# 1 Orthotics and Prosthetics in Rehabilitation: Multidisciplinary Approach☆

MILAGROS JORGE

**LEARNING OBJECTIVES**

***On completion of this chapter, the reader will be able to do the following:***

1. Describe the role of the orthotist, prosthetist, physical therapist, and other professionals in the rehabilitation of persons with movement dysfunction.
2. Discuss the history and development of physical rehabilitation professions associated with the practice of orthotics and prosthetics in health care.
3. Identify contemporary critical factors that continue to influence the need for the use of orthotics and prosthetics in rehabilitation.
4. Apply the use of disablement frameworks in physical rehabilitation.
5. Discuss the role of health professionals in multidisciplinary and interdisciplinary rehabilitation teams.
6. Determine key attributes and attitudes that health professionals should possess to be successful members of interdisciplinary rehabilitation teams.

The author extends appreciation to Caroline Nielson, whose work in prior editions provided the foundation for this chapter.

Health professionals work in health care settings to meet the physical rehabilitation needs of diverse patient populations. The current health care environment strives to be patient-centered and advocates the use of best-practice models that maximize patient outcomes and contain costs. The use of evidence-based treatment approaches, clinical practice guidelines, and standardized outcome measures provides a foundation for evaluating and determining efficacy in health care across disciplines and health conditions. The World Health Organization (WHO) International Classification of Functioning, Disability and Health (ICF)[1] provides a disablement framework that enables health professionals to maximize patient/client participation and function while minimizing disability. The current complex environment of health care and evolving patterns of health care delivery require a focus on multidisciplinary and interdisciplinary approaches to the total care of the patient.

For a health care team to function effectively, each member of the health care team must develop a positive attitude toward multidisciplinary and interdisciplinary collaboration. The collaborating health professional must understand the functional roles of each health care discipline within the team and must respect and value each discipline's input in the decision-making process of the health care team. Rehabilitation, particularly when related to orthotics and prosthetics, requires an interdisciplinary approach and lends itself well to collaboration among the various health professionals involved in the management of providing physical rehabilitation. Persons with orthopedic and neurologic impairments caused by a variety of health conditions require a wide range of expert knowledge and technical skills. The physician, prosthetist, orthotist, physical therapist, occupational therapist, nurse, and social worker are important participants in the rehabilitation team who will provide the knowledge and skills necessary for effective patient management. Understanding the roles and professional responsibilities of each of these disciplines maximizes the ability of the rehabilitation team members to function effectively to provide comprehensive care for the patient.

According to disability data from the American Community Survey 2017,[2] 12.6% of noninstitutionalized populations, male or female, of all ages and races regardless of ethnicity, reported having a disability. Nearly 24% (23.6%) of noninstitutionalized civilian veterans aged 21 to 64 years report having a Veterans Administration (VA) service–connected disability. In the 2015 US Congressional Research Service report, "A Guide to U.S. Military Casualty Statistics,"[3] the US military engagements that have continuously persisted for the past 15 years in Iraq, Afghanistan, and other countries have resulted in traumatic brain injury (TBI), amputation, and physical disabilities with life-long impairments.[4] The continued rise in persons with obesity has increased the number of people with diabetes. The Centers for Disease Control and Prevention 2017 Diabetes Surveillance System Report indicates 30.3 million Americans have diabetes[5]—1 out of every 10 persons; 84 million Americans (1 out of every 3 persons) have prediabetes (Box 1.1). Persons with diabetes are at risk for dysvascular

☆The author extends appreciation to Caroline C. Nielsen, whose work in prior editions provided the foundation for this chapter.

**Box 1.1 Fast Facts on Diabetes**

30.3 million Americans have diabetes (1 out of every 10 persons)
Diagnosed: 23.1 million people
Undiagnosed: 7.2 million people
84 million Americans have prediabetes (1 out of every 3 persons)

Source: https://www.cdc.gov/diabetes/pdfs/data/statistics/national-diabetes-statistics-report.pdf.

disease, such as peripheral arterial disease (PAD),[6] which often results in musculoskeletal and neuromuscular impairments to the lower extremities. Ischemic disease can cause peripheral neuropathy, loss of sensation, poor skin care and wound formation, trophic ulceration, osteomyelitis, and gangrene, which can result in the need for limb amputation.

Persons coping with illness, injury, disease, impairments, and disability often require rehabilitation inclusive of special orthotic and prosthetic devices to help with mobility, stability, pain relief, and skin and joint protection. Appropriate prescription, fabrication, instruction, and application of the orthotic and prosthetic devices help persons to engage in activities of daily living as independently as possible. Orthotists and prosthetists are health care professionals who custom-fabricate and fit orthoses and prostheses. Along with other health care professionals, including nurses, physical therapists, and occupational therapists, orthotists and prosthestists are integral members of the multidisciplinary and interdisciplinary rehabilitation teams responsible for returning patients to productive and meaningful lives. The WHO ICF[7] is a common framework to understand and describe functioning and disability. To make the ICF more applicable for everyday use, the WHO and ICF research branch created a process for developing core sets of data to be considered when addressing persons with disabilities. ICF categories, or ICF Core Sets,[8] facilitate the description of functioning by providing lists of essential categories that are relevant for specific health conditions and health care contexts. The use of the WHO ICF disablement framework enables health professionals to evaluate and support individuals with impairments that maximize function and minimize disability. The WHO ICF disablement framework has broadened considerably the original pathology model framework in which disability was a function of a particular disease or group of diseases.[9] In developing the ICF Core Sets, the WHO engages professionals from across health care disciplines to endorse a more inclusive model that uses expertise within the many sectors in rehabilitative care. A multidisciplinary approach to patient care in rehabilitation is the current standard when addressing the needs of persons with physical impairments, limitations, and disabilities. The 2016 American Heart Association (AHA)/American College of Cardiology (ACC) clinical guideline supports an interdisciplinary approach to the management of persons with PAD.[10] The AHA/ACC clinical guideline identifies a team of professionals representing different disciplines to assist in the evaluation and management of the patient with PAD. This chapter discusses the developmental history of the art and science of orthotics, prosthetics, and physical therapy as professions dedicated to rehabilitating persons with injury, impairment, and disability.

## Orthotists and Prosthetists

Orthotists provide care to persons with neuromuscular and musculoskeletal impairments that contribute to functional limitation and disability by designing, fabricating, and fitting orthoses or custom-made braces. The orthotist is responsible for evaluating the patient's functional and cosmetic needs, designing the orthosis, selecting appropriate components, and fabricating, fitting, and aligning the orthosis. The orthotist educates the patient and the care providers on appropriate use of the orthosis, care of the orthosis, and how to assess continued appropriateness of the orthosis (Figs. 1.1 and 1.2).

Prosthetists provide care to patients with partial or total absence of limbs by designing, fabricating, and fitting prostheses or artificial limbs. The prosthetist creates the design to fit the individual's particular functional and cosmetic needs; selects the appropriate materials and components; makes all necessary casts, measurements, and modifications (including static and dynamic alignment); evaluates the fit and function of the prosthesis on the patient; and teaches the patient how to care for the prosthesis (Figs. 1.3 and 1.4).

According to the US Department of Labor, Bureau of Labor Statistics, in 2016, there were 7500 certified orthotists and prosthetists practicing in the United States.[11] Individuals who enter the fields of orthotics and prosthetics must complete advanced education (beyond an undergraduate degree) and a residency program before becoming eligible for certification. Registered assistants and technicians in orthotics or prosthetics assist the certified practitioner with patient care and fabrication of orthotic and prosthetic devices.

**Fig. 1.1** Orthotist is evaluating the proper fit of a spinal orthosis to determine whether it meets the prescriptive goals and can be worn comfortably during functional activities or whether modifications need to be made.

**Fig. 1.2** Child is wearing a spinal orthosis during a physical therapy session. Orthotist is observing the child as she is engaged in therapeutic play, to assess the child's level of support and comfort while wearing the orthosis.


**Fig. 1.3** Prosthetist is assisting child in donning prosthetic limb. Prosthetist will check the prosthesis for alignment, fit, and comfort.

## History

The emergence of orthotics and prosthetics as health care professions has followed a course similar to the profession of physical therapy. Development of all three professions is closely related to three significant events in world history: World War I, World War II, and the onset and spread of polio in the 1950s. Unfortunately, it has taken war and disease to provide the major impetus for research and development in these key areas of rehabilitation.

Although the profession of physical therapy has its roots in the early history of medicine, World War I was a major impetus to its development. During the war, female "physical educators" volunteered in physicians' offices and Army hospitals to instruct patients in corrective exercises. After the war ended, a group of these "reconstruction aides" joined together to form the American Women's Physical Therapy Association. In 1922, the association changed its name to the American Physiotherapy Association and opened membership to men and aligned itself closely with the medical profession. In the late 1940s the Association had once again changed its name to the American Physical Therapy Association (APTA), as it remains at present.[12]

**Fig. 1.4** Prosthetist using computer-aided design in fabricating a lower-extremity prosthesis.

Until World War II, the practice of prosthetics depended on the skills of individual craftsmen. The roots of prosthetics can be traced to early blacksmiths, armor makers, other skilled artisans, and even the individuals with amputations, who fashioned makeshift replacement limbs from materials at hand. During the Civil War, more than 30,000 amputations were performed on Union soldiers injured in battle; at least as many occurred among injured Confederate troops. At that time, most prostheses consisted of carved or milled wooden sockets and feet. Many were procured by mail order from companies in New York or other manufacturing centers at a cost of $75 to $100 each.[13] Before World War II, prosthetic practice required much hands-on work and craftsman's skill. D.A. McKeever, a prosthetist who practiced in the 1930s, described the process: "You went to [the person with an amputation's] house, took measurements and then carved a block of wood, covered it with rawhide and glue, and sanded it." During his training, McKeever spent 3 years in a shop carving wood: "You pulled out the inside, shaped the outside, and sanded it with a sandbelt."[14]

The development of the profession of orthotics mirrors the field of prosthetics. Early "bracemakers" were also artisans such as blacksmiths, armor makers, and patients who used many of the same materials as the prosthetist: metal, leather, and wood. By the 18th and 19th centuries, splints and braces were also mass produced and sold through catalogs. These bracemakers were also frequently known as "bonesetters" until surgery replaced manipulation and bracing in the practice of orthopedics. "Bracemaker" then became a profession with a particular role distinct from that of the physician.[15]

World War II and the period following were times of significant growth for the professions of physical therapy, prosthetics, and orthotics. During the war, many more physical therapists were needed to treat the wounded and rehabilitate those who were left with functional impairments and disabilities. The Army became the major resource for physical therapy training programs, and the number of physical therapists serving in the armed services increased more than sixfold.[16] The number of soldiers who required braces or artificial limbs during and after the war increased the demand for prosthetists and orthotists as well.

After World War II, a coordinated program for persons with amputations was developed. In 1945, a conference of surgeons, prosthetists, and scientists organized by the National Academy of Sciences revealed that little scientific effort had been devoted to the development of artificial limbs. A "crash" research program was initiated, funded by the U.S. Department of Veterans Affairs Office of Scientific Research and Development and continued by the VA. A direct result of this effort was the development of the patellar tendon–bearing prosthesis for individuals with transtibial (below-knee) amputation and the quadrilateral socket design for those with transfemoral (above-knee) amputation. This program also included educating prosthetists, physicians, and physical therapists in the skills of fitting and training of patients with these new prosthetic designs.[16]

The needs of soldiers injured in the military conflicts in Korea and Vietnam ensured continuing research, further refinements, and development of new materials. The development of myoelectrically controlled upper extremity prostheses and the advent of modular endoskeletal lower extremity prostheses occurred in the post–Vietnam conflict era. The US Department of Defense reports data on the casualties from military engagements in Iraq and Afghanistan, including Operation Freedom's Sentinel; Operation Inherent Resolve; Operation New Dawn; Operation Iraqi Freedom; and Operation Enduring Freedom. Based on the 2015 Congressional Research Service report on the military casualties of war, 327,299 service men and women sustained TBI and 1645 sustained major limb amputations.[17]

The use of orthotics and prosthetics to support individuals with TBI and amputation is critical when seeking to reduce impairments and enhance functional abilities. The Veterans Health Administration Research Development is committed to exploring the use of new technology such as robotics, tissue engineering, and nanotechnology to design and build lighter, more functional orthoses and prostheses.[18]

The current term *orthotics* emerged in the late 1940s and was officially adopted by American orthotists and prosthetists when the American Orthotic and Prosthetic Association was formed to replace its professional predecessor, the Artificial Limb Manufacturers' Association. *Orthosis* is a more inclusive term than *brace* and reflects the development of devices and materials for dynamic control in addition to stabilization of the body. In 1948 the American Board for Certification in Orthotics and Prosthetics[19] was formed to establish and promote high professional standards.

Although the polio epidemic of the 1950s played a role in the further development of the physical therapy profession, this epidemic had the greatest effect on the development of orthotics. By 1970, many new techniques and materials, some adapted from industrial techniques, were being used to assist patients in coping with the effects of polio and other neuromuscular disorders. The scope of practice in the field of orthotics is extensive, including working with children with muscular dystrophy, cerebral palsy, and spina bifida; patients of all ages recovering from severe burns or fractures; adolescents with scoliosis; athletes recovering from surgery or injury; and older adults with diabetes, cerebrovascular accident, severe arthritis, and other disabling conditions.

Like physical therapists, orthotists and prosthetists practice in a variety of settings. The most common setting is the private office, where the professional offers services to a patient on referral from the patient's physician. Many large institutions, such as hospitals, rehabilitation centers, and research institutes, have departments of orthotics and prosthetics with on-site staff to provide services to patients. The prosthetist or orthotist may also be a supplier or fabrication manager in a central production laboratory. In addition, orthotists and prosthetists serve as full-time faculty in orthotic and prosthetic professional education programs. Orthotists and prosthetists also serve as residency directors and clinical educators in a variety of facilities for the year-long residency program required before the certification examination.

## Prosthetic and Orthotic Professional Roles and Responsibilities

With rapid advances in technology and health care, the roles of the prosthetist and orthotist have expanded from a technologic focus to a more inclusive focus on being a member of the rehabilitation team. Patient examination, evaluation, education, and treatment are currently significant responsibilities of practitioners. Most technical tasks are completed by technicians who work in the office, in the laboratory, or at an increasing number of central fabrication facilities. The advent and availability of modifiable prefabrication systems have reduced the amount of time that the practitioner spends crafting new prostheses and orthoses.

Current educational requirements reflect these changes in orthotic and prosthetic practice. Entry into professional training programs requires completion of a bachelor's degree from an accredited college or university, with a strong emphasis on prerequisite courses in the sciences. Professional education in orthotics or prosthetics requires an additional academic year for each discipline. Along with the necessary technical courses, students study research methodology, kinesiology and biomechanics, musculoskeletal and neuromuscular pathology, communication and education, and current health care issues. Orthotics and prosthetics programs are most often based within academic health centers or in colleges or universities with hospital affiliations. On completion of the educational and experiential requirements, the student is eligible to take the certification examinations. To address the rehabilitation needs of individuals who will benefit from the art and science of the fields of prosthetics and orthotics, physical therapists,

orthotists, prosthetists, and other members of the health care team must have discreet knowledge and skills in the management of persons with a variety of health conditions across the life span. Working as a rehabilitation team, physicians, nurses, prosthetists, orthotists, physical therapists, occupational therapists, social workers, patients, and family members seek to alleviate disease, injury, impairments, and disability by maximizing function.

## Disablement Frameworks

Historically, disability was described using a theoretical medical model of disease and pathology. Over time, various conceptual frameworks have been developed to organize information about the process and effects of disability.[20] Disablement frameworks in the past have been used to understand the relationship of disease and pathology to human function and disability.[20-23] The need to understand the impact that acute injury or illness and chronic health conditions have on the functioning of specific body systems, human performance in general, and on the typical activities of daily living from both the individual and a societal perspective has been central to the development of the disablement models. The biomedical model of pathology and dysfunction provided the conceptual framework for understanding human function, disability, and handicap as a consequence of pathological and disease processes.

The Nagi model was among the first to challenge the appropriateness of the traditional biomedical model of disability.[21] Nagi developed a model that looked at the individual in relationship to the pathologic condition, functional limitations, and the role that the environment and society or the social environment played. The four major elements of Nagi's theoretical formulation included active pathology (interference with normal processes at the level of the cell), impairment (anatomic, physiologic, mental, or emotional abnormalities or loss at the level of body systems), functional limitation (limitation in performance at the level of the individual), and disability. Nagi defined disability as "an expression of physical or mental limitation in a social context."[21] The Nagi model was the first theoretical construct on disability that considered the interaction between the individual and the environment from a sociologic perspective rather than a purely biomedical perspective. Despite the innovation of the Nagi model in the 1960s, the biomedical model of disability persisted.

In 1980, the WHO developed the International Classification of Impairments, Disabilities, and Handicaps (ICIDH) to provide a standardized means of classifying the consequences of disease and injury for the collection of data and the development of social policy.[24] This document provided a framework for organizing information about the consequences of disease. However, it focused solely on the effects of pathologic processes on the individual's activity level. Disability was viewed as a result of an impairment and considered a lack of ability to perform an activity in the normal manner. In 1993, the WHO began a revision of ICIDH disablement framework that gave rise to the concept that a person's handicap was less related to the health condition that created a disadvantage for completing the necessary life roles but rather to the level of participation that the person with the health condition was able to engage in within the environment. The concept of being handicapped was changed to be seen as a consequence of the level of participation for the person and the interaction within an environment.

The Institute of Medicine enlarged Nagi's original concept in 1991 to include the individual's social and physical environment (Fig. 1.5). This revised model describes the environment as "including the natural environment, the built environment, the culture, the economic system, the political system, and psychological factors." In this model, disability is not viewed as a pathologic condition residing in a person but instead is a function of the interaction of the person with the environment.[25]

In 2001 the ICIDH was revised to ICIDH-2 and renamed "International Classification of Functioning, Disability and Health" and is commonly referred to as ICF.[26] The ICF disablement framework includes individual function at the level of body/body part, whole person, and whole person within a social context. The model helps in the description of changes in body function and structure, what people with particular health conditions can do in standard environments (their level of capacity), and what they actually do in their usual environments (their level of performance). One of the major innovations of the ICF model is the presence of an environmental factor classification that considers the role of environmental barriers and facilitators in the performance of tasks of daily living. Disability becomes an umbrella term for impairments, activity limitations, and participation restrictions. The ICF model emphasizes health and functioning rather than disability. The ICF model provides a radical departure from emphasizing a person's disability to focusing on the level of health and facilitating an individual's participation to whatever extent is possible within that level of health. In the ICF, disability and functioning are viewed as outcomes of interactions between health conditions (diseases, disorders, and injuries) and contextual factors (Fig. 1.6).

As is stated on the ICF website,[27] "To make the ICF more applicable for everyday use, WHO and the ICF Research Branch created a process for developing core sets of ICF categories, or "ICF Core Sets."[28] ICF Core Sets facilitate the description of functioning, for example, in clinical practice by providing lists of essential categories that are relevant for specific health conditions and health care contexts. These ICF categories were selected from the entire ICF following a scientific process based on preparatory studies and the involvement of a multidisciplinary group of experts.

The evolution of disablement frameworks from the biomedical models to the newer, contemporary models that include the biopsychosocial domains provides theoretical constructs that guide the rehabilitation professional in clinical practice. The development of the ICF Core Sets derived from input members of the rehabilitation team is essential for clinical decision-making that addresses pathologic conditions or disease processes, impairments, functional limitations, and disabilities. Interrelationships among all four of these elements are the focus of the rehabilitation team. The physical therapist, orthotist, prosthetist, and other team members work together to create the most effective outcome for the patient by identifying and addressing pathologic processes, functional limitations, impairments, and disability. The ICF Core Sets and ICF Documentation System[29] allow for data collection that can be useful in research leading to

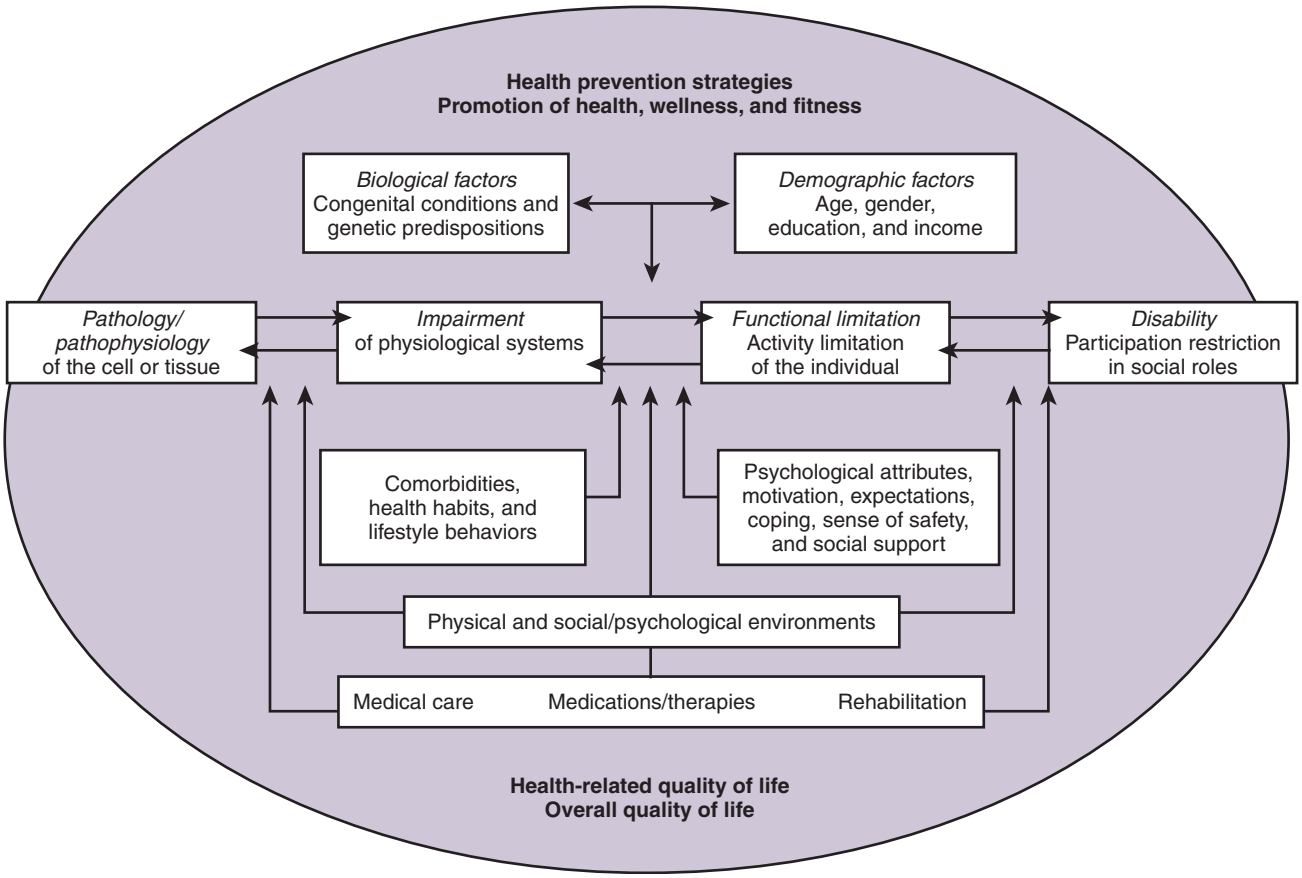


**Fig. 1.5** The revised Institute of Medicine/Nagi model of the disablement process considers the impact of pathologic conditions and impairment, as well as intraindividual and extraindividual factors, that may influence functional limitation and disability affecting health-related and overall quality of life. (Modified from Guccione AA. Arthritis and the process of disablement. *Phys Ther.* 1994;74[5]:410, the Nagi Model.)

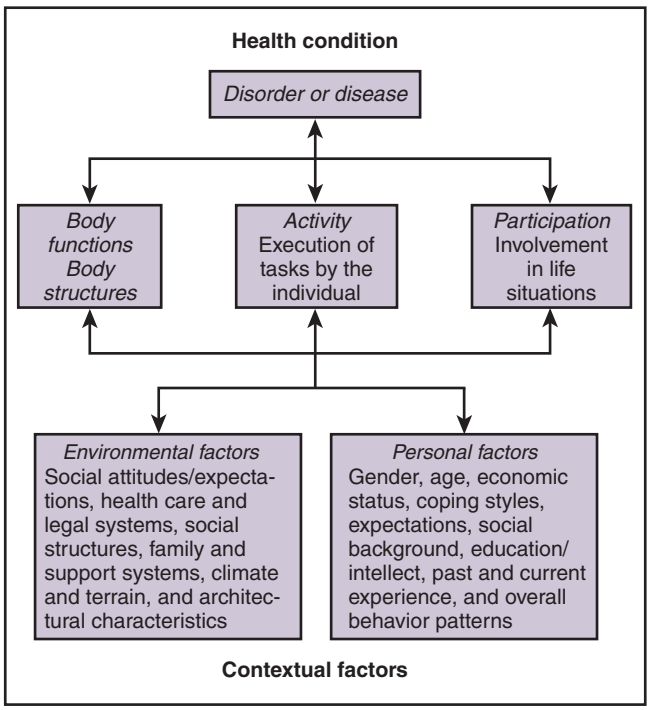


**Fig. 1.6** World Health Organization International Classification of Functioning, Disability and Health Framework. (Modified from World Health Organization. *Towards a Common Language for Functioning, Disability and Health*. Geneva: World Health Organization; 2002: 9–10.)

improved patient interventions, assessment of patient outcomes, and development of health and social policies.

## Characteristics of Rehabilitation Health Care Teams

The complexity of the health care arena and the level of care required by individuals in rehabilitation care settings require the collaboration of many health care practitioners with varied professional skills who can form multidisciplinary, interdisciplinary, and transdisciplinary teams as needed.[30-32] The multidisciplinary rehabilitation team is composed of the different health professionals such as the physician, nurse, physical therapist, occupational therapist, prosthetist, orthotist, and social worker. Each professional operates with an area of specialization and expertise. The members of the multidisciplinary team work parallel to one another, and the medical record is the collecting source for the information gleaned and shared. Interdisciplinary teams also include the representatives of a variety of health disciplines, but there is interdependence among the professionals. In the interdisciplinary team process, there is structure and organization that promotes program planning to support patient-centered care through effective communication and effective clinical management. Clinical practice guidelines that seek to promote best practices for

**Table 1.1** AHA/ACC Clinical Guidelines for Management of Patients With Lower-Extremity Peripheral Artery Disease

- Nurses
- Orthopedic surgeons and podiatrists
- Endocrinologists
- Internal medicine specialists
- Infectious disease specialists
- Radiology and vascular imaging specialists
- Physical medicine and rehabilitation clinicians
- Orthotics and prosthetics specialists
- Social workers or exercise physiologists
- Physical and occupational therapists
- Nutritionists/dieticians

Recommendations for interdisciplinary care team members include: Vascular medical and surgical specialists (i.e., vascular medicine, vascular surgery, interventional radiology, interventional cardiology).

*ACC*, American College of Cardiology; *AHA*, American Heart Association.

From Gerhard-Herman MD, et al. 2016 AHA/ACC Lower Extremity PAD Guideline. 2016 AHA/ACC Guideline on the Management of Patients With Lower Extremity Peripheral Artery Disease. A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines. *Journal of the American College of Cardiology*. 2017;69(11):1465-1508.

specific health conditions often include information on the interdisciplinary team.[33] Table 1.1 provides an example of the suggested composition of an interdisciplinary team for the management of patients with PAD. The interdisciplinary team members work to establish goals for the team that drive the rehabilitation process for the patient. Interdisciplinary teams traditionally follow a patient-centered approach to goal setting. Establishing the patient as the focus of the work for the team, the interdisciplinary team members collaborate to execute the goals and meet the desired outcomes. Most team processes in rehabilitation centers strive for an interdisciplinary team approach that promotes patient-centered care. Each discipline works within its scope of practice to optimize care through coordinated efforts.

Transdisciplinary teams are comprised of the same professional members identified in the multidisciplinary and interdisciplinary teams; however, the team members in the transdisciplinary model function differently in that they share clinical responsibilities and overlap in duties and responsibilities. In the transdisciplinary model of team building, the professional roles and responsibilities are so familiar to the team members that there is an interchange of tasks and functions.[34] Transdisciplinary teams engage in release of professional roles typical to the discipline in an effort to have the patient receive the interventions needed within a context that is supportive of the learning and the practice. The transdisciplinary model is operational in the management of infants and toddlers who receive early intervention rehabilitation services and have an Individualized Family Service Plan (IFSP).[35]

Two major issues emerging in health care that affect health care professionals include (1) the need for health care professionals with advanced education and training in specialty and subspecialty areas and (2) the need for collaboration among health practitioners to ensure efficiency of patient management that results in best practice and improves patient outcomes. The information explosion in health care, particularly in rehabilitation, has led to increasing specialization and subspecialization in many fields. The multidisciplinary, interdisciplinary, or transdisciplinary health care team concept has evolved, in part, because no single individual or discipline can have all the necessary expertise and specialty knowledge required for high-quality care, especially the care of patients with complex disorders. Rehabilitation health care teams provide patient care management approaches that capitalize on clinical expertise by engaging members from diverse medical and rehabilitation professions working together, collaborating, and communicating closely to optimize patient care.[36]

*Collaboration* is defined as a joint communication and decision-making process with the goal of meeting the health care needs of a particular patient or patient population. Each participant on the rehabilitation team brings a particular expertise, and leadership is determined by the particular rehabilitation situation being addressed. The rehabilitation team has the opportunity to meet and engage in "asking the answerable questions" that are critical in current clinical practice when engaging in an evidence-based model of practice. According to Strauss and colleagues,[37] evidence-based practice is the integration of the best research evidence, clinical expertise, and patient values. Evidence-based practice and clinical decision-making enhance the role of the rehabilitation team professionals as they share their clinical insights supported by historical and current evidence. Rehabilitation teams that are diverse in professional representation can bring a wide perspective of expertise on particular rehabilitation issues. With this perspective, clinical decision-making becomes a more inclusive process.

The role of the health care professional on a rehabilitation team begins during professional education. Rehabilitation sciences health professionals must work at understanding, evaluating, and analyzing the many facets of health care that require specialized professionals who will work to meet the goals and objectives of the specialty and of health care delivery on the whole. The formation of a rehabilitation team provides a cohort of professionals who individually and collectively strive for effective and efficient management of patients. The team process allows for a deeper understanding of and appreciation for the contributions of the other rehabilitation disciplines in the assessment and treatment of the patient and management of patient problems.

In addition to discipline-specific skills and knowledge, health professionals must be aware of the interrelationships among health care workers. One of the major barriers to effective team functioning is a lack of understanding or misconception of the roles of different disciplines in the care of the whole patient.[38] A clear understanding of the totality of the health care delivery system and the role of each professional within the system increase the potential effectiveness of the health care team. A group of informed, dedicated health professionals working together to set appropriate goals and initiate patient care to meet these goals uses a model that exceeds the sum of its individual components.

Almost all current rehabilitation health care is provided in a team setting using a patient-centered approach. This integrated approach facilitates appreciation of the patient as a person with individual strengths and needs rather than as a dehumanized diagnosis or problem. The diverse perspectives and knowledge that are brought to the rehabilitation process by the members of the interdisciplinary team provide insight into all aspects of the patient's concerns

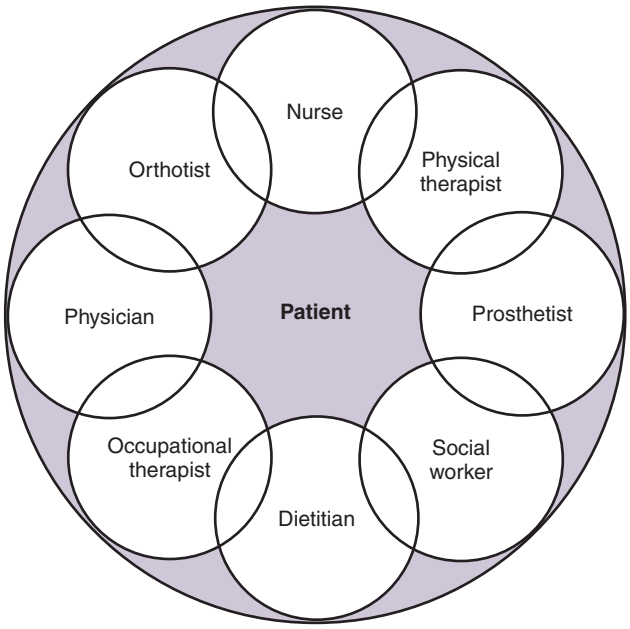


**Fig. 1.7** Patient-centered rehabilitation teams. Key components of the successful health care team are a clear understanding of the role, responsibilities, and unique skills and knowledge of each member of the rehabilitation team, combined with open and effective communication.

(Fig. 1.7). Conceptually, all members of the health care team contribute equally to patient care. The contribution of each is important and valuable; otherwise, quality of patient care and efficacy of intervention would be diminished. Although one member of the team may take an organization or management role, decision-making occurs by consensus building and critical discussion. Professionals with different skills function together with mutual support, sharing the responsibility of patient care.

Effective team-based health care assumes that groups of health care providers representing multiple disciplines can work together to develop and implement a comprehensive, integrated treatment plan for each patient.

Much of our understanding of team function is drawn from organization and management research literature, the theories of which provide insight and information on how interdisciplinary teams operate and the factors that facilitate or inhibit their effectiveness. A number of factors are important influences on health professionals' perception of team membership that can be positive or negative to the team process.

## VALUES AND BEHAVIORS

Some of the factors that tend to limit the effectiveness of a work group are large group size, poor decision-making practices, lack of fit between group members' skills and task demands, and poor leadership.[39-41] Other factors that influence team dynamics are classified as formal (tangible or visible) and informal (submerged). Formal factors include the policies and objectives of the group or its parent organization, the systems of communication available to the group, and the job descriptions of its members. Informal factors, which are often less obvious but equally influential on group process, include working relationships among team members; power networks within and external to the group; and the values, beliefs, and goals of individuals within the group. Team-building initiatives are often focused on the formal, or visible, areas, but informal communication, values, and norms play key roles in the functioning of the health care team.

A variety of characteristics and considerations also enhance the effectiveness of the interdisciplinary health care team. In addition to having strong professional backgrounds and appropriate skills, team members must appreciate the diversity within the group, taking into account age and status differences and the dynamics of individual professional subgroups.[42] The size of the team is also important: the most capable and effective teams tend to have no more than 12 members. Team members who know each other and are aware of and value each other's skills and interests are often better able to set and achieve goals. Clearly defined goals and objectives about the group's purpose and primary task, combined with a shared understanding of each member's roles and skills, increase the likelihood of effective communication.

Values and behaviors that facilitate the collaborative team care model include the following:

- Trust among members that develops over time as members become more familiar with each other
- Knowledge or expertise necessary for the development of trust
- Shared responsibility for joint decision-making regarding patient outcomes
- Mutual respect for all members of the team
- Two-way communication that facilitates sharing of patient information and knowledge
- Cooperation and coordination to promote the use of skills of all team members
- Optimism that the team is indeed the most effective means of delivering quality care

In the early stages of development, it is essential that the team spend time developing goals, tasks, roles, leadership, decision-making processes, and communication methods. In other words, the team needs to know where it is going, what it wants to do, who is going to do it, and how it will get done. One of the most important characteristics of an effective health care team is the ability to accommodate personal and professional differences among members and to use these differences as a source of strength. The well-functioning team often becomes a means of support, growth, and increased effectiveness and professional satisfaction for the physical therapist and other health professionals who wish to maximize their strengths as individuals while participating in professional responsibilities.

## REHABILITATION TEAMS

The interdisciplinary health care team has become essential in the rehabilitation of patients whose body function and level of participation in the tasks of daily living could be enhanced by assistive technology such as an orthosis or prosthesis. The complexity of the rehabilitation process and the multidimensional needs of patients frequently

require the expertise of many different professional disciplines. The rehabilitation team is often shaped by the typical needs and characteristics of the patient population that it is designed to serve. The individuals most often represented on the rehabilitation team include one or more physicians with specialties in rehabilitation medicine, orthopedics, vascular surgery or neurology; nurses; prosthetists and/or orthotists; physical therapists; occupational therapists; dietitians; social workers; and vocational rehabilitation counselors, as well as patients and caregivers (see Fig. 1.7). Each member of the interdisciplinary team has an important role to play in the rehabilitation of the patient. Patient education is often one of the primary concerns of the team. Imparting information regarding the health condition, etiology, treatment, progression, management, and prognosis helps patients to become active partners in the rehabilitation process rather than passive recipients of care. Patient education addresses prevention and treatment strategies; patients and their families are able to identify their needs and concerns and communicate them to the team members. Each member of the team has the responsibility for contributing to patient education so that patients have the information needed for an effective partnership and positive outcome of rehabilitation efforts.

Research studies across a wide variety of medical conditions and health disciplines contain evidence that patients who feel prepared and informed are most likely to invest in and comply with recommended interventions and often have the most positive health outcome. Ideally, patient education about amputation and prosthetics begins in advance of, or at least immediately after, the amputation surgery.[43]

The Department of Veterans Affairs has instituted a system of care for US veterans with limb amputations, using outcome measures. The Amputation System of Care (ASoC) was introduced in 2008 with a goal of providing "lifelong care for service members with combat-related amputations from military conflicts in Iraq and Afghanistan and for veterans with amputations from diseases such as diabetes and peripheral vascular disease." The ASoC provides coordinated care that enables persons with amputation to receive the prosthetic technology and rehabilitation management that will maximize function and independence.[44]

Coordinated patient-centered care by an interdisciplinary rehabilitation team is just as essential for effective rehabilitation of children as it is for adults. For children with myelomeningocele or cerebral palsy, the broad knowledge base available through team interaction provides a stronger foundation for tailoring interventions to the ever-changing developmental needs of the child and family. Initially, the optimal delivery of care for children is best provided in a comprehensive health care setting in which the various specialists can provide a truly collaborative approach. Orthopedic surgeons, neurologists, orthotists, prosthetists, physical therapists, occupational therapists, nurses, dietitians, social workers, psychologists, and special education professionals may all be involved in setting goals and formulating and carrying out plans for intervention and outcomes assessment.

The concept of a multidisciplinary pediatric clinic team was formulated as World War II came to an end.[45] This structure has evolved further over the years and is particularly effective for the more complex orthotic and prosthetic challenges. A "mini-team" consisting of the patient's physician, a physical therapist, and a prosthetist or orthotist can usually be assembled, even in a small town with few facilities. Regardless of its size, an effective team views the child and family from a holistic perspective, with the input from each specialty being of equal value. Under these circumstances, the setting of treatment priorities, such as whether prosthetic fitting or training in single-handed tasks is most appropriate at a child's current age or developmental level, is made on the basis of the particular needs of the individual. Children with orthotic and prosthetic needs are followed in the community and within the school setting. As appropriate, a child may receive rehabilitation or habilitation services under the Individuals with Disabilities Education Act (IDEA).[46] The rehabilitation/educational team is a diverse group of health care professionals, educators, family, and caregivers, each with essential skills necessary to address the needs of the child that encourage maximum participation in tasks of daily living. Each member of the team works in a collaborative manner with the family and caregivers and with the child's teachers and other health professionals to ensure that the goals of the IFSP or the Individualized Education Plan (IEP) are addressed and met. Clear and frequent communication is essential for the team to function effectively and to achieve the desired outcomes for the child.

## Case Example 1.1 **Interdisciplinary Teams**

P.G. is a 23-year-old man admitted to a level 3 trauma center 2 weeks ago after sustaining severe crush injuries to both lower extremities and a closed-head injury in an accident involving a motorcycle and a sport utility vehicle. Initially unconscious with a Glasgow Coma Scale score of 8, P.G. was placed on life support in the emergency department. Radiographs revealed a severely comminuted fracture of the distal right femur and displaced fractures of the left tibia and fibula at midshaft. Examination revealed partial-thickness "road burn" abrasions on the left anterior thorax and thigh; these were thoroughly cleaned and covered with semipermeable dressings. A computed tomography scan of his cranium and brain revealed a subdural hematoma over the left Sylvian fissure and moderate contusion of the anterior pole and undersides of the frontal lobes. Arteriography indicated rupture of the right femoral artery 4 inches above the knee. Given the extent of the crush injuries, the trauma team determined P.G. was not a candidate for reconstructive surgery to salvage his right limb.

P.G. was taken to the operating room, where a standard-length transfemoral amputation was performed on the right lower extremity. Simultaneously, orthopedic surgeons performed an open-reduction internal fixation with an intramedullary rod in the tibia and used surgical plates and screws to repair the fibula. Neurosurgeons drained the subdural hematoma through a burr hole in his skull. P.G. was started on high-dose broad-spectrum antibiotics in the operating room. He was transferred to the surgical intensive care unit for postoperative care.

P.G. was weaned from the ventilator and is now functioning at a Rancho Los Amigos Scale level of 7. He is able to follow one- and two-step commands but becomes easily confused and