treatment can be used as an indicator of quality of care. Patient satisfaction surveys often seek to determine the benefit of treatment based on the patient's own assessment of his or her status at the conclusion of treatment compared with status at the onset of treatment.[144] Instruments, such as the Physical Therapy Outpatient Satisfaction Survey (PTOPS)[144] or the MedRisk Instrument for Measuring Patient Satisfaction with physical therapy (MRPS),[15,16] also measure a patient's perception of many other areas of care. An important quality of patient satisfaction questionnaires is their ability to discriminate among the factors that influence satisfaction. Identification of factors that adversely influence satisfaction may enable the clinician to take steps to modify these factors to deliver an optimal level of services to patients.[16]

Factors that may influence the extent of patient satisfaction are noted in Box 1.16.[15,16,27,144]

BOX 1.16 Examples of Determinants of Patient Satisfaction*

- Interpersonal attributes of the therapist (communication skills, professionalism, helpfulness, and empathy) and the affect on the patient-therapist relationship
- Perception of a therapist's clinical skills
- Continuity of the provider/therapist over the episode of care
- Extent of functional improvement during the episode of care
- Extent of participation in goal setting and treatment selection
- The acuity of the patient's condition (higher satisfaction in acute conditions)
- Convenience of access to services
- Administrative issues, such as flexible hours for scheduling, waiting time at each visit, duration of treatments, and cost of care

*Determinants are not rank ordered.

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A systematic review of the literature addressed the degree of patient satisfaction with musculoskeletal physical therapy care and identified the factors that were associated with high patient satisfaction in outpatient settings across North America and Northern Europe.[71] The review included articles if they were a survey, clinical trial, qualitative study, or patient interview. Only 15 of several thousand articles met the inclusion criteria. A meta-analysis of pooled data from the included studies revealed that on a scale of 1 to 5 (5 being the highest level of satisfaction), the degree of patient satisfaction was 4.41 (95% confidence interval = 4.41–4.46), indicating that patients are highly satisfied with physical therapy care directed toward musculoskeletal conditions. One finding of interest in the studies reviewed is the quality of the patient-therapist relationship consistently ranked higher as an indicator of patient satisfaction than the extent of improvement in the patient's physical functioning as a result of the episode of care.

In conclusion, the patient management model discussed in this section establishes a comprehensive, systematic approach to the provision of effective and efficient physical therapy care and services. This model is a mechanism to demonstrate the interrelationships among the phases of the continuum of patient care set in a conceptual framework of functioning and disability; it is aimed at improving a patient's function and health-related quality of life. This model also places an emphasis on reducing risk factors for disease, injury, impairments, or disability and promoting health and well-being in patients seeking and receiving physical therapy services.

Strategies for Effective Exercise Intervention and Patient Instruction

Two categories of intervention from the Patient Management Model that deserve additional focus in this foundational chapter are therapeutic exercise and patient instruction (Box 1.14). Although the management model provides a step-by-step process for developing and establishing patient care, the creation of individualized exercise programs and the instruction of the patient in performing exercises are hallmark skills of the physical therapist that require specialized perspective, knowledge, and experience.

Exercise Prescription and Progression

Determining Specific Goals

The first priority when choosing a therapeutic exercise is to determine the specific goals and expected outcomes of the intervention. Exercise parameters will differ based on the desired outcome for the patient, so a clear decision about the purpose of the intervention must be established by the therapist. For example, if increased strength is the primary expected patient outcome, the exercises must create the right loading conditions to improve force production. In contrast, if improved motor control is the primary desired patient outcome, the therapist will select interventions that challenge movement attributes like timing and smoothness. Determining specific goals will greatly improve the likelihood of therapeutic effectiveness.

Selecting and Advancing Interventions

Two important tasks related to developing a patient-specific therapeutic exercise prescription are first determining the appropriate starting parameters, and then adjusting the loading demands in a manner that achieves desired outcomes. If the initial exercise prescription fails to challenge the patient appropriately, the intervention is unlikely to be therapeutic. In contrast, overly demanding activities may result in compensatory strategies or injury. Similarly, failing to progress the exercise demands in an appropriate manner will limit the patient's ability to achieve their goals and expected outcomes.

In the observant and reflective clinician, the decision-making skills related to these two tasks develop over time such that the initial exercises prescribed become much more appropriately aligned with the patient's current capabilities and then are advanced skillfully through a process of continual assessment and adjustment. While these skills do develop over time, applying a decision-making framework that considers a set of comprehensive factors may accelerate the process. The following considerations and recommendations are suggested to facilitate the initial prescription and progression of therapeutic exercises and interventions.

Initial Exercise Prescription

To develop an initial exercise prescription, both load and tolerance must be considered.

- ***Load:*** Load constitutes the many variables that can be manipulated to create a therapeutic environment, such as exercise mode, intensity, volume, frequency, and duration.
- ***Tolerance:*** Tolerance refers to the ability of the patient to successfully manage a given input or load based on their current level of abilities, impairments, and overall health.

To begin making decisions about initial exercise prescription, the clinician first makes an estimate of patient tolerance by collecting and interpreting data through a clinical examination. During the examination, the clinician assesses tolerance by estimating the patient's potential to manage loading while tests and measures are applied. In addition to information from the clinical examination, the clinician also considers modifiers that may influence patient tolerance. Modifiers include information related

to tissue integrity and stage of healing, the adaptability or plasticity of the tissue, the exercise capacity of the patient, the patient goals and expected outcomes, and any other patient characteristics that may influence decisions about loading (see Part III of this text). Table 1.3 lists the potential modifiers to consider in this decision-making process.

Once an estimate of tolerance is determined, the clinician selects the exercise parameters that will result in an appropriate load. Load and tolerance are directly related in that if a patient has low tolerance, the applied load should also be low, and when tolerance is high, load can be high. Figure 1.9 demonstrates the load/tolerance relationship and illustrates how after an estimate of tolerance is made, loading can be determined. Because the relationship arrow in the figure is broad, it allows a range of appropriate loading. The broad arrow also contains a *Modifiers* label, suggesting that from the initial tolerance estimate, the clinician may move along the arrow in either direction to adjust loading estimates based on patient factors.

It is also vital that the clinician has a firm understanding of the body's expected response to exercise. Knowledge of how various types of exercise loads affect tissue health is paramount to making sound decisions about an exercise prescription (see Chapters 6–8). Applying loads in ways that align with the principles of the Physical Stress Theory (PST)[117] is critical to creating conditions that are therapeutic.

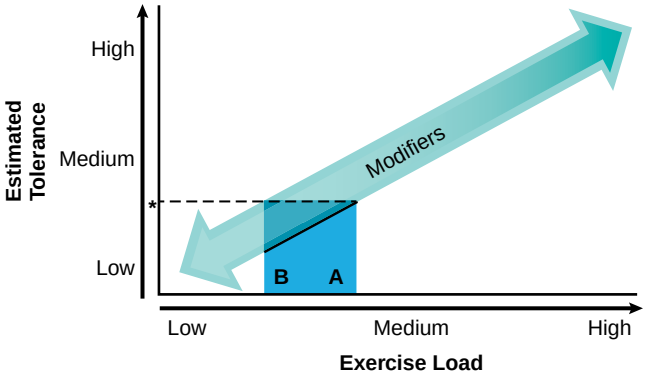

FIGURE 1.9 Initial Exercise Prescription: Tolerance and exercise load relationship. Asterisk (*) represents the estimate of patient tolerance to exercise, with the grey box indicating a suggested range of exercise load. Point A represents more aggressive loading, whereas point B is indicated when several modifiers are present.

TABLE 1.3 Modifiers That Influence Exercise Prescription

Modifier	Examples	Suggestive of Lower Tolerance	Suggestive of Higher Tolerance
Tissue Characteristics	Stage of healing	Acute stage Postsurgical	Remodeling stage
	Overall Integrity	Fatty infiltrate Atrophied	Sound architecture, morphology and substrate expected
	Plasticity and adaptability	Low potential	High potential
Exercise Capacity	Overall health	Deficits in multiple components of movement system BMI	Most body systems are healthy History of exercise
	Motor control	Poor coordination, dexterity Lack stability in adjacent regions	Coordinated in most gross and fine motor activities Good stability in adjacent joints and regions
	Strength	Deficient in multiple areas	Minimal to moderate limitations
	ROM	Limited	Close to or at normal limits
Patient Characteristics	Motivation	Low	High
	Demographics	Elderly Health desert	Young
	Support System	Poor	Strong Broad
	Comorbidities/Precautions	Multiple comorbidities Several precautions	Few or none
	Goals/Expected Outcomes	Low level	Functional Achievable

NOTE: The PST states that the amount and type of physical stresses applied to specific tissues will result in predictable changes to that tissue. The theory describes five potential tissue adaptations in response to applied stress: Atrophy, Maintenance, Hypertrophy, Injury, and Death. In principle, loading that results in physical stresses above the maintenance level but below the injury level of a specific tissue will achieve a positive therapeutic effect by increasing the tolerance of that tissue to future stresses. The PST considers total tissue stress to be a composite value influenced by loading magnitude, duration, and direction, with the recent history of loading another important variable to consider.[117]

The clinician must also have a keen understanding of the biomechanics of exercise. Not only must initial prescription be based on a clear knowledge of forces, moment arms, and torques, but also how these biomechanical variables change during activities and how they interact to influence tissue loading (see Chapter 6).

Finally, it is important to think broadly about the movement system as initial exercise prescription is determined. Because the movement system requires the successful interaction among many separate systems to ensure a supportive substrate for therapeutic exercise, movement system components and their potential interactions should be considered. For example, a compromised immune system, a systemic disease, or impairments of metabolic function may influence a patient's energy levels or recovery times during exercise.

Progression of Exercise

The first step to successfully progressing therapeutic exercises with every patient is ongoing assessment of their current capabilities and their response to the prescribed activities. The exercise prescription for each patient should be on a continuum that is anchored on one end by their baseline capabilities and by their desired outcomes at the other end. During care, the patient lies somewhere along that continuum; this is considered their current state. It is the clinician's responsibility to regularly evaluate the relationships among the patient's current state, their initial capabilities/tolerance, and their desired outcomes. Then, based on that evaluation, the clinician skillfully modifies the applied load as needed to keep the patient progressing toward the desired outcomes. This progression must be done at a pace that respects stages of healing, uses PST theory to create therapeutic conditions, and maximizes patient motivation, confidence, and compliance.

The second step in progressing therapeutic exercise is the thoughtful manipulation of the variables that create appropriate loading. The most common variables manipulated relate to dose (intensity, frequency, duration), which are easily manipulated by increasing (or decreasing) the resistance applied, and the number of repetitions and/or sets for a specific exercise. Additionally, clinicians can and should manipulate variables other than dose to progress patients toward their desired outcome. Table 1.4 notes many of the additional variables that may be manipulated to adjust the total load and patient effort. Figure 1.10 demonstrates the continuum between baseline capabilities and desired outcome, as well as the patient's current status/capacity and the suggested therapeutic load to progress the patient toward their desired outcome.

TABLE 1.4 Variables Used to Progress and Regress Therapeutic Load

Exercise Load Factor	Variables to Manipulate
Exercise Dose	Volume ▪ Amount of Resistance ▪ Number of Repetitions, Sets ▪ Length of Hold
Exercise Mode	Resistance Type ▪ Gravity/Body Weight ▪ Weights ▪ Pulley System ▪ Manual Resistance ▪ Elastic Band ▪ Isokinetic Dynamometer ▪ Plyometrics Stretch Type ▪ Passive ▪ Dynamic ▪ PNF
Exercise Speed	Slow, Medium, Fast Ballistic Isokinetic
Contraction Type	Eccentric Isometric Concentric
External Load	Self (Patient) Therapist Device
Patient Position	Gravity eliminated/challenged Supported/Unsupported Joint Angle and Stability Open vs Closed Chain

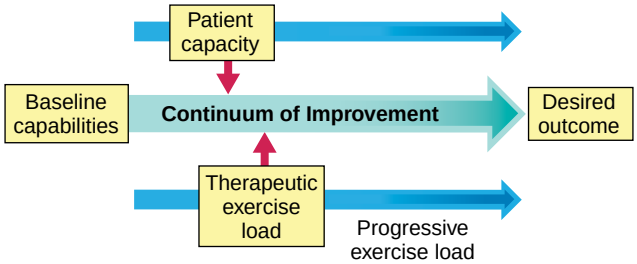

FIGURE 1.10 Progression of Exercise. To progress toward desired outcomes, the therapeutic exercise load target is slightly greater than the patient's current capacity.

What should be apparent is that the exercise load applied to a patient can be modified in numerous ways. In addition, the ability to manipulate several variables simultaneously results in a significant number of opportunities for adjusting the exercise load. With the many options available, it should be possible in most instances to be able to make incremental increases or decreases to an exercise or activity.

Specific descriptions of exercise prescriptions are presented in Chapter 17, for the shoulder, and Chapter 20, for the hip.

Patient Instruction

Patient instruction is the only intervention category used by physical therapists that is specified to be used for every patient throughout the entire episode of care[5] (see Box 1.14). Education should include not only the patient, but also family members, caregivers, and other health professionals involved in the care of the patient. There is no question that physical therapists perceive themselves as patient educators, facilitators of change, and motivators.[31,50,77,100,123] Education ideally begins during a patient's initial contact with a therapist and involves the therapist *explaining* information, *asking* pertinent questions, and *listening* to the patient or a family member.

Patient-related instruction is the means by which a therapist helps a patient *learn* how to reduce his or her impairments and how to participate fully in the plan of care to achieve goals.[31] Patient-related instruction first may focus on providing a patient with background information, such as the interrelationship of the primary health condition and the associated impairments and limitations in activity or explaining the purpose of specific interventions in the plan of care. Instruction, such as clinician–directed exercise counseling,[172] may be implemented as an alternative to direct supervision of an exercise program and typically focuses on specific aspects of a treatment program, such as teaching a patient, family member, or caregiver a series of exercises to be carried out in a home program. Education also helps to prepare an individual for transition to a different role or setting or to understand risk factors and the need for health, wellness, or fitness programs. Therapists should also review health and wellness materials and clarify directions for safe use of equipment to be used at home.

A therapist should use multiple methods to convey information to a patient or family member, such as one-to-one, therapist-directed instruction; videotaped instruction; or written materials. Patients who are taught exercises individually by a therapist have been shown to perform their programs more accurately than those who were provided only with written materials, and those who were instructed with videotaped instructions showed better compliance than those with only verbal or written instructions.[46,137]

As a patient educator, a therapist also must be able to recognize a patient's learning style, implement effective teaching strategies, and motivate a patient to *want* to learn new skills, adhere to an exercise program, or change health-related behaviors. Communicating in plain language, including the use of easily understood handouts, brochures, videos, pictures, and feedback, closes the gap between what the professional knows and what the patient understands.[45,137]

Preparation for Exercise Instruction

When preparing to teach a patient a series of exercises, a therapist should have a plan that will facilitate learning before and during exercise interventions. A positive relationship between the therapist and the patient is a fundamental aspect for creating a motivating environment that fosters learning. A collaborative relationship should be established when the goals for the plan of care are negotiated. Effective exercise instruction is also based on knowing a patient's learning style—that is, if he or she prefers to learn by watching, reading about, or doing an activity.

Identifying a patient's attitudes toward exercise helps a therapist determine how receptive a patient is likely to be about learning and adhering to an exercise program. Answers to the following questions may help a therapist formulate a strategy for enhancing a patient's motivation to exercise:

- Does the patient believe exercise will lessen symptoms or improve function?
- Is the patient concerned that exercising will be uncomfortable?
- Is the patient accustomed to engaging in regular exercise?

One method for promoting motivation is to design the exercise program so the least complicated or stressful exercises are taught first, thus ensuring early success. Always ending an exercise session with a successful effort also helps maintain a patient's level of motivation. Box 1.17 summarizes some practical suggestions for effective exercise instruction.

Adherence to Exercise

Effective patient-related instruction for a functionally oriented exercise program must include methods to foster *adherence.* This is particularly challenging when a patient is unaccustomed to regular exercise or when an exercise program must be carried out for an extended period of time. Positive outcomes from treatment are contingent not so much on designing the "ideal" exercise program for a patient, but rather on designing a program that a patient or family will actually follow.[76,77,160]

NOTE: Although the terms adherence and compliance are often used interchangeably by clinicians and in the literature, the term adherence has been selected for this discussion because it has a stronger connotation of active involvement of the patient and patient-therapist collaboration. In contrast, compliance tends to imply a more passive connotation with respect to a patient's behavior.

BOX 1.17 Practical Suggestions for Effective Exercise Instruction

- Select a nondistracting environment for exercise instruction.
- Initially teach exercises that replicate movement patterns of simple functional tasks.
- Demonstrate proper performance of an exercise (safe vs. unsafe movements; correct vs. incorrect movements).
- Engage or include the patient in determining the type of exercises that are interesting and that fit into the patient's schedule and lifestyle.
- Use clear and concise verbal and written directions.
- Complement written instructions for a home exercise program with illustrations (sketches) or videos of the exercise.
- Have the patient demonstrate an exercise to you as you supervise and provide feedback.
- Provide specific, action-related feedback rather than general, nondescriptive feedback. For example, explain why the exercise was performed correctly or incorrectly.
- Teach an entire exercise program in small increments to allow time for a patient to practice and learn components of the program over several visits.

Factors That Influence Adherence to an Exercise Program

Many factors influence adherence to an exercise program. These factors can be grouped into several categories: patient-related factors, factors related to a patient's health condition or impairments, and program-related variables.[28,56,61,76,77,104,112,123,160,]

Patient-Related Factors

The following patient-related factors can have a positive or negative influence on adherence: understanding the health condition, impairments, or exercise program; level of motivation, self-discipline, attentiveness, memory, and willingness and receptivity to change; degree of fatigue or stress; the availability of time to devote to an exercise program; the patient's self-perception of his or her compatibility with the therapist or the degree of control in the exercise program; socioeconomic and cultural background; the beliefs and attitudes about exercise and the value the patient places on the exercise program; and the patient's access to resources. The patient's gender also affects adherence to an exercise program, with men having higher adherence rates than women.

Factors Related to the Health Condition or Impairments

The acuity, chronicity, severity, or stability of the primary health condition and related impairments, in addition to the presence of comorbidities, all influence adherence. Pain is a deterrent to adherence and therefore must be minimized in an exercise program. The potential affect of kinesiophobia on the patient's participation in an exercise program should also be considered.[159] If impairments are severe or long-standing, setting short-term goals that can be achieved incrementally fosters adherence to an exercise program that must be followed over a long period of time.

Program-Related Variables

The complexity and expected duration of an exercise program; the quality of instruction, supervision, and feedback from the therapist; and, the continuity of care from an inpatient to an outpatient or home setting can all influence patient adherence. Programs that address the interest level and motivational needs of a patient have higher adherence rates. In the outpatient setting, logistics such as location and scheduling, the availability of social support, and individualized attention or counseling from personnel also are important factors that foster adherence.

Strategies to Foster Adherence

A therapist should expect that most patients will not dutifully adhere to any treatment program, particularly if regular exercise has not been a part of the patient's life before the occurrence of disease or injury. The most a therapist can hope to do is implement strategies that foster adherence. Some suggestions from a number of resources in the literature are noted in Box 1.18.[28,56,61,76,77,93,112,123,160]

BOX 1.18 Strategies to Foster Adherence to an Exercise Program

- Explore and try to appreciate the patient's beliefs about exercising or the value the patient places on exercising as a means to improve or resolve their physical condition.
- Screen the patient for kinesiophobia: fear of movement
- Help the patient identify personal benefits derived from adhering to the exercise program.
- Explain the rationale and importance of each exercise and functional activity.
- Identify how specific exercises are designed to meet specific patient-centered goals or functional outcomes.
- Allow and encourage the patient to have input into the nature and scope of the exercise program, the selection and scheduling of practice and feedback, and decisions of when and to what extent exercises are progressively made more difficult to enhance a patient's sense of self-control.
- Keep the exercise program as brief as possible.
- Identify practical and functionally oriented ways to do selected exercises during everyday tasks.
- Suggest that the patient keep an exercise log to show progression and adherence.
- If possible, schedule follow-up visit(s) to review or modify exercises.
- Point out specific exercise-related progress.
- Identify barriers to adherence (not enough time in the day to do the exercises, discomfort during the exercises, and lack of necessary equipment); then suggest solutions or modify the exercise program.

Concepts of Motor Learning: A Foundation for Exercise and Task-Specific Instruction

Effective strategies founded on principles of motor learning contribute to successful outcomes for the patient. Integration of motor learning principles into exercise instruction optimizes learning an exercise or functional task. An exercise is simply a motor task (a psychomotor skill) that a therapist teaches and a patient is expected to learn.

Motor learning is a complex set of internal processes that involves the acquisition and *relatively permanent* retention of a skilled movement or task through practice.[127,154,155,179,183] In the motor learning literature a distinction is made between motor performance and motor learning. *Performance* involves acquisition of the ability to carry out a skill, whereas *learning* involves both acquisition and retention.[52,154,155] A patient's ability to perform an exercise or skilled movement early in the motor-learning process does not necessarily indicate they have truly learned the new exercise or skill.

It is thought that motor learning probably modifies the way sensory information in the central nervous system is organized and processed and affects how motor actions are produced. In addition, because motor learning is not directly measurable, it must be inferred by a combination of observation and analysis of how an individual performs a skill.

Types of Motor Tasks

There are three basic types of motor tasks: discrete, serial, and continuous.[154,155]

Discrete Task

A discrete task involves an action or movement with a recognizable beginning and end. Isolating and contracting a specific muscle group (as in a quadriceps setting exercise), grasping an object, doing a push-up, locking a wheelchair, and kicking a ball are examples of discrete motor tasks. Almost all exercises, such as lifting and lowering a weight or performing a self-stretching maneuver, can be categorized as discrete motor tasks.

Serial Task

A serial task is composed of a series of discrete movements that are combined in a particular sequence. For example, to eat with a fork, a person must be able to grasp the fork, hold it in the correct position, pierce or scoop up the food, and lift the fork to the mouth. Many functional tasks in the work setting, for instance, are serial tasks with simple as well as complex components. Some serial tasks require specific timing between each segment of the task or momentum during the task. Wheelchair transfers are serial tasks. A patient must learn how to position the chair, lock the chair, possibly remove an armrest, scoot forward in the chair, and then transfer from the chair to another surface.

Continuous Task

A continuous task involves repetitive, uninterrupted movements that have no distinct beginning and ending. Examples include walking, ascending and descending stairs, and cycling.

Recognizing the type of skilled movement a patient must learn to do helps a therapist decide which instructional strategies will be most beneficial for acquiring specific functional skills. Consider the variables that must be learned to apply a self-stretch to the hamstrings. In this example, a patient must learn how to position and align his or her body, how much stretch force to apply to perform the maneuver correctly, and how to assess the sensory input they receive during the stretch. As flexibility improves, the patient must then learn how to safely control active movements in the newly gained portion of the range during functional activities. This requires muscles to contract with correct intensity at an unaccustomed length.

In this example, motor learning must occur for the exercise and functional training to be effective. By viewing exercise interventions from this perspective, it becomes apparent why applications of strategies to promote motor learning are an integral component of effective exercise instruction.

Conditions and Progression of Motor Tasks

If an exercise program is to improve a patient's function, it must include performing and learning a variety of tasks and it must place demands on a patient under varying conditions. A taxonomy of motor tasks, proposed by Gentile,[52] is a system for analyzing functional activities and a framework for understanding the conditions under which simple to complex motor tasks can be performed. Figure 1.11 depicts these conditions and the dimensions of difficulty of motor tasks.

An understanding of the components of this taxonomy and the interrelationships among its components is a useful framework for a therapist to identify and increase the difficulty of functional activities systematically for a patient with impaired function.

There are four main task dimensions addressed in the taxonomy: (1) the environment in which the task is performed, (2) the intertrial environmental variability that is imposed on a task, (3) the need for a person's body to remain stationary or to move during the task, and (4) the presence or absence of manipulation of objects during the task. Examples of simple to complex everyday activities characteristic of each of the 16 different but interrelated task conditions are shown in Figure 1.12.

Closed or Open Environment_

Environmental conditions of a task address whether objects or people (around the patient) are stationary or moving during the task and if the surface on which the task is performed is fixed or moving. A *closed environment* is one in which objects around the patient and the surface on which the task is performed do not move. When a functional task is performed in this type of environment, the patient's complete attention can be focused on performing the task and the task can be self-paced. Examples of tasks performed in a closed environment are drinking or eating while sitting in a chair and maintaining an erect trunk, standing at a sink and washing your hands or combing your hair, and walking in

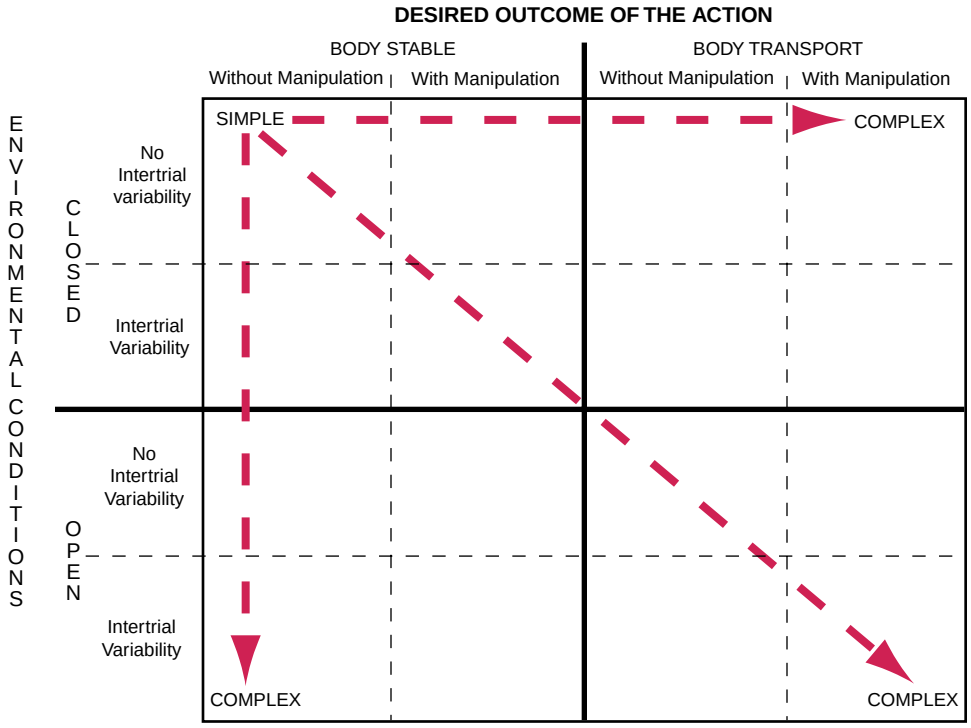

FIGURE 1.11 Taxonomy of motor tasks: dimensions of task difficulty.

ENVIRONMENTAL CONDITIONS	BODY STABLE		BODY TRANSPORT	
	Without Manipulation	With Manipulation	Without Manipulation	With Manipulation
CLOSED — Without Intertrial Variability	Maintaining balance in sitting on bed while caregiver combs hair Maintaining balance in standing in hallway as caregiver buttons coat	Sitting at the table and eating a meal Sitting doing household accounts Sitting at desk to write a letter	Rolling over in bed Sit <=> stand from bed Tub transfers Bed <=> bathroom, using same route daily	Carrying a tray of food or drinks from the kitchen to the living room, using the same tray and same route each time
CLOSED — With Intertrial Variability	Maintaining sitting balance on different chairs in the room e.g., rocker, straight-backed chair, sofa. Maintaining standing balance on different surfaces: carpet, wood	Standing in the kitchen unloading a dish-washer Sitting on a low stool in the yard, bending over to weed the vegetable garden	Rolling over in a twin bed and a queen bed Sit <=> stand from different heights and surfaces Up and down curbs of different heights	Carrying a tray of food or drinks from the kitchen to the living room, using different trays and routes each time
OPEN — Without Intertrial Variability	Maintaining balance in a moving elevator	Rearranging packages while standing in a moving elevator	Walking up or down a moving escalator or a moving sidewalk	Rearranging packages while walking up or down the moving escalator
OPEN — With Intertrial Variability	Maintaining sitting or standing balance in a moving bus	Drinking a cocktail on the deck of a cruise ship	Community ambulation Walking through a living room where children are playing	Shopping in the supermarket Walking a precocious pet on a leash

FIGURE 1.12 Activities of daily living in the context of the taxonomy of motor tasks.

an empty hallway or in a room where furniture placement is consistent.

A more complex environment is an *open environment.* It is one in which objects or other people are in motion or the support surface is unstable during the task. The movement that occurs in the environment is not under the control of the patient. Tasks that occur in open environments include maintaining sitting or standing balance on a movable surface (a balance board or BOSU®; Fig. 1.13), standing on a moving train or bus, ascending or descending stairs in a crowded stairwell, crossing a street at a busy intersection, or returning a serve in a tennis match or volleyball game. During tasks such as these, the patient must predict the speed and directions of movement of people or objects in the environment or must anticipate the need to make postural or balance adjustments as the support surface moves. Consequently, the patient must pace the performance of the tasks to match the imposed environmental conditions.

FIGURE 1.13 Learning to maintain standing balance on an unstable surface is an example of a motor skill that is performed in an open (moving) environment.

Intertrial Variability in the Environment—Absent or Present

When the environment in which a task occurs is constant from one performance of a task to the next, intertrial variability is absent. The environmental conditions for the task are predictable; therefore, little attention to the task is required, which often enables a patient to perform two tasks at one time. Some examples of tasks without intertrial variability are practicing safe lifting techniques using a box of the same dimensions and weight, practicing the tasks of standing up and sitting down from one height or type of chair, or walking on one type of surface.

A task becomes more complex when there is intertrial variability in the environmental conditions—that is, when the demands change from one attempt or repetition of a task to the next. With such variability, the patient must continually monitor the changing demands of the environment and adapt to the new circumstances by using a variety of movement strategies to complete the task. Lifting and carrying objects of different sizes and weight, climbing stairs of different heights, or walking over varying terrain are tasks with intertrial variability.

Body Stable or Body Transport

Tasks are also considered from the perspective of the person doing the task. Tasks that involve maintaining the body in a stable position, such as maintaining an upright posture, are considered simple tasks, particularly when performed under closed environmental conditions. When the task requirements involve the patient moving from one place to another (body transport), such as performing a transfer, walking, jumping, or climbing, the task is more complex. When a body transport task is performed in an open environment with intertrial variability, such as walking in a crowded corridor or on different support surfaces, such as grass, gravel, and pavement, the task becomes even more complex and challenging.

Manipulation of Objects—Absent or Present

Whether a task does or does not require upper extremity manipulation activities also affects the degree of difficulty of the task. When a task is performed without manipulating an object, it is considered less complex than if manipulation is a requirement of the task. Carrying a cup of coffee without spilling it while at home alone and walking from one room to another is a more complex task than walking with hands free. Doing the same task in a busy hallway further increases the complexity and difficulty of the task.

In summary, Gentile's taxonomy of motor tasks can be used to analyze the characteristics of functional tasks in the context of the task conditions. The taxonomy provides a framework to structure individual treatment sessions with a patient or to progress the level of difficulty of motor tasks throughout a functional training program.

Stages of Motor Learning

There are three stages of motor learning: cognitive, associative, and autonomous.[128,154,155] The characteristics of the learner are different at each stage of learning and consequently affect the type of instructional strategies selected by a therapist in an exercise and functional training program.