MEDICAL ASPECTS OF DISABILITY for the REHABILITATION PROFESSIONAL
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MEDICAL ASPECTS OF DISABILITY for the REHABILITATION PROFESSIONAL

Fifth Edition

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Steven R. Flanagan, MD
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Editors
With gratitude for my family, teachers, and students.
—Alex Moroz

Many thanks to my friends and family, especially Lou, for their inspiration and support. In particular, a debt of gratitude is extended to Linda Yuen-Moy for her persistence, determination, and hard work, without which this text would not have been possible.
—Steven R. Flanagan

To my wife, Diane, for her love, inspiration, extraordinary support, and cherished friendship; to my daughter, Lauren; my son, Andrew; my son-in-law, Lee; my daughter-in-law, Brooke; and to my grandchildren, Alec, Will, Jake, and Kinley, each of whom is a constant source of joy and love in my life.
—Herb Zaretzky
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Preface

The delivery of medical and rehabilitative care is in continuous and rapid flux. Shrinking resources, growing regulatory pressures, and novel technologies are only some of the factors that significantly impact all health care. Parallel to increasing efforts to establish evidence-based rehabilitation practices, economic and political forces continue to challenge the delivery of care to people with disabilities. This fifth edition of Medical Aspects of Disability for the Rehabilitation Professional has been substantially updated to reflect advancements in medical care for specific disabling conditions as well as changes in forces that impact the delivery of that care. In particular, reviews of relevant legislature, quality improvement frameworks, accreditation systems, and trends in payments for rehabilitation and other health care services complement the core areas of medical conditions and clinical care for people with disabilities. Chapters in the fifth edition have been either substantially updated by previous authors or rewritten by new contributors. New chapter authors, among the most widely respected authorities in their respective fields, include Aleksandar Beric (neuromuscular disorders), Heidi N. Fusco and Koto Ishida (stroke), Mary Anne Loftus (rehabilitation nursing), and Charles Kim (integrative medicine), among others. Our primary goal in this latest edition is to provide health care professionals, teachers, and students with a comprehensive guide that addresses the conditions and topics impacting people with physical, developmental, and cognitive disabilities.

Alex Moroz, MD
The History of Rehabilitation

In the ancient world, people with disabilities were summarily excluded from everyday life (Conti, 2014). The notion that disabilities were punishments from the gods and deities was widely accepted. Disabilities were assumed to be the direct result of one’s moral failings, sins, or acts against the gods. People with disabilities were thus prescribed complete removal from society. Unfortunately, this provides us with little information about disabilities of the time—the disabled were hidden away to live a life of reclusion and banishment. Individuals unfortunate enough to be suffering from a physical affliction were left to their own resources and often labeled as cripples, invalids, or worse. Because people were not widely treated for disabilities but were rather removed from society, the treatments for disabilities did not advance for thousands of years.

The first known medical document was discovered in Egypt and dates back to 2000 BCE. This document is known as The Edwin Smith Surgical Papyrus (named after the American Egyptologist who purchased the treatise in 1862). The treatise describes the general sentiment of how most disabilities were treated, which could be summarized as sparse at best. For example, when describing spinal cord injuries, this injury was often deemed “an ailment not to be treated” because treatment options were nonexistent (Donovan, 2007).

A seismic shift occurred when Hippocrates (460–370 BCE), the father of modern medicine, started to categorize illness and disability in terms of physiology as opposed to divine affliction. This, coupled with the Greek focus on physical abilities and conditioning as the Olympic games were becoming of paramount importance in society, helped to usher in an era and culture of physical training and interest in the effects of exercise and rehabilitation for peak performance. Soldiers and athletes were considered precious commodities, and they provided numerous subjects for case studies.

As power shifted from Greece to Rome, so did the medical leaders with the resources to study disability. The famed physician Galen (130–200) in the first century CE recognized the association between physical activity and medical outcomes. Because of the numerous Roman military campaigns at the time, Galen had ample soldiers as subjects to work with. He researched medical rehabilitation of the war injuries that were common at the time. As we shall see, wars tragically continue to provide fodder for research advances in rehabilitation.

Wars often produce many injuries and conditions that require rehabilitation. A common war injury is amputation. The French surgeon Paré (1510–1590) is credited with inventing modern lower limb prostheses (Conti, 2014). In the Middle Ages, prostheses were made of metal. These early prostheses were very heavy and, as the reader can easily imagine, very uncomfortable. Paré was also credited with establishing that phantom limb pain (a condition in which a limb that is no longer present continues to provide the sensation of pain) was of cerebral origin.

The Renaissance brought advancements in the technical study and understanding of disability and disease especially in terms of anatomy and the study of kinetics (Conti, 2014). In addition, the Renaissance period also put forward the practice and idea of disability prevention using “medical gymnastics.” Medical gymnastics was the term used at the time to describe therapeutic exercises designed with the aim of helping patients recover from a physical disability or impairment.
One monumental advancement in the history of rehabilitation was by the Swiss physician Joseph Clément Tissot (1747–1826). He proposed early mobilization for surgical patients. Traditionally, bedrest was prescribed for almost all surgical and nonsurgical patients. Tissot proposed moving or mobilizing patients and getting them out of bed quickly. This proved to be beneficial, and his principles are still being slowly advanced to this day (Kress, 2014).

It was the Swedish teacher of “medical gymnastics,” Pehr Henrik Ling (1776–1839), who put forth the direct link between medical rehabilitation and functional recovery. Function refers to one’s ability to engage with one’s surroundings and the environment. It was a fight indeed, as light exercise and gentle massage were the standard of care (Conti, 2014). Ling realized that more aggressive rehabilitation often resulted in better outcomes for patients. It is interesting because even when we fast-forward to today, we have not found the ceiling effect in terms of how far we can and should progress patients in terms of the intensity of the rehabilitation program.

Despite these pockets of advances in the history of rehabilitation (and with the slowly growing notion that disabilities were not caused by divine punishment), most patients with disabilities were treated by their families or in religious establishments until the latter part of the 20th century (Ohry, 2004). In fact, General George Patton (1885–1945), who is famous for many highly successful campaigns in World War II, sustained a spinal cord injury shortly after returning from the war. It is said that he was well aware (likely from seeing injured soldiers firsthand) that there were no cures or efficacious treatments available, and thus he refused all treatments. Patton died as a result of his injuries in the hospital on December 21, 1945 (Donovan, 2007). It was Alexander Fleming’s discovery of penicillin that greatly decreased deaths from infections, including those seen in spinal cord injury care, and a host of other disabilities that revolutionized all of medicine, including physical medicine and rehabilitation (PM&R; Donovan, 2007).

It was not until the early 1900s that rehabilitation as a profession started to gain prominence, even though it was initially viewed in large part as quackery (Folz, Opitz, Gelfman, & Peters, 1997). The struggle for legitimacy continued during much of the early years as the field developed.

Two icons in the field who transformed and essentially established rehabilitation as a profession were Frank H. Krusen, MD, and Howard A. Rusk. Drs. Krusen and Rusk were instrumental in creating the scope of the field as it is known today. Dr. Krusen’s (1898–1973) interest in rehabilitation was shaped by personal experience. While working in his first year of surgical residency training, he was infected with tuberculosis (Folz et al., 1997). He spent 5 months in a sanitarium, during which time he recognized that he and other patients were becoming physically deconditioned, causing them to become increasingly more dependent on the institution for care. It was then that he came up with the idea of physical rehabilitation with an emphasis on social reintegration, physical reconditioning, and vocational rehabilitation as essential components of convalescence, which ultimately became his life’s work.

The American Medical Association (AMA) did not initially view physical rehabilitation favorably. It was not until 1939 that the first scientific paper on rehabilitation was accepted in a medical journal (Folz et al., 1997). Dr. Krusen experienced great resistance from several groups that organized against him. His most significant opponents were from the fields of orthopedics and pediatrics as well as from the National Foundation for Infantile Paralysis (Peters, Gelfman, Opitz, & Folz, 1997). Many were concerned about the use of the word “rehabilitation” in this developing specialty because it was felt to have a place in many other disciplines.

Dr. Howard Archibald Rusk (1901–1989) had a similar insight as Dr. Krusen. Although he is often mistaken for a physiatrist, Howard Rusk was an internist who organized comprehensive medical rehabilitation departments in Army Air Corps hospitals during World War II (Peters et al., 1997). While working in medical rehabilitation, he noticed that the soldiers were becoming deconditioned and listless during their convalescence. Rusk organized academic classwork and physical exercise during the soldiers’ hospitalization. He also emphasized interdisciplinary teams and psychosocial functioning in addition to physical and vocational rehabilitation (Peters et al., 1997). Through his work, soldiers regained...
physical fitness and were able to return to active duty at a faster pace while experiencing significantly lower rates of hospital readmission (an important concept that is still being analyzed and studied today). He also included military training as part of the academic coursework provided to the soldiers to enhance their performance when they returned to active duty. For example, he organized small replicas of German planes to cycle over the soldiers’ hospital beds to assist in identifying them when they returned to the battlefield (Rusk, 1977).

Rusk was also a pioneer in the concept and implementation of early mobilization after illness or injury. He conducted experiments to analyze the impact of returning to activity quickly after surgery, and the initial findings were favorable. This success spurred further research, and like the earlier work of Joseph Clément Tissot, research into early mobilization is continuing to take shape and advance today.

When Dr. Rusk completed his military service, he petitioned the AMA to start residencies in medical rehabilitation. The AMA deferred to the Council on Physical Medicine because of the similarities of the two fields (Peters et al., 1997). Dr. Krusen also recognized the close association, and with their backing, the AMA Council on Physical Medicine approved a motion to change the residencies to a combination of physical medicine and rehabilitation (Peters et al., 1997). Dr. Rusk, who is generally recognized as the “father of comprehensive rehabilitation,” went on to teach and train physicians across the United States and throughout the world, including Russia, Korea, China, and Vietnam.

Just as World War II shaped Rusk’s views and thoughts on rehabilitation, the wars in Afghanistan and Iraq have also profoundly influenced the field in more recent times. Many soldiers have returned from combat with amputations, traumatic brain injuries (TBI), multisystem blast injuries, and post-traumatic stress disorder (PTSD). There has been an increase in research and development in these areas because of the prevalence of these injuries and the desire to help the soldiers return to productive, functional, and meaningful lives. As described throughout this book, the reader will learn of recent advances in the care and rehabilitation for people with conditions such as limb loss and TBI resulting from these conflicts and other more common causes (e.g., motor vehicle accidents) of disability.

DEFINITIONS AND EPIDEMIOLOGY

“Physical rehabilitation in its essence is the preservation and restoration of function” (anonymous; Haig, Nagy, Lebreck, & Stein, 1995). A significant portion of the U.S. population lives with physical disabilities. Rehabilitation is a process aimed at enabling people with disabilities to reach and maintain their optimal physical, sensory, intellectual, psychological, vocational, social, and functional potential. Rehabilitation provides people with disabilities the tools they need to attain greater independence. In 2013, the World Health Organization (WHO) estimated that 12.6% of the world’s population experienced some form of disability or impairment. The number of people with disabilities is increasing due to population growth, aging, emergence of chronic diseases, increasing motor vehicle use, and medical advances that preserve and prolong life. The most common causes of impairment and disability include chronic diseases such as diabetes, cardiovascular disease, cancer, traumatic injuries, mental impairments, birth defects, malnutrition, HIV/AIDS, and other communicable diseases. These conditions are creating overwhelming demands for health and rehabilitation services (WHO, 2014). Managing these conditions is one of the biggest challenges our health care system faces as we move through the 21st century. People are living longer, yet the percentage of those living with chronic diseases has increased significantly over the past two decades. Between 110 million and 190 million adults worldwide have significant difficulties in functioning. With proper care, the onset and progression of these diseases can be better contained and controlled for many years. In addition to the suffering and early death they can cause, “these chronic conditions cost a staggering $1.7 trillion yearly” (www.barackobama.com, 2009 and WHO December 2014).

According to the U.S. Census Bureau American Community Survey (ACS), the Disability Statistics Annual Report classifies disability into one or more of six categories (hearing, visual, cognitive,
ambulatory, self-care, independent living). The 2013 annual report indicates that 12.6% of the entire population has a disability (one or more of the six listed categories of disability). However, the percentage of disability increases over time as individuals age:

<table>
<thead>
<tr>
<th>Disability Rate</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.8%</td>
<td>Less than 4 years old</td>
</tr>
<tr>
<td>5.3%</td>
<td>5 to 15 years old</td>
</tr>
<tr>
<td>5.6%</td>
<td>16 to 20 years old</td>
</tr>
<tr>
<td>10.8%</td>
<td>21 to 64 years old</td>
</tr>
<tr>
<td>25.8%</td>
<td>65 to 74 years old</td>
</tr>
<tr>
<td>50.7%</td>
<td>Greater than 75 years old</td>
</tr>
</tbody>
</table>

People with disabilities have less access to health care services and therefore experience unmet health care needs. Rehabilitation provides people with disabilities the tools they need to attain greater independence through the continuum.

While some health conditions associated with disability result in poor health and extensive health care needs, others do not. However all people with disabilities have the same general health care needs as everyone else, and therefore need access to mainstream health care services. Article 25 of the UN Convention on the Rights of Persons with Disabilities (CRPD) reinforces the right of persons with disabilities to attain the highest standard of health care, without discrimination. (www.un.org/en/universal-declaration-human-rights)

The International Classification of Functioning, Disability and Health (ICF) defines disability as an umbrella term for impairments, activity limitations, and participation restrictions. Disability is the interaction between individuals with a health condition (e.g., cerebral palsy, Down’s syndrome, and depression) and personal and environmental factors (e.g., negative attitudes, inaccessible transportation and public buildings, and limited social supports).

In the 66th World Health Assembly (May 2013), it was recognized that disability is a human rights issue and a development issue. The UN General Assembly has continued focused work in these two key areas around the world.

The following text consists of a brief description of the most common team members.

The patient is by far the most important member of the interdisciplinary team and should be involved in all decisions regarding his or her care. If the patient (or the designee, if the patient is incapable of participation) is not included or is not in agreement with the plan of treatment, rehabilitation is unlikely to succeed.

OTs are licensed professionals who help promote health and enhance independence in the performance of activities of daily living (ADLs) for
people with disabilities. OTs assess people’s skills and limitations regarding ADLs and use meaningful and purposeful activities in addition to specialized equipment and adaptive aids to promote independent function.

PTs are licensed professionals who provide services to patients with physical impairments, functional limitations, disabilities, or changes in function and health resulting from injury or disease. PTs assess and treat bed mobility, the ability to move from place to place (e.g., wheelchair to bed), ambulation skills, balance, strength, range of motion, and function.

Physiatrists are physicians specializing in the field of PM&R and lead the rehabilitation team. After reviewing the history and performing the physical examination, the physiatrist prescribes the rehabilitation program and provides medical treatment to people with disabilities.

Psychologists are licensed professionals who assess patients’ cognitive status and mental health. Psychologists help emotionally distressed patients adjust to life that has changed due to injury or illness and provide therapy to improve cognitive performance when necessary.

TRSs are trained and certified to provide treatment, education, and recreational services to help people with illnesses and disabilities develop leisure activities that enhance their health, functional abilities, independence, and quality of life.

RNs are licensed professionals responsible for monitoring patients’ medical status including, but not limited to, vital signs, skin integrity, and sleep status. RNs also evaluate the patient’s mental

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**FIGURE 1.1** Patient-centered interdisciplinary team approach.
state, medication usage and effectiveness, pain, and bowel and bladder function, and provide essential education to both patients and their families. Many rehabilitation units have RNs who have a specialty certification in rehabilitation (Certified Rehabilitation Registered Nurse [CRRN]).

SLPs are licensed professionals who assess the patient’s ability to communicate by both spoken and written language in addition to evaluating swallowing ability, which is often impaired following brain injury. They provide treatment to improve both communication skills and the ability to safely swallow food and liquids.

SWs are licensed professionals who assess patients’ psychosocial status, including their living situations, support system, and financial status. They assist patients by helping them cope with social issues that impact their life, particularly as the issues pertain to their disability, in addition to dealing with patients’ personal and professional relationships.

VRCs assess patients’ ability to return to work or to activities they enjoyed prior to the commencement of their disability. VRCs determine the jobs that are best suited to their patients via interviews, evaluation of their abilities, and selected tests.

The historical culture in most health care settings has traditionally been hierarchical, which is a model that has been described as potentially hindering care (Paradis et al., 2013). Team leaders in a hierarchical system may have positive attitudes toward teamwork, but may be undecided in sharing decision-making roles in an interprofessional team, which may be due to lack of clear understanding of potential roles of the team members (Klinar et al., 2013). Recently, a move toward interprofessional collaborative practice has been occurring in health care because it has been shown to lead to efficiencies in care. In rehabilitation settings, some of the traditional hierarchical cultures exist; however, as previously discussed, the nature of the work favors a team-based culture. This positions rehabilitation professionals to lead the way in developing a successful model for interprofessional collaborative practice.

**PATIENT EXPERIENCE**

Patients, depending on many factors (e.g., age, level of ability, access to services), have varied experiences as they interact with the health care system. A patient’s experience depends on the setting in which the rehabilitation is being provided. “Patient experience” is defined as the sum of all interactions, shaped by an organization’s culture, that influence patient perceptions across the continuum of care. There has been a rapid expansion in the use of the term “patient experience” in general health care, both in clinical practice and in research (Locatelli, Turcios, & LaVela, 2014).

Patients, being at the front and center of their experience, have helped the shift in both public policy as well as providers recognizing the impact this can have on outcomes. This is now a top priority for health care leaders. For example, services provided acutely after injury in an acute inpatient rehabilitation hospital, subacute rehabilitation (SAR) facility, or outpatient venue have unique characteristics and regulations that dictate the type and intensity of treatment provided. Services can also vary within each setting, with individual rehabilitation centers often offering highly specialized programs to meet the needs of the patients they serve. After the onset of an adverse medical event (e.g., stroke, cardiac event, or neurologic event), patients will usually be taken to an acute care hospital. Once patients are medically stabilized, they are discharged from the acute care hospital and may be transferred to an acute rehabilitation facility if they can participate and benefit from intensive therapy.

A common element for patients destined for acute rehabilitation is that their lives have been altered physically, psychologically, and often spiritually by the experience. Imagine for a moment that your ability to walk, dress, and even comprehend a loved one’s speech has been suddenly lost because of an acute medical event such as a stroke or TBI. Now you find yourself in a medical center with a team of individuals working with you to restore what previously was taken for granted.

This scenario is quite typical for patients in need of acute rehabilitation following a sudden illness or injury and outlines some key points. In most acute inpatient rehabilitation facilities (IRFs), bedside rounds attended by representatives of the team occur daily. This is a time to review daily progress, receive updates on medical status and medication changes, review issues that occurred overnight, and answer questions from the patients or their significant others. This is also an opportunity to get
the patient’s feedback, review team goals, discuss discharge planning, and get information on the patient’s preferences.

The team conference is a gathering of the various disciplines that are working with the patient and typically occurs weekly in acute inpatient settings. This conference, usually led by the physician, will include updates on the patient’s medical condition, functional changes, progress toward patient goals, unusual occurrences, discharge planning, and modification of desired or expected goals. In addition to setting individual goals that are specific to each discipline, the team will create and review goals that cross disciplines, such as community mobility that requires the use of mass transportation. Discussions will also focus on planning for discharge, which may include the need for continued medical, nursing, and rehabilitation care. Potential barriers to discharge will be reviewed, including access to and within the patient’s home and the availability of others to assist in the patient’s care once in the community. Ongoing rehabilitation is often needed after discharge, which may be provided at home, as an outpatient, or at a subacute facility. SAR is provided in a skilled nursing facility (SNF), but at a lower intensity with about 1 hour of therapy given daily, as opposed to acute rehabilitation where at least 3 hours of daily therapy is provided.

Family meetings are typically arranged by the SW or case coordinator and include the physician and many of the team members. The psychologist is often present at these meetings as family dynamics are often explored. When possible and appropriate, the patient is included in these meetings. This is a good opportunity for problem solving of discharge planning issues and making arrangements for the next level of care. Many factors are considered, such as the availability and adequacy of family and community support and the provision of continued needed care.

Conditions seen for rehabilitation include, but are not limited to, persons who have suffered from the following:

- TBI
- Stroke
- Multiple sclerosis
- Limb loss
- Sports injury
- Vestibular disorders
- Spinal cord injuries
- Developmental delay
- Parkinson’s disease
- Muscular dystrophy
- Cerebral palsy
- Amyotrophic lateral sclerosis

Patients requiring rehabilitation often have complex medical, psychological, and social needs that warrant a coordinated and interdisciplinary approach. The definition of the interdisciplinary team “refers to activities performed towards a common goal by individuals from a group of different disciplines” (Melvin, 1980). The members of the interdisciplinary team need to be skilled not only in their specific discipline but in others as well to be effective interdisciplinary team members. The goal should be “to accomplish an outcome which is greater than each functioning separately” (Keith, 1991). This also requires considerable education for the patients, their families, and significant others.

CONTINUUM OF CARE

The delivery of services provided throughout the continuum of care is continually changing as health care reform progresses. The current model in the United States can provide all aspects of rehabilitation care in various settings, noting that the intensity of services in these practice settings varies. Most rehabilitation professionals are available throughout the continuum of care that is described in the following. National, state, and local laws dictate who is authorized to provide these services. In considering the patients’ experience through the continuum, the mantra of “nothing about me without me” in health care has fostered professionals to engage patients and families in the overall care delivery and the importance of engagement and partnership at a more robust level.

The Patient Protection and Affordable Care Act (PPACA), commonly called the Affordable Care Act (ACA), is the U.S. federal statute signed into law by President Barak Obama on March 23, 2010. Together with the Health Care and Education Reconciliation Act amendment, it represents the most significant regulatory overhaul.
of the U.S. health care system since the passage of Medicare and Medicaid in 1965. Under the act, hospitals and physicians are to transform their practices financially, technologically, and clinically to ensure better health outcomes, lower costs, and improve their methods of distribution to ensure accessibility. Since its inception, there have been multiple mechanisms to ensure accessibility to all. In March 2015, the Centers for Disease Control and Prevention (CDC) reported that the average number of uninsured during the period from January to September 2014 was 11.4 million fewer than in 2010 (Alonso-Zaldivar, 2015; Pear, 2015).

Rehabilitation is involved in all levels of the continuum of care.

The core of the law expands coverage, consistency within care, providing structures and accountable cost-efficient, higher quality care. The pressure on PM&R is to develop uniform standards across the post-acute continuum to cope with providing services to 32 million more insured lives and to report numerous quality metrics. (American Medical Rehabilitation Providers Association [AMRPA], 2015)

The opportunity to participate in the full continuum is significant. Several of the areas that PM&R is already actively participating in are the discussion of the CARE tool (Continuity Assessment Record and Evaluation) and implications for practical use across all levels of care, bundled payment initiatives, as well as value-based purchasing and value-based medicine and implications for PM&R to affect cost and care.

The triple aim, described by Institute for Healthcare Improvement, is a framework to navigate health care reform to allow for the optimization of individuals and systems. The three dimensions of the triple aim include population health (better health for the population), experience of care (better care for individuals), and per capita cost (lower cost through improvement). Defining the continuum of care and rehabilitation’s involvement in each is critical to understand it as a patient-centered approach to care along with the legislative requirements to manage through each.

The levels of care described in the following text are based on the U.S. health care model.

**Acute Care**

Acute care is provided in a hospital setting. The patient is typically admitted following an acute injury, medical occurrence, or for a surgical procedure. Length of acute hospitalization varies but is often only a few days, and patients are routinely discharged to another level of care or to their homes when medically stable.

**Acute Inpatient Rehabilitation Facility**

Patients admitted to acute rehabilitation facilities require around-the-clock medical care but do not require the level of medical service provided in an acute care hospital. Patients are usually transferred to IRF centers after medical stability has been achieved in an acute hospital. These patients must be able to tolerate at least 3 hours of therapy services daily (working with a PT, OT, and/or SLP), require both acute nursing care and physician availability 24 hours a day, and have the ability to make timely functional improvements.

**Subacute Rehabilitation**

SAR provides care that is less intense than in acute rehabilitation, but patients continue to manifest the potential to improve their functional skills through rehabilitation. Patients are generally required to tolerate only 1 to 2 hours of daily therapy, but will still require acute nursing care 24 hours a day and periodic physician care.

**Skilled Nursing Facility**

These facilities have distinct beds that allow patients the opportunity to recuperate for an extended period of time, with some therapy services on a daily basis. These designated beds can also be within a freestanding acute licensed rehabilitation hospital, a freestanding long-term care facility, or a freestanding skilled rehabilitation hospital. Patients treated in this setting have fewer acute medical needs than either acute rehabilitation or SAR. It is typically targeted at older, postacute
patients who may not be able to tolerate the intensity of acute rehabilitation but who have the capacity for functional recovery.

■ Home-Based Therapy

Home therapy is provided to patients who need continued rehabilitation but no longer require care within a hospital, subacute facility, or SNF. Patients are typically considered homebound and are therefore incapable of participating in outpatient rehabilitation programs.

■ Outpatient Therapy

Outpatient services are provided to those patients who no longer require hospital-based therapies and who are not homebound. Services are designed to provide either general rehabilitation to a wide group of individuals or more specialized care to specific groups of patients. Depending on the individual needs of the person being served and the specific discipline prescribed, outpatient therapy is typically provided two to three times per week per discipline. The number of sessions and frequency of treatment depend on the amount of treatment needed and the patient’s progress.

■ Wellness and Prevention Centers

These are centers that are often within community fitness centers, health clubs, or health care facilities. Their goal is to educate, instruct, and promote the practices of wellness and the prevention of illness or injury. A physiatrist and other rehabilitation professionals often refer individuals to these centers after they have had a course of a more traditional rehabilitation. These services are currently very rarely covered by health insurance and are a self-pay option for individuals. The goal of these programs is to support and encourage community reintegration and maintenance of functional outcomes attained during formal rehabilitation services.

■ Comprehensive Day Treatment Programs

Comprehensive day rehabilitation programs have the goal of preventing long-term institutionalization while providing a daily program of activities. Some comprehensive day rehabilitation programs provide restorative services and are geared toward achieving specific therapeutic end points within a defined period of time, with the goal of living a more independent life in the community. Some common types of day treatment programs include brain injury day treatment programs, adult day treatment programs, and dementia day treatment programs. These programs often provide some degree of respite for full-time care providers of severely disabled individuals. If these programs were otherwise not available, it would necessitate that many individuals be institutionalized due to the level of care they require.

In addition to the various settings designed to assist the patients in recovery, there are also organizations that work on a large scale to improve the lives of people who require rehabilitation services. Most states have governing bodies to assist in policy interpretation and regulations as supportive groups to all levels of health care operations. National organizations such as the AMRPA and the American Congress of Rehabilitation Medicine (ACRM) are bodies within the United States that work to improve rehabilitation care for people with disabilities. WHO is an international leader providing resources and support to hospitals, communities, and individuals with disability. To enhance the quality of life and to promote and protect the rights and dignity of people with disabilities, the key focus is the following:

- Advocacy
- Data collection
- Medical care and rehabilitation
- Community-based rehabilitation
- Assistive devices/technologies
- Capacity building
- Policies

DISABLEMENT MODELS

WHO and other groups have been instrumental in creating models to understand function and disability, which are better known as “disability models.” One of the earliest theories in rehabilitation, and the most familiar, concerns the consequences
of disease and injury, that is, disablement, and how they integrate the medical and social models of practice. In the medical model, disability is viewed as a “characteristic or attribute of the person, which is directly caused by disease, trauma, or other health condition and requires some type of intervention provided by professionals to ‘correct’ or ‘compensate’ for the problem” (Jette, 2006). In the social model, disability is viewed as a “socially created problem and not as an attribute of the person.” In the social model of disability, the underlying problem is created by an unaccommodating or inflexible environment brought about by the attitudes or features of the social and physical environment itself, which calls for a political and physical response or solution (Jette, 2006). The combination of the medical and social model subsequently is the biopsychosocial model. It attempts to integrate both models of disability. This is the key framework of the disablement model that is widely used today.

Rehabilitation medicine experts had struggled with the concepts and language that describe disablement for decades. Nagi in the 1960s and WHO in the 1980s were among the major contributors to the literature of rehabilitation medicine (Table 1.1).

The World Health Assembly developed a common language and framework to understand and describe similar concepts of rehabilitation. WHO’s model of the International Classification of Impairments, Disabilities, and Handicaps (ICIDH; Jette, 2006) was completed in the early 1980s and differentiated health conditions into impairments, disabilities, and handicaps. Each model works to try to provide a language and a structure to define disablement (Figure 1.2).

The WHO model, currently known as the International Classification of Functioning, Disability and Health (ICF), was not endorsed by the World Health Assembly at the United Nations until 2001, after major revisions from the initial document were made. The intent in the development of the ICF as a disablement model was to provide professionals in the field of rehabilitation medicine a universal, standardized disablement language. One of its goals is to provide a scientific basis for understanding and studying health and health-related disability throughout the world. This common language was designed to help with research, care, and provision of services. The ICF provides a standard language and framework for the description of health and health related states. . . . It is a classification of health-related domains—domains that help us to describe changes in body function and structure, what a person with a health condition can do in a standard environment (level of capacity) as well as what they actually do in their usual environment (level of performance). (www.cdc.gov/nchs/data/icd/icfoverview_finalforwho10sept.pdf)

The ICF also lists environmental factors that interact with all these components: “It is the prevailing

### TABLE 1.1

<table>
<thead>
<tr>
<th>Nagi</th>
<th>International Classification of Functioning, Disability and Health (ICF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active pathology—interruption or interference with normal processes and effort of the organism to regain normal state</td>
<td>• Health conditions—diseases, disorders, and injuries</td>
</tr>
<tr>
<td>Impairment—anatomical, physiological, mental, or emotional abnormalities</td>
<td>• Body function—physiological functions of body systems</td>
</tr>
<tr>
<td>Functional limitation—limitation in performance at the level of the whole organism or person</td>
<td>• Body structures—anatomical parts of the body</td>
</tr>
<tr>
<td>Disability—limitation in performance of socially defined roles and tasks within a sociocultural and physical environment</td>
<td>• Impairments—problems in body functions or structure</td>
</tr>
<tr>
<td></td>
<td>• Activity—the execution of a task or an action by an individual</td>
</tr>
<tr>
<td></td>
<td>• Activity limitation—difficulties an individual may have in executing activities</td>
</tr>
<tr>
<td></td>
<td>• Participation—involvement in a life situation</td>
</tr>
<tr>
<td></td>
<td>• Participation restriction—problems an individual may experience in involvement in life situations</td>
</tr>
</tbody>
</table>


Stineman and Streim (2010) have proposed yet another new model that introduces “Health Environment Integration” or HEI into our health care models. They believe that the current ICF framework does not completely address the needs of the medically complex and environmentally challenged populations that PM&R specialists care for (Stineman & Streim, 2010).

The current disablement model supports the biopsychosocial approach. Stineman and Streim’s approach includes the ecological principles and their impact on disability. We may hear more on this approach in the years to come.

**RESEARCH**

This is an exciting time for research in rehabilitation. Many challenging unanswered questions need to be resolved. It is always a challenge to conduct a well-designed study, and in rehabilitation, there are several added hurdles. First, there are many team members with overlapping responsibilities. Second, there are many types of disabilities and a multitude of different treatments occurring simultaneously (e.g., surgical, pharmaceutical, various therapies, and medical management). In addition, it is also difficult to isolate how much of an impact rehabilitation has versus the effect of time alone on recovery.

Disease-specific research in rehabilitation holds great promise. For example, what is the etiology of Parkinson’s disease and multiple sclerosis? Can these and other conditions be prevented? If we understand the disease process better, we can develop more effective interventions or prevent them altogether. Additionally, research about the efficacy of specific treatment interventions can assist us with providing the most appropriate and effective care for patients in the least amount of time, which can have a favorable effect on the overall cost of health care. With health care reform, access to health care and cost to individuals is changing annually. The goal is to have strong, equal access to care for all.

A specific type of research relates to outcomes achieved by a group of patients receiving care from a defined group of health practitioners. Outcomes data are becoming a more common means of assessing the effectiveness of health care including medical rehabilitation. Outcome measures allow an organization to chart its performance over time and compare its performance with others in the region and the nation.

Many types of outcomes, such as patient satisfaction, can be assessed. These data points are used to analyze how patients report their overall satisfaction with those health care professionals and organizations that provided their care. For example, Press Ganey® is a popular and widely used patient satisfaction tool. This and other similar tools have been found to be valid and reliable and allow comparisons of patient satisfaction between medical centers throughout the country, which use the same tool. However, one difficulty with these types of data is that they are obtained by patients volunteering to complete a survey, which often includes a majority of those who are either highly satisfied or highly dissatisfied, potentially skewing the results.

Another commonly used outcome assessment in inpatient rehabilitation is the Functional Independence Measure (FIM®), which quantifies a patient’s progress and burden of care. The FIM is considered a PM&R industry standard and measures a patient’s improvement (or regression) across several standardized domains such as length of inpatient rehabilitation, abilities in locomotion, transfers, dressing, bathing, cognition, and bowel and bladder function. FIM data can be combined...
among specific diagnostic groups within a particular rehabilitation organization and can be compared with similar patients in other organizations. This type of benchmarking provides a means to compare the magnitude of outcomes a particular rehabilitation organization has on a specific group of patients against others in their immediate area, their state, or even the country. This information can then be used to highlight exemplary care or identify problem areas that may be addressed through quality improvement initiatives.

Although the FIM is the most widely used instrument to measure outcomes, it does have some limitations. For example, one limitation relative to using the FIM in evaluating survivors of TBI is that it is not diagnosis specific. Although found to be reliable and valid, the scale has few cognitive, behavioral, and communication-related functional items relevant to assessing persons with TBI (Center for Outcome Measurement in Brain Injury, 2016). The FIM is a tool that reflects the level of care or assistance a patient needs to perform functional tasks and thus does not necessarily reflect a patient’s true functional abilities. For this reason, the collection of additional data such as ambulation distance in addition to the FIM score can provide a more accurate picture of a patient’s function (Cournan, 2012).

Outcomes data have led to a critical assessment of inpatient length of stay. Length of stay is a measure of how long a patient remains in the hospital or other setting. Currently, there is a lack of good-quality scientific data to show what the ideal length of stay should be to benefit patients most efficiently with various diagnoses and conditions. To further complicate matters when trying to predict the ideal length of stay, there are individual factors that may influence a patient’s rehabilitation course. Patients are unique and thus the patient’s age, severity of disability, presence of comorbid conditions, ability to participate in rehabilitation, and intensity of services provided in a particular setting can all have an effect on the length of stay. A patient’s progress and change in functional status give important individual information when determining length of stay, but the ideal length of stay for various conditions and presentations remains largely unknown.

Length of stay for inpatient rehabilitation has continually decreased over the past two decades. For example, in the early 1990s, many patients had more than 30 days of continual inpatient care. Today, the average adult patient stays in the inpatient rehabilitation setting for only 12.4 days (Dobson DeVanzo & Associates, 2014). Until optimal length of stay data are clearly delineated, it is likely that inpatient rehabilitation lengths of stay will continue to decrease. Whereas it is certainly initially less costly to have shorter lengths of stay, it remains unclear whether patients receive maximum benefit, or if an early discharge potentially leads to greater disability and cost over time. The current fiscal climate appears to beckon for continued length of stay reductions and this will likely continue until research can show that there is a point of diminishing returns whereby patients with shorter lengths of stay begin to experience worse outcomes as compared with those who experienced a longer length of stay.

Increased regulation in health care has also led to some changes in patients who qualify for admission to inpatient rehabilitation. Certain diseases and conditions are now considered to be best managed at other settings within the continuum of care. This, coupled with the previously mentioned trend toward shorter lengths of stay in inpatient rehabilitation, has caused a shift toward more rehabilitation in the acute care setting, outpatient rehabilitation, SAR, and home-based therapy services for patients who would have previously been accepted into IRFs. We are starting to explore the effects of limiting the patients who qualify for inpatient rehabilitation on outcomes. There is some evidence to support that patients who are admitted to inpatient rehabilitation settings have better outcomes, including lower mortality, fewer readmissions, and more days at home than those who have rehabilitation in SNFs (Dobson DeVanzo & Associates, 2014). This warrants further exploration as it could influence changes in health care regulations.

One example where outcomes data have supported the role of rehabilitation and have had an effect on the delivery of care is in the acute care setting. Recent efforts to study the intensity of services provided by therapists to critically ill patients while in the hospital have yielded promising results. It has been demonstrated that by increasing the amount of rehabilitation provided by therapists in the acute care setting, the overall length of the hospital stay and costs associated with providing care have been reduced. An additional benefit is that patients who receive more intensive rehabilitation in acute care are also more likely to be
discharged to home-based and outpatient services rather than facility-based care (Needham, 2010). Outcomes data such as these need to be further explored for all settings, they have implications for health care policy and are critical in establishing the importance of rehabilitation as we all move toward achieving the triple aim in health care.

There are many exciting research questions to answer in the next decade. The answers to these and many other questions that we have not even begun to explore will have a profound influence on rehabilitation care and quality of life for generations to come. Chapter 33 in this book provides additional insight into the important role research plays in the future of health care.

**ACCREDITATION**

To accredit means to “certify as meeting certain set standards” (Webster’s New World College Dictionary, 2004). The accreditation process for a rehabilitation hospital involves review of conformance to written standards outlining best practice principles from a third-party regulatory body. The most widely known rehabilitation accrediting entity is the Commission on Accreditation of Rehabilitation Facilities (CARF©).

CARF was formed in 1966 and is an international independent, nonprofit accreditor of health and human service entities (CARF, 2015). CARF outlines a series of best practice standards, which are created with input from experts in the field across a broad spectrum of the industry.

CARF takes a consultative approach to the accreditation process and focuses on patients’ experience and considers patients as its “moral owners” (CARF, 2015). CARF also looks for new and innovative practices in the field, which are considered exemplary. Exemplary practices are groundbreaking and have the potential to profoundly and positively affect the experience of the persons served (the term CARF uses to refer to patients and clients). These new exemplary practices are then shared with the rehabilitation community at large in a process of continuous quality improvement. The goal is that all rehabilitation hospitals and institutes will have access to these new and innovative methods of service delivery. In short, the CARF accreditation process is a systematic means of ensuring quality, value, and optimal outcomes (CARF, 2015). Much more is learned about CARF and other regulatory bodies in Chapter 35 in this textbook.

**NEW AREAS OF REHABILITATION AND CURRENT CONCEPTS**

**Assistive Devices/Technologies**

Assistive devices and technologies such as wheelchairs, prostheses, mobility aids, hearing aids, visual aids, and specialized computer software and hardware improve mobility, hearing, vision, and communication capacities. With the aid of technology, people with a loss in functioning are able to enhance their abilities and are better able to live independently and participate in their communities.

In many low-income and middle-income countries, only 5% to 15% of people who require assistive devices and technologies have access to them because their production is low and often of limited quality. There is a scarcity of personnel trained to manage the provision of such devices and technology, especially at the provincial and district levels. In many settings where access might be possible, costs are prohibitive (Eldi & Parkin, 2005).

The U.S. Assistive Technology Act of 1998 defines these devices as “any item, piece of equipment, or product system, whether acquired commercially, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of individuals with disabilities” (Eldi & Parkin, 2005). Accessing this equipment and technology is often a critical component to successfully reintegrating many individuals with their communities, home, school, and work lives.

The CRPD (Articles 20 and 26), the World Health Assembly resolution (WHA58.23), and the UN Standard Rules on the Equalization of Opportunities for Persons with Disabilities all highlight the importance of assistive devices. States are requested to promote access to assistive devices and technologies at an affordable cost and facilitate training for people with disabilities and for professionals and staff working in habilitation and rehabilitation services (Violence and Injury Prevention, 2009).
Safe Patient Handling

Safe patient handling has very recently become a much more mainstream and accepted concept in health care. According to the U.S. Department of Labor’s (DOL) Bureau of Labor Statistics, health care occupations rank among the highest in the incidence of work-related musculoskeletal disorders and days away from work resulting from an injury (DOL, 2015). Rehabilitation professionals, in the course of performing their daily work tasks, encounter many opportunities to sustain work-related musculoskeletal injuries. These injuries typically occur during the course of manually assisting patients to move and perform functional tasks. Safe patient handling is a term used to describe the use of assistive equipment to reduce manual patient handling. Adoption of safe patient handling practices, such as the use of mobile lifts, ceiling lifts, and transfer aids, has been shown to reduce the risk of injuries among health care workers (Powell-Cope, 2014), and most hospitals now have a safe patient handling program with staff and technology to support it.

Although safe patient handling techniques have been shown to decrease injury rates for both patients and staff, there are some who have been slow to adopt safe patient handling practices. There are those in rehabilitation who have not been historically as proactive in using safe patient handling equipment as their colleagues from nursing. PTs and OTs have traditionally been slower to adopt safe patient handling, citing concerns that using technology in order to move patients could interfere with their progress with respect to rehabilitation. Research suggests that this is not true. Incorporating safe patient handling practices into treatment has been shown to lead to similar outcomes in rehabilitation (Darragh, Shiyko, Margulis, & Campo, 2014).

To date, 11 states have enacted safe patient handling laws or regulations, and 10 states require a comprehensive program in health care facilities in which there is established policy and guidelines for securing appropriate equipment and training, collection of data, and evaluation (American Nurses Association [ANA], 2015). Although the legislation regarding safe patient handling is similar, there is still some variation in legislation by state, and there is some evidence to suggest that health care facilities rely more on standards of regulatory agencies such as CARF, the Leapfrog group, and the Joint Commission, than they do on legislation to improve safety (Devers, Pham, & Liu, 2004).

Rehabilitation professionals have a unique role in the care of patients and are experts in patient handling. In the future, rehabilitation professionals should focus on establishing themselves as leaders in safe patient handling by developing unique ways to use existing safe patient handling equipment to enhance treatment and consult with companies to design equipment to meet patients’ needs.

Disasters, Disability, and Rehabilitation

Disasters are times of great stress and challenge for all people. This is just as true of natural disasters (e.g., hurricanes, tornadoes, floods, earthquakes, volcanic activity) as it is with man-made disasters (e.g., acts of terrorism, industrial accidents, blackouts). For people with disabilities, a disaster of any kind often presents exponential challenges. As was witnessed during Super Storm Sandy in 2012 as flooding reached the east side of Manhattan, able-bodied patients in a hospital walked down the stairs to evacuate when the power failed and the elevators stopped operating. Those who were bedbound, wheelchair dependent, or who needed assistance required alternative means of evacuation (e.g., Med Sleds®).

Hospitals have special resources and are equipped to respond to many types of emergencies. This may not be the case for people with disabilities residing in their home. Planning well in advance of a disaster by both able-bodied people and those with disabilities is an essential component of ensuring safety. For example, having a “Go Bag” ready at all times with essential items (e.g., flashlights, extra batteries, medications, medical supplies, medical contact information, water, and nonperishable food items [Ready New York, 2015]) will help ensure access to needed resources. It is also important for people with disabilities to alert local emergency services (e.g., fire department, emergency medical services [EMS]) about their needs prior to and during an emergency (e.g., requiring emergency generator power for medical devices during a blackout or other causes of loss of electricity). Emergency services may also be able to provide resources if elevators and/or lifts
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stop operating during a disaster and an individual needs assistance to exit the home to a more secure area.

Many governmental bodies and organizations now provide resources for people with disabilities before, during, and after a disaster (e.g., Red Cross, WHO, and Federal Emergency Management Agency [FEMA]).

Disasters have an impact on disability, by disproportionately affecting persons with existing disabilities and by creating a new generation of persons with disabilities who will be in need of rehabilitation services. In settings where resources are limited, the impact of disasters on these groups of people can be long term and far reaching. (www.barackobama.com [2009]; www.who.int/violence_injury_prevention [2009])

Local and institutional emergency preparedness has become more of a recognized need, the resolution of which rehabilitation professionals are actively involved.

In addition, it is important that people with disabilities be part of the planning committees for designing resources, plans, and educational materials for emergency management (National Organization on Disability, 2015). As issues arise, the impact on individuals with disabilities can be addressed by rehabilitation professionals who are readily available to aid them. Some issues significantly affecting those with a disability during a disaster may include the following:

- Persons with disabilities are often more at risk of injury or abandonment.
- Many persons with disabilities lose their assistive devices, including prostheses, crutches, hearing aids, and glasses.

Rehabilitation infrastructure is often disrupted during a disaster because care providers are often diverted, cannot reach the individuals in need whom they care for, or are injured themselves. Therefore, individuals with special needs are left in even greater need.

Preparation is the key to being able to sustain oneself during an emergency or natural disaster. Many important lessons have been learned during recent devastating natural disasters such as the earthquakes in Nepal, Haiti, and Pakistan, Super Storm Sandy, and the tsunami in Japan. We also have learned repeatedly that much more needs to be done to prepare for future disasters and the larger impact disasters have on people with disabilities.

Technology and Innovation in Rehabilitation

Technology is continuously being developed to assist with solving everyday problems encountered in all areas of health care, and it is becoming more prevalent in rehabilitation. Robotics is an area that has seen tremendous growth recently. Advancements are being made in the implantation of cerebral electrodes in patients with spinal cord injury as an area of future interest and promise (Blakeslee, 2009).

The use of computer chips embedded in people’s bodies and brains may sound like science fiction, but the technology is already here. Computer chips or microelectrodes embedded in the cerebral cortices of the human brain are currently allowing some people with paralysis to control robotic arms (Hiremath, 2015). The technology, known as brain–computer interface (BCI) connects the human brain to robotic components. Now some individuals with paralysis can not only move a robotic arm but they can “sense” the actions and reactions of the robotic arm as well. BCI research is very likely to expand much further and be refined to enhance its utility. It is also likely that the use of robotic arms will expand to the use of robotic legs, and people with amputations or paralysis will exert sophisticated and more coordinated control of robotic components with their thoughts.

On a more macroscopic scale, we are also already seeing the use of implanted mechanical heart assists (e.g., left ventricle assist device—an implanted mechanical assist device that replaces the work of the failing left ventricle). The use of robotic gait systems and robotic upper extremity devices in rehabilitation after a loss of function now enables patients to move their affected extremities in normal physiologic patterns to increase muscle strength and range of motion. We are seeing better and lighter exoskeletons that help patients with spinal cord injuries to walk and even negotiate stairs. These devices are now being further developed so that one day they will be used with patients who have had strokes, brain injuries,
or other diagnoses. We are also seeing this technology start to expand beyond the rehabilitation setting and enter the home. Although initially exoskeletons were only available to those who were having rehabilitation in inpatient or outpatient facilities, some are currently approved by the U.S. Food and Drug Administration (FDA) and available for people living with spinal cord injury to use on a daily basis in their homes and the community.

This merging of technologies and the pace at which innovation in health care technology is moving are very exciting to the rehabilitation community. The merging of robotics and biology are exciting frontiers in rehabilitation. Computer technology is also empowering patients in rehabilitation. The use of technology to help with communication is upcoming. Many patients whose illness precluded or limited communication (e.g., being mechanically ventilated or having a severe stroke) will now have several options to restore communication via various computer applications. This is critical, as many patients have reported the loss of the ability to communicate as one of the most frightening situations to experience in a hospital setting.

As devices become more mainstream and clinicians become more familiar with using technology, even greater innovation will be possible. Makerspaces associated with hospitals and rehabilitation centers are beginning to be developed where people can work to come up with solutions for everyday problems encountered in health care. A makerspace, also known as a hackerspace or an innovation lab, is a physical space where people have access to technology, including three-dimensional printers, electronics, and other supplies, and can create devices to be used for patient care. Development of such spaces where rehabilitation professionals can collaborate with engineers and other technological specialists is an important step in the future of rehabilitation innovation and technology.

Rehabilitation should be at the forefront of prevention. For a variety of reasons, prevention is not prominently promulgated or incentivized in the United States. The reasons for this disconnect are variable (e.g., the high value placed on independence and free choice, insurance companies with little or no structured programs for rewards to embark on a healthy lifestyle). Building incentives for an active, healthy lifestyle may decrease the burden of type 2 diabetes, stroke, some forms of cancer, and so forth. In addition, some diseases and future disabilities can be predicted and possibility averted. For example, based on changes in gait speed and simple balance testing, it can be predicted who will likely fall in the near future. An annual wellness visit to a rehabilitation professional may highlight these areas of concern, prompting the initiation of treatment that possibly decreases the occurrence of falls. This model of prevention has the potential for saving a great deal of individual pain and suffering, reducing overall disabilities, and decreasing health care dollars by reducing the need for emergency medical procedures (e.g., corrective surgery after an injury from a fall and resultant hospitalization).

Rehabilitation is entering a renaissance period. Nearly all research studies on outcomes in the field have shown favorable results. Rehabilitation has been shown to decrease length of stay, decrease delirium, improve function, improve cognition, increase quality of life, assist with individuals staying at home/in their communities rather than in health care facilities, and decrease health care costs overall. The Institute of Medicine has defined health care quality as “the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.” Rehabilitation fosters function. The more we study function in a systematic fashion, the more it is evident that function transcends everything. “As we function, so shall we live” (Granger & Kishner, 2015). Rehabilitation naturally interfaces with nearly every element of the hospital and almost all medical specialties. It has been shown that the added staffing costs of adding rehabilitation services to a hospital is offset by decreased average direct costs, medication use, medical–surgical supplies, and decreased length of stay (Lord et al., 2013). At some point, nearly all of us will need rehabilitation services. As we enter this renaissance period of rehabilitation, people will begin to receive optimal value, outcomes, and benefit from these services.

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Traumatic Brain Injury

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OVERVIEW

In this chapter, medical aspects of traumatic brain injury (TBI) are reviewed with attention paid to its epidemiology, etiology, mechanisms of injury, measurement of injury severity, and potential complications. The role of an interdisciplinary treatment team in addressing the unique cognitive and behavioral rehabilitation needs of individuals with varying severity of TBI in both the acute inpatient rehabilitation setting and in the community are discussed.

INTRODUCTION

A TBI often results in devastating and lifelong challenges that can impact a person’s physical, cognitive, and psychological functioning. These challenges reveal the importance of understanding TBI and its impact on both persons who have experienced the injury and their family/friends. Although post-TBI physical impairments undoubtedly can hinder functional independence, the behavioral, cognitive, emotional, psychosocial, and personality changes associated with TBI frequently lead to even greater functional dependency. Although not all TBIs result in dysfunction in all of these domains, it is also not uncommon for some or all of these domains to be affected. As typical of many disabilities, the more functional domains that are impacted by the TBI, the more challenging the recovery course would be. When the cultural, social, and personality backgrounds of each individual are also considered, it is easy to see how all individuals with a TBI require a unique approach to their acute care management and their postacute rehabilitation efforts to optimize recovery.

Although there has been improved education in medical schools, professional training programs in rehabilitation interventions, and the public regarding the unique cluster of challenges that emerge after brain injury, more than superficial knowledge about the challenges faced by individuals following TBI and appropriate and targeted interventions have been slow to develop. Increased awareness on the part of clinical assessment teams will allow for appropriate referral of patients for either inpatient or outpatient rehabilitation services.

EPIDEMIOLOGY OF TBI

TBIs occur worldwide resulting in many deaths (i.e., mortality) as well as in significant disability and dysfunction (i.e., morbidity) within a subset of every nation’s population. In 1996, one estimate attributed at least 10 million deaths or hospitalizations to TBIs worldwide, with an estimated 57 million people living who have been hospitalized with one or more TBIs. Undoubtedly, there are many more people who were never diagnosed or who never sought treatment after a TBI (Langlois, Rutland-Brown, & Wald, 2006), indicating that these figures underestimate the true burden of this condition.

Long-term outcomes after a TBI differ across nations significantly. In general, mortality secondary to TBI is greater in low- and middle-income countries, whereas disability rates after TBI are less in these countries when compared with high-income countries (De Silva et al., 2009). One probable reason for these findings is that high-income nations have developed better detection and acute care interventions for severe TBI resulting in more individuals surviving with significant disabilities.
In the United States, the Centers for Disease Control and Prevention (CDC) reported that in 2010, approximately 50,000 deaths, 280,000 hospitalizations, and 2.2 million emergency department visits occurred as a result of TBIs. High incidences of TBI in both the young and the elderly formed two peak age groups, with the highest risk of TBI occurring among 0- to 4-year-olds and 15- to 19-year-olds. However, later studies with modified age ranges revealed that the young adult and middle-aged populations were equally at an elevated risk of TBI. A significantly higher risk of severe TBI resulting in hospitalizations and mortality was identified in those older than 65 years. Men were one-and-a-half to two times as likely to experience a TBI as women, except in the elderly where the gender ratio is fairly even (Langlois et al., 2006).

Findings across select nations suggest that certain subgroups of individuals are at elevated risk of TBI. For example, multiple studies from Australia, New Zealand, and the United States reveal that more than half of the prisoners surveyed had sustained a TBI in their past (Schofield et al., 2006).

Based on CDC data from the 2015 report to Congress, it is estimated that 2.5 million TBIs occurred in the United States in 2010. Available CDC data probably underestimates the full impact of TBI, as many mild injuries remain undiagnosed (Powell, Ferraro, Dikmen, Temkin, & Bell, 2008), many people who experience a TBI do not seek treatment despite experiencing problems related to their injury, and many injuries are treated outside of a traditional hospital system such as in private clinics and/or doctors’ offices (Langlois et al., 2006). Mild TBIs, even among individuals seen in emergency departments, often remain undetected, especially if the deficits are subtle enough not to interfere with basic functioning. This is particularly the case when an individual has experienced other life-threatening body trauma, which shifts the focus of acute care interventions to these injuries. Injuries resulting in a TBI may also go unreported in the workplace if there is motivation by either the worker or employer not to report an injury.

Sports-related TBIs are notoriously underreported and underdiagnosed. This may be the result of numerous factors including a lack of understanding and recognition of concussions, a lack of proper personnel available with the understanding and training to fully evaluate the impact of a potential concussion, pressure among players and staff to minimize the severity of sports injuries, and/or an existing false belief that there are no long-term consequences from a concussion. The CDC estimates that 1.6 to 3.8 million sports-related concussions occur in the United States each year, with many of these athletes never seeking medical treatment beyond that given by a sideline medical specialist (Langlois et al., 2006). A majority of these injuries do not result in a loss of consciousness, further hindering detection (Guskiewicz, Weaver, Padua, & Garrett, 2000). Yet, even for those without loss of consciousness, a concussion can result in significant cognitive decline (Collins et al., 1999). Football is estimated to account for the majority of these injuries, with a significant number occurring among high-school athletes (McCrea, Hammeke, Olsen, Leo, & Guskiewicz, 2004). It is important to note that sports-related concussions are not limited to men and football; high incidences of concussions occur in other sports and recreational activities, even those not usually associated with high-impact collisions, for both men and women. The existing fallacy that there were no long-term consequences from a concussion is now being challenged by multiple studies showing that individuals can have residual cognitive deficits on neuropsychological testing for a significant period of time after concussion even when the patient reports being symptom-free (Broglio, Macciochi, & Ferrara, 2007; Fazio, Lovell, Pardini, & Collins, 2007). Furthermore, individuals who have experienced one concussion are at a greater risk of having a second concussion (Guskiewicz et al., 2003).

Substance abuse often plays an indirect role in the onset of a TBI. By far, the most widely used substance is alcohol, with more than 50% of patients who experience a TBI found to have elevated blood alcohol levels at the time of injury (Levy et al., 2004; Kolakowsky-Hayner et al., 1999).

Another large source of underreporting in current databases is due to the lack of integration of data on individuals in the military who sustain TBIs. Although there is some controversy as to the exact number of military personnel who sustain a TBI due to potential misdiagnosing of post-traumatic stress disorder (PTSD) as TBI (Hoge, Goldberg, & Castro, 2009), it is undeniable that...
TBI is a significant source of disability among injured soldiers and has been described as the signature injury of the Afghanistan/Iraq wars. Better protective equipment and improved acute care interventions in the field have increased the probability of survival from blast injuries in combat. Therefore, it is not unreasonable to expect that the number of nonfatal TBIs among soldiers will only continue to increase (Okie, 2005).

In much the same way that a prior concussion increases the risk of a subsequent concussion, a prior TBI of any severity also places an individual at an increased risk of a repeat TBI. This risk rises further with each subsequent TBI (Annegers, Grabow, Kurland, & Laws, 1980). Most TBI surveillance systems do not include these repeat TBIs in their data. When these varied sources of undetected TBI are combined with the known prevalence of TBI, it is clear that the incidence of TBI is much higher than reported in any one source.

CAUSES OF TBI

According to the CDC 2002 to 2010 data, falls are the leading cause of TBI overall, accounting for 40% of TBI from 2006 to 2010. This is followed by struck by/against events (where either intentional or unintentional contact is made between one person and another person/object or where a person is caught between two people/objects) or motor vehicle accidents dependent on whether the population is in the emergency department or hospitalized. Other researchers feel that motor vehicle accidents may be the leading cause of TBI, especially if all forms of transportation, and not just automobiles, are considered (Silver, McAllister, & Yudofsky, 2005).

When the causes of injury are examined with respect to specific subsets of the general population, there are differences as compared with the population as a whole. In young children (<4 years) and the elderly (>65 years), falls are the clear leading cause of TBI. Among hospitalized patients aged 15 to 44 years, motor vehicle accidents are the most common cause of TBI according to CDC data from 2006 to 2010. Sports- and bicycle-related injuries are also a leading cause of TBI, especially mild TBI, in children, teenagers, and young adults. Firearm use has been reported as one of the leading causes of death related to TBI, with a large percentage of these events being suicidal in nature (Langlois, Rutland-Brown, & Thomas, 2004). However, the most recent CDC report to Congress in 2015 suggests that motor vehicle accidents are the leading cause of death from TBI followed by suicide. Unlike in the civilian population, blast exposures are a common cause of TBI in active military personnel during combat operations. However, servicemen and servicewomen are also injured by the most common mechanisms found in the general population. Alcohol use has been shown to be present in a large percentage of TBIs. One study in patients presenting with mild traumatic brain injury (mTBI; Scheenen et al., 2016) reported that approximately 30% of the patients were intoxicated on presentation. A study in patients presenting with moderate to severe brain injury (Joseph et al., 2015) reported that approximately 60% of the patients were under the influence of alcohol on admission. Understanding the causes of TBIs within specific subsets of the population is crucial for developing focused and effective prevention programs.

COST OF TBI

The burden on the United States due to TBI is significant. The care and medical costs of a person with a severe TBI can easily surpass $1 million over a lifetime. In a study on the public health implications of TBI, approximately 3.17 million Americans were determined to be living with long-term disability related to TBI (Zaloshnja, Miller, Langlois, & Selassie, 2008). The cost to caretakers, both financially and emotionally, can be significant. Family members of individuals who suffer a TBI often need to leave their jobs or reduce their responsibilities at work in order to take care of their injured relative. Given that there are probably a significant number of TBIs that go undetected and even a seemingly mild TBI can lead to permanent disabilities, which limit a person’s functional independence and/or capacity to maintain employment, this is undoubtedly a low estimate of the actual proportion of the population that is affected socioeconomically (Langlois et al., 2006). Consequently, the $60 billion was calculated to be the financial toll from medical expenses and lost productivity due to TBI in this country in the year 2000 (Finkelstein, Corso, & Miller, 2006) is likely underestimated.
MECHANISMS OF TBI

Mechanisms of TBI are typically described by either the timing of the injury in relationship to the inciting TBI event (primary vs. secondary injuries) or the characteristics of the traumatic event itself (open vs. closed injuries, blunt vs. sharp trauma, and penetrating vs. nonpenetrating injuries). Each mechanism is described in the following.

Primary injuries occur at the moment of impact directly due to the actual trauma. These injuries include contusions or bruises of the brain itself, lacerations or tears in the lining of the brain, diffuse axonal injury (DAI), rupture of blood vessels leading to hemorrhages, and cranial nerve injuries.

Secondary injuries occur as a consequence of the primary injury and can develop anywhere from hours to days after the initial injury. The mechanisms of secondary injuries include compression of brain structures, hypoxia (lack of oxygen to the brain), cerebral edema or swelling, and metabolic cellular damage. Causes of these injuries include intracranial hypertension, hypotension, intracranial or intraventricular hemorrhage or fluid collection, vasospasm (spasm of cerebral blood vessels), infection, electrolyte and metabolic disturbances, hyperthermia (elevated body temperature), anemia, endocrine disturbances, and seizures.

Closed injuries are those injuries where the skull and lining of the brain are left intact. Open injuries are those injuries where the intracranial vault is exposed to the outside environment. These injuries expose the patient to a higher risk of infection.

Nonpenetrating injuries are caused by a trauma that does not break the skin or enter the body. Penetrating injuries are those that do enter the body. In those penetrating injuries caused by a projectile such as a bullet, the velocity of the projectile directly influences the extent of brain damage that occurs. The velocity of the projectile is important to consider because the size of the fluid wave, which is dependent on how fast the projectile was traveling as it entered the brain, usually causes more widespread damage to the brain than the actual path of the projectile itself.

Blunt force trauma refers to impact against a relatively flat object or surface. Blunt trauma does not necessarily imply a closed head injury because blunt forces can cause skull fractures and soft tissue injury as well. Sharp force trauma is caused by an object with an edge or point and usually implies a penetrating injury.

Blast injuries such as those experienced by many military personnel do not necessarily fit completely into any of these categories because blast injuries typically result from acceleration–deceleration type forces on the brain as well as a unique mechanism of injury by which blast waves enter the brain itself causing neuronal damage (Courtney & Courtney, 2009).

The mechanism of injury does not necessarily indicate the severity of the TBI or its clinical presentation. Counterintuitively, open skull, sharp force, and penetrating injuries may lead to less brain damage than closed skull, blunt force, or nonpenetrating traumas if the skull fracture is nondisplaced and/or the penetration is minor. Fracturing the skull may actually lead to a dissipation of forces, lessening the movement of the brain and its impact against the skull.

TBI PATHOPHYSIOLOGY

Trauma to the brain can result in significant pathology. Typically, individuals identified as having experienced a TBI are seen in an emergency department and, along with a clinical examination, undergo immediate neuroradiological assessment, usually with a non-contrast head CT scan. Those with identified brain pathology on CT scans are typically admitted to a trauma or neurological/neurosurgical unit for close observation and needed interventions. Common pathology associated with TBI is discussed in this section.

Brain contusions, or bruises of the brain, occur due to impact of the brain against the bony ridges of the skull and are detected on head CT and MRI as areas of localized hemorrhages and/or different attenuation as compared to the rest of the brain. Two types of injury leading to contusions are coup and contrecoup injuries: Coup injuries refer to damage caused by the initial impact of the brain against the skull; contrecoup injuries occur at the opposite side of the brain as a result of the brain rebounding against the skull. These contusions manifest in a wide variety of neurological and behavioral dysfunction depending on the area of the brain impacted. The most common area affected in TBI...
is the lower frontotemporal region of the brain due to the bony anatomy at the base of the skull.

DAI results in shearing forces on the brain from acceleration–deceleration and rotational forces that are often associated with high-velocity impact, such as those occurring in a motor vehicle accident and/or blast injury. These shearing forces disrupt nerve cells in the brain, especially where the more freely moving portion meets the more fixed portion of the brain. DAI is a common underlying reason for the abrupt onset of neurological deficits in a significant proportion of patients with TBI. Patients can present with variable severity of cognitive deficits, from those detectable only under stressful situations to altered levels of consciousness, depending on the severity of injury. CT and MRI of the brain may reveal microhemorrhages in select areas of the brain (i.e., the corpus callosum, central white matter, and midbrain), but many times there are no discernible findings on imaging. As a result, the diagnosis of TBI is often based on clinical examination and subjective complaints of new-onset neurological symptoms, especially in those with mild injuries.

Intracranial hemorrhages or hematomas are caused by bleeding underneath the skull from ruptured blood vessels. They are most commonly described by the layer of the brain within which the bleeding occurs. The brain is lined by three layers of tissue: the dura mater, pia mater, and arachnoid mater.

Epidural hematomas are collections of blood between the skull and the outermost layer of the brain called the dura mater. This type of hematoma grows rapidly in size and can lead to death within a matter of hours if untreated. The presence of a lucid interval, where the patient appears to recover from the initial trauma for a short period of time soon after the event, often confuses the clinical presentation. In these situations, the patient’s level of arousal rapidly declines after this brief lucid time interval.

Subdural hematomas are collections of blood between the dura and arachnoid mater layers of the brain. These bleeds are usually slower growing, and if they grow slow enough, they can increase for weeks or even months before obvious clinical symptoms of dysfunction are noted.

Subarachnoid hematomas occur between the pia mater and the arachnoid membrane, the former being the closest lining surrounding the brain. They often develop as a result of blood vessel abnormalities (i.e., rupture of an arteriovenous malformation or saccular aneurysm) but also occur as a result of trauma. The classic presentation is that of the patient describing “the worst headache of my life” followed by a sudden loss of consciousness.

Intracerebral or intraventricular hematomas are collections of blood within the brain or ventricles of the brain itself. As with the other hemorrhagic injuries, the patient can develop subsequent neurological deficits and can present with symptoms of increasing headaches, visual changes, nausea, vomiting, dizziness, confusion, weakness, difficulties with balance, and, ultimately, loss of consciousness and death. Although intracranial hemorrhages can lead to ischemia due to decreased blood supply to parts of the brain, pressure on the brain as the hematoma grows is usually the more life-threatening and devastating cause of neurological decline. In cases of ischemia, where there is cell death, treatment is aimed at reducing the extent of surrounding swelling and inflammation in an attempt to preserve nerve function.

Skull fractures themselves do not usually cause neurological deficits, but the potential complications associated with certain fractures can be significant. Depressed skull fractures are associated with worse neurological deficits and outcomes as opposed to nondepressed fractures, and any open injury will increase the risk of infection as mentioned earlier. With temporal bone fractures, there is an increased risk of epidural hematomas due to the vascularity of the area as well as injury to the facial nerve. Basilar skull fractures can damage the facial, acoustic (i.e., hearing), and vestibular (i.e., balance) nerves.

Cranial nerve damage can occur following more severe TBIs. The type of injury, such as compressive versus direct insult to the nerve, will also affect the nature of the deficit, the most appropriate treatment, and the prognosis for recovery. The most common cranial nerve injury after a TBI is to the olfactory nerve (cranial nerve I), leading to anosmia (i.e., a loss of the sense of smell and possible alterations in taste; Marion, 1999). A lack of awareness of this deficit can potentially lead to significant safety risks such as if the patient fails to detect smoke or a gas leak in the home. Depending on the nerve injured, cranial nerve damage can result in other deficits such as monocular blindness, diplopia, visual field deficits, blurring, blind spots, paralysis of the eyes, ptosis of the eyelid, abnormal dilation of the pupil, numbness of the face, decreased salivation, corneal
drying, paralysis of the face, hypersensitivity to sound, ringing in the ears, hearing loss, positional vertigo, autonomic system dysfunction, tongue dysfunction, swallowing and speech difficulties, and shoulder muscle dysfunction.

**CLASSIFICATION OF TBI**

Historically, some definitions of TBI state that the diagnosis must involve a known traumatic impact to the head that has resulted in the disruption of brain functioning. This narrow view does not account for disrupted brain functioning caused by energy forces without a direct traumatic impact to the head such as shock waves from explosions (Zasler, Katz, & Zafonte, 2013) or acceleration—deceleration forces in motor vehicle collisions. Often, especially in milder TBIs, there is lack of documented physical evidence of the injury on either physical examination or brain imaging. Trauma can cause focal or diffuse injury in the brain. More diffuse and/or microscopic damage after TBI is often not visible on standard neuroradiological assessment tools such as head CT or brain MRI. In such cases, more advanced neuroradiological imaging such as PET, single-photon emission computed tomography (SPECT), diffusion tensor imaging (DTI), and susceptibility weighted imaging (SWI) scans may be of greater help in identifying neuronal damage secondary to trauma. However, the clinical history, neurological exam, and neuropsychological testing remain important diagnostic assessment tools.

TBIs are categorized along a continuum of severity: severe, moderate, and mild injury. The vast majority of TBIs are classified as mild in nature. Guidelines for classification typically consider factors such as the presence or absence of consciousness, the duration of the posttraumatic amnesia (PTA) state, and the initial level of function after injury. In general, the more severe the TBI, the more likely the patient is to have a longer recovery course and permanent functional deficits. However, the prognosis for any given individual after a TBI depends on multiple factors including, but not limited to, age, occupation, education, medical and surgical history, severity of injury, location of injury, medical complications of injury, and recovery course to date.

### ALTERED LEVELS OF CONSCIOUSNESS

Consciousness, defined as the state of being alert, aware, and responsive to one’s environment, is a function of the ascending reticular activating system. In the early phase of recovery after a TBI, a more severely injured patient typically presents with an altered level of consciousness. Altered states of consciousness are usually divided into coma, vegetative, and minimally conscious state, with coma representing the least responsive state. Once beyond the minimally conscious state, patients usually evolve through some combination of confused, agitated, and amnestic states before behaviors become appropriate. The duration of altered consciousness after an injury is indicative of the level of TBI severity. Some patients never progress beyond the lower levels of consciousness and ultimately require long-term care. Each level of altered consciousness requires differing acute and long-term rehabilitation interventions. Significant research has been done and continues to investigate these altered levels of consciousness and possible interventions, including medications and devices, to facilitate recovery from lowered levels of consciousness.

**Coma**

Coma is a state of unconsciousness from which the patient cannot be aroused. The eyes remain continuously closed, there is no spontaneous purposeful movement or communication, there is no ability to localize noxious stimuli, and there is no evidence of a sleep–wake cycle on EEG. Coma can occur acutely after a traumatic or non-TBI.

**Vegetative State**

The Multi-Society Task Force on persistent vegetative state (Multi-Society Task Force on PVS, 1994) defines vegetative state as an unawareness of the environment and self in conjunction with a preservation of sleep–wake cycles, hypothalamic function, and brainstem autonomic functions. The transition to vegetative state is apparent when the patient exhibits spontaneous arousal through eye opening, but there is no evidence of purposeful behavior or verbal or gestural communication. The defining characteristic of a vegetative state...
is intermittent wakefulness with the presence of a sleep–wake cycle on EEG. The vegetative state can be a phase in recovery as the patient becomes more interactive and aware of the environment. However, there is a subset of patients who remain in the vegetative state for an extended period of time, often termed persistent vegetative state.

The prognosis for emergence from the vegetative state is different for TBIs and non-TBIs. Recovery of consciousness within 12 months was reported in 52% of patients in a vegetative state after TBI. In contrast, for patients in a vegetative state after nontraumatic injury, only 11% had recovered consciousness 3 months after injury (The Multi-Society Task Force on PVS, 1994). The different timelines suggest that the usual period of most rapid recovery is longer following a TBI than in a non-TBI. For patients in a vegetative state after TBI, good recovery of function at 1 year, as defined by the Glasgow Outcome Scale, is poor, reported at only 7%. The remaining patients had either died (33%), remained in a persistent vegetative state (15%), or were left with moderate (17%) to severe (28%) disability (The Multi-Society Task Force on PVS, 1994).

Minimally Conscious State

The detection of visual tracking is indicative of the transition out of the vegetative state into the minimally conscious state. The Aspen Workgroup (Giacino et al., 2002) described the minimally conscious state as a state in which there is evidence of minimal, but definite, awareness of self or the environment. The patient is able to demonstrate inconsistent yet reproducible behaviors, such as simple command following, intelligible verbalization, gestural responses, or object manipulation. The Aspen Workgroup proposed that the patient has progressed beyond the minimally conscious state when there is demonstration of consistent command following, functional object use, and functional interactive communication.

ASSESSMENT TOOLS TO CLASSIFY TBI

Several standardized assessment measures are commonly used to assess the severity of TBI and to track patients’ progress and recovery. Several of these measures are described in the following.

The Glasgow Coma Scale (GCS) is traditionally used by early response, emergency, and trauma teams to rapidly determine the level of responsiveness of a patient (Table 4.1). Although multiple factors should be considered when trying to classify the severity of a TBI, many times the GCS is used alone to make a simplified determination of severity. The GCS quickly assesses the depth of impaired consciousness across three categories: eye opening, verbal response, and motor response. Each category is scored and totaled to obtain a composite score between 3 and 15, with higher scores suggesting a greater level of responsiveness. Scores of 3 to 8 are considered an indicator of a severe TBI, 9 to 12 of a moderate TBI, and 13 to 15 of a mild TBI. Of the three items in the GCS, the motor response is the best acute predictor of long-term outcome. The best GCS score within the first 24 hours of recovery has been described as the best predictor of recovery (Jennett, 1979).

The Galveston Orientation and Amnesia Test (GOAT) is a standardized tool used to evaluate the duration of PTA. PTA is a state of acute

<table>
<thead>
<tr>
<th>Score</th>
<th>Best Motor Response</th>
<th>Best Verbal Response</th>
<th>Eye Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Decerebrate posturing (extension) to pain</td>
<td>Mutters unintelligible sounds</td>
<td>Opens eyes to pain</td>
</tr>
<tr>
<td>3</td>
<td>Decorticate posturing (flexion) to pain</td>
<td>Utters inappropriate words</td>
<td>Opens eyes to loud voice (verbal commands)</td>
</tr>
<tr>
<td>4</td>
<td>Withdraws limb from painful stimuli</td>
<td>Able to converse—confused</td>
<td>Opens eyes spontaneously</td>
</tr>
<tr>
<td>5</td>
<td>Localizes pain/pushes away noxious stimuli</td>
<td>Able to converse—alert and oriented</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Obey verbal commands</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: Adapted from Teasdale and Jennett (1974).
confusion marked by difficulty with perception, thinking, and concentration that occurs during the early stages of recovery after TBI. Patients often cannot form new memories (anterograde amnesia) or recall memories that were made just prior to the injury (retrograde amnesia). The duration of PTA is a common predictor of long-term outcome, with longer duration of PTA being an indication of a poorer prognosis. The GOAT includes evaluation of a person’s orientation, ability to recall the events prior to and after the injury, and ability to describe the circumstances of the hospitalization. Scores can range from 0 to 100, with a score of 75 or higher for 2 consecutive days indicating that the patient is no longer in a state of PTA (Levin, O’Donnell, & Grossman, 1979).

The JFK Coma Recovery Scale-Revised (CRS-R) is a measure used to determine when a patient enters into, and progresses beyond, the minimally conscious state. The scale consists of six subscales that investigate the auditory, visual, motor, oro-motor, communicative, and arousal functions of a patient with an altered level of consciousness. Evidence of purposeful activity with testing at any time indicates that a patient has entered into the minimally conscious state (Giacino, Kezmarsky, DeLuca, & Cicerone, 1991).

The Rancho Los Amigos Levels of Cognitive Function is an instrument used to categorize behavioral and cognitive patterns typically seen during acute brain injury recovery (Kay & Lezak, 1990). The original eight stages range from a patient exhibiting no response (Level I) to a patient who exhibits purposeful/appropriate behavior (Level VIII). The levels between categorize a patient’s response to stimuli, confusion, and behavior. There has been expansion of the original scale to include 10 levels, which further describe the level of assistance (minimum assist, standby assist, modified independent) required by those patients with appropriate behavior.

**EARLY-ONSET COMPLICATIONS OF TBI**

Medical complications occur fairly often during the acute phase of recovery after a TBI and can be life-threatening if not addressed in a timely fashion. The most common early-onset medical complications include the following.

Increases in intracranial pressure (ICP) due to cerebral edema or bleeding can cause compression of brain structures, cerebral ischemia from reduced cerebral blood perfusion, or herniation of the brain through the skull. Physicians can detect elevated ICPs by finding papilledema (swelling at the rear of the eye) on exam, evidence of brain compression on head CT scans, or elevated pressures with a lumbar puncture or ICP monitoring device. Clinically, a reduction in the patient’s level of consciousness may occur with an elevated ICP, ultimately resulting in death if untreated. When this occurs, establishing an airway for breathing, or mechanical ventilation, and restoring adequate blood flow to the brain are the first steps in medical management. Declines in neurological functioning on follow-up examinations or evidence of worsening findings on serial head CT imaging are suggestive of delayed neurological compromise. Various intracranial surgeries may be needed to decrease ICP. One such surgery is a decompressive hemicraniectomy, although a reduction in morbidity and mortality after this surgery has not been definitively established (Braddom, 2011).

Posttraumatic hydrocephalus (PTH) is caused by blockage of normal cerebrospinal fluid (CSF) flow, overproduction of CSF, or insufficient absorption of CSF back into the body. If PTH is left untreated, there is an increased risk of morbidity and mortality (Mazzini et al., 2003). The first symptoms of PTH can also be intermittent headache, vomiting, confusion, drowsiness, and/or a functional plateau or decline in rehabilitation progress. CT imaging of the brain is helpful in determining whether PTH is present and to what extent. A surgically inserted ventricular drain may be indicated in some cases for the treatment of hydrocephalus. In more severe cases, a ventricular shunt emptying somewhere else in the body (usually into the abdominal cavity) may be permanently placed.

Posttraumatic agitation, described as a subtype of delirium, is marked by restlessness, impulsivity, aggression, emotional lability, disinhibition, and confusion usually occurring during early recovery. The first line of treatment is nonpharmacological, with a focus on reducing environmental stimulation and providing calm and reassuring cues. The protection of the patient from harming self or others is paramount and can be facilitated using nonpharmacological means such as de-escalation techniques, close monitoring, safety devices, and...
nonthreatening barriers. Assessing for and addressing potential medical issues such as pain, urinary issues, constipation, and infection are important because they can trigger or exacerbate agitation. When conservative interventions fail and/or the safety of the patient or others is jeopardized, there is a role for pharmacological intervention. The most commonly used agents are mood stabilizers, atypical antipsychotic medications, beta-blockers, and anxiolytic (antianxiety) medications. Neurostimulants have also been utilized to decrease agitation based on the principle that improving cognitive function may help the patient behave more appropriately. However, these medications should be used judiciously as these same medications may increase agitation or promote delirium in some patients. Certain medications used for agitation management in other situations, such as benzodiazepines, anticholinergic medications, or certain antipsychotics, are avoided as much as possible in the TBI population due to their sedating and cognitively impairing effects.

**ONGOING COMPLICATIONS OF TBI**

TBIs can be complicated by a wide variety of chronic physical, cognitive, and emotional sequelae that are discussed in the following. They often require lifelong medical and rehabilitation management.

Hypertension following a TBI often resolves spontaneously with time. Earlier generation beta-blockers such as propranolol are commonly mentioned to treat hypertension in TBI patients because they provide additional cardiovascular benefits and can help decrease anxiety and restlessness.

Headaches occur commonly after a TBI, both in patients with and without evidence of intracranial bleeding. Typically, these headaches will improve with time if it is a result of the TBI and not related to any other pathology or condition. However, a small proportion of TBI patients continue to have chronic headaches, especially under situations of stress or intense cognitive activity. Treatment includes addressing any other causes for the headache besides TBI, minimizing stress, avoiding other triggers if possible, and using analgesic medications.

Sleep disturbances are often seen in patients after a TBI. Early on, patients usually present with decreased sleep, poor-quality sleep, and/or altered sleep–wake cycles. These problems usually improve during the course of recovery. Measures taken to facilitate these improvements include fostering better sleep hygiene, decreasing stimuli during desired sleep hours, addressing any pain or medical issues that may be a source of irritation, and using medications that promote sleep. Although all sleep-promoting medications have a sedating effect by their very nature, those with longer lasting effects and those known to cause more cognitive inhibition such as benzodiazepines and anticholinergics are typically avoided. Long-term sleep disturbances may still exist and often shift to excessive sleepiness. In these cases, addressing any psychiatric disturbance such as depression is important. Furthermore, neurostimulant medications, psychological counseling, better sleep hygiene, and attempts to engage patients regularly in social interactions, activities, and hobbies may be beneficial.

Dysautonomia, also called autonomic dysfunction syndrome, can occur after a TBI as a result of damage to sections of the brain involved in regulating the autonomic system. Clinical symptoms may include fever, hypertension, rapid heartbeat, increased respiratory rate, agitation, sweating, pupillary dilatation, and extensor posturing. Treatment involves addressing both the symptoms as well as any underlying medical triggers for the dysautonomic episode. As a result, multiple classes of medications are used to treat dysautonomia.

Posttraumatic seizures can develop after a TBI. Seizures occurring in the first 24 hours after a TBI are classified as immediate, those in the first week are called early seizures, and those after that time period are late seizures (Temkin, Dikmen, & Winn, 1991). The American Academy of Physical Medicine and Rehabilitation and the American Association of Neurological Surgeons recommend that all TBI patients with postresuscitation GCS scores of less than 12 receive a course of antiseizure medication for 1 week. Most studies were originally performed with phenytoin (Teasell, Bayona, Lippert, Villamere, & Hellings, 2007), but clinically, levetiracetam is now the more common choice of antiepileptic medication. If the patient has an immediate or early-onset seizure, there is no substantial evidence that ongoing antiepileptic medication is necessary. However, a seizure in the late period may necessitate ongoing antiepileptic medications. Attention must be paid to the use of...
antiepileptic medications as certain medications such as phenytoin may impair cognitive recovery (Timble, 1987).

Deep venous thrombosis (DVT) is a common complication after a TBI and is associated with immobility, fractures, and soft tissue damage during the early stages of TBI recovery. Although DVTs can be painful and cause swelling, the more serious concern associated with having a DVT is that it increases the risk of developing a pulmonary embolus, a blood clot that travels to the lung vasculature that can be fatal. The most commonly used diagnostic tool for DVT detection is a Doppler ultrasound. Due to the serious health risk posed by pulmonary emboli, DVT prevention is important. Preventive measures include early ambulation or the use of anticoagulation medications and sequential compression devices in nonambulatory patients.

Malnutrition can occur after a TBI as patients may be less responsive, confused and agitated, or have impaired swallow function. In addition, energy demands after a TBI are thought to be higher than those of a noninjured individual. Appetite stimulant medications may be used in cases where the patient has an intact swallow ability but inadequate nutritional intake. If the patient is at risk for aspiration due to swallowing dysfunction, a softer consistency or thickened diet may be necessary. If the patient has swallow dysfunction that is severe enough or decreased overall function to the point where he or she is unable to engage in oral intake, a nasogastric tube or gastrostomy tube can be placed to provide access for nutritional support.

Bowel-related issues such as delayed gastric emptying, constipation, nausea, and gastroesophageal reflux are commonly encountered problems in the TBI patient with impaired mobility and more severe deficits. Stool softeners, laxatives, and motility agents are often used to try to keep the patient’s bowel movements regular. Antiemetic agents and proton pump inhibitors are used to decrease symptoms of nausea and reflux. Attempts are usually made to avoid anticholinergic and antihistamine medications as they can impair cognition.

Urological dysfunction after a TBI can result in both overactivity and retention of urine. Bladder overactivity can lead to incontinent episodes as the bladder contracts uncontrollably. These patients benefit from a timed voiding program and the use of medications to increase the bladder capacity or decrease bladder contractility. Urinary retention can also develop after a TBI due to bladder hyporeflexia, where the bladder fails to contract normally, or bladder sphincter dyssynergia, where the bladder contracts against a closed urethral sphincter. This latter condition is more often associated with injury to the spinal cord and often requires intermittent catheterizations to empty the bladder and the use of medications to relax the sphincter muscle and facilitate voiding. Urodynamic studies may be beneficial in determining the mechanism of dysfunction.

Spasticity, or an involuntary velocity-dependent increase in muscle resistance to passive range of motion, can develop after a brain injury. Evaluating and managing spasticity is important to avoid such complications as pain, skin breakdown, functional compromise, and joint contractures. Physical approaches to treating spasticity include removing noxious stimuli, repositioning and stretching the affected extremity, and using pressure or vibration modalities. In more severe cases, splinting or serially casting the affected extremity in a stretched position may be necessary. If these physical approaches are ineffective, there are a range of pharmacologic and more invasive approaches that can be considered including oral antispasticity medications (often with limited efficacy), nerve blocks, neuromuscular blocks, intrathecal baclofen pumps, and surgical interventions.

Pressure ulcers in the TBI population most commonly occur in those patients with altered levels of consciousness due to their decreased spontaneous repositioning. Pressure ulcers develop as a result of prolonged pressure or friction over bony surfaces of the body, such as the sacrum, heels, and hips, leading to tissue ischemia. Moisture on the skin can decrease skin integrity making incontinent patients more at risk for pressure ulcer formation. Keys to prevention are diligent skin care and minimization of prolonged pressure on one area of the body. Repositioning every 2 hours is a common practice adopted in the nursing care for these patients because pressure ulcer formation has been seen in research studies after 1 to 4 hours of sustained pressure (Gefen, 2008). When a significant skin breakdown does occur, local infection and osteomyelitis (bone infection) must be considered. These infections can lead to extensive tissue damage and even become life-threatening if not treated promptly. Treatment involves addressing any infectious issues, either locally or systemically.
as needed. For clean wounds, local wound care and proper nutrition to prevent infection and promote healing are important.

Endocrine dysfunction can occur as a result of damage to select structures within the brain. Overt and subtle hormonal abnormalities can increase fatigue or exacerbate behavioral and cognitive impairments. Treatment entails management of symptoms and sequelae and/or hormone replacement, if necessary. Abnormalities may resolve spontaneously with time as well. Sodium derangement is a common acute endocrine complication after TBI. Hypernatremia can result from vasopressin deficiency, termed diabetes insipidus. Hyponatremia can result from the syndrome of inappropriate antidiuretic hormone (SIADH) or less commonly cerebral salt wasting, which is usually present in a volume-depleted patient.

Heterotopic ossification (HO) is the formation of bone in soft tissue or muscle. The risk factors for the formation of HO include prolonged coma and/or immobility, spasticity, edema, limb trauma, and pressure ulcers. The joints commonly involved are the hips, elbows, shoulders, and knees. HO can cause a low-grade fever as well as pain, decreased range of motion, swelling, redness, and warmth at the involved joint. Range of motion exercises, medications, and radiation treatment have been used to prevent the formation and slow the growth of HO. Surgical resection of calcified soft tissue or muscle is usually reserved for more severe cases of HO, and it is often best to wait until new bone formation has stopped before undergoing resection (Braddom, 2011).

Balance and coordination deficits may develop after a TBI due to injury to the vestibular system or the cerebellum. Injury to cranial nerve VIII, also known as the vestibulocochlear nerve, can result in hearing loss as well as vertigo. Treatment involves physical therapy for balance, vestibular therapy, medications to decrease dizziness and nausea, and patient education. Symptoms of dizziness and lightheadedness can also be seen in patients who are beginning to mobilize after a prolonged period of decreased mobility. This is often due to orthostatic hypotension, which is a significant decrease in blood pressure upon sitting or standing from a prone or supine position. Pressure support devices such as abdominal binders and stockings, avoidance of rapid changes in position, and physical therapy to try to acclimate the patient to changes in positioning are used to minimize the pressure change. In severe cases of orthostasis resistant to nonpharmacological treatment, medications can be used to sustain a normal blood pressure.

Cognitive and behavioral dysfunction after a TBI can range from severe debilitating impairments to milder subtle deficits only noticeable under situations of increased stress or fatigue. Cognitive issues can include decreased attention, reduced processing speed, memory and learning difficulties, and executive functioning difficulties in planning/organization and flexible problem solving. Behavioral problems can include disinhibition, personality alterations, outbursts of profanity, poor hygiene practices, hypersexuality (increased libido), and hyposexuality. Decreased awareness of deficits and behavioral disturbances often hinder progress in therapy. Inpatient and outpatient management of these challenges require interventions by rehabilitation professionals experienced and knowledgeable regarding TBI. Both cognitive and behavioral issues can be confusing, distressing, and/or difficult for a patient’s family to manage. Family education and support by the treating team in both the inpatient and outpatient settings can serve to minimize family distress. These issues including interventions and treatment are addressed in later sections of this chapter.

Emotional lability, depression, and PTSD are common after TBI and can hinder progress and recovery from the injury. Treatment includes counseling, supportive therapy, and medication management. In patients with significant cognitive impairments, effective counseling may not be feasible. In these cases, a greater focus on medication management is indicated. Some patients develop inappropriate laughter or crying after their TBI (pathological laughter and crying). Treatment usually consists of selective serotonin reuptake inhibitor medications but other antidepressant and mood-stabilizing medications have been used as well.

Medications to facilitate cognitive recovery or manage behavioral issues are commonly used in the management of TBI throughout the course of recovery. Although there are few, if any, conclusive studies supporting the use of these medications in TBI management, there is significant evidence indicating that many of these medications can be beneficial (Chew & Zafonte, 2009; Warden et al., 2006). As such, a discussion between the treating team and the patient and/or
family should occur when considering these medications. Furthermore, there may be some ethical concerns to consider when patients are unable to make decisions regarding medication use for themselves, especially with the use of medications that can alter mood or sexual behavior. Patients with TBI often display increased sensitivity to medications. They may experience typical side effects at lower doses, develop toxic encephalopathy, or reveal a worsening of their TBI-related neurological deficits after initiation of pharmacotherapy (Zasler et al., 2013). For this reason, nonpharmacological management options should always be considered before initiating medications as many issues may be more effectively and safely addressed without the initiation of medications at all. When medications are indicated, doses should be titrated up slowly to monitor for side effects. Medications with side effects that may impede cognitive recovery or exacerbate behavioral problems, such as sedatives or anticholinergics, should be avoided. Although there are medications that are usually better tolerated for most issues associated with TBI, at times it is necessary to use medications that may have significant detrimental effects on cognition or behavior when there are more pressing medical issues. In these cases, the risks and benefits of the medication must be considered and vigilance must be maintained to discontinue the medication as soon as it is appropriate to do so.

**TBI REHABILITATION: A TEAM APPROACH**

TBI-focused rehabilitation services are delivered by a team of specially trained professionals with specific knowledge of interventions for TBI-related issues. An interdisciplinary team approach facilitates communication among team members and allows for rapid sharing of goals for treatment that are tailored to each patient’s unique rehabilitation needs. This communication among all team members is vital for an effective rehabilitation program. The rehabilitation team consists of different health care professionals under the leadership of a physician in addition to the patient and the patient’s family and friends. The roles of the specific team members in both inpatient and outpatient settings are outlined in the following. However, there is significant overlap among team members in regard to interventions and treatment goals.

The TBI rehabilitation physician specializes in rehabilitation medicine for individuals with cognitive and physical deficits due to a brain injury. The physician is responsible for the overall coordination of care and continuous, often lifelong, medical and medication management of the patient.

Neuropsychologists address alterations in brain functioning that impact the patient’s thinking processes, behavior, and emotions after a brain injury. The neuropsychologist will deliver psychological as well as neurocognitive interventions in both inpatient and outpatient settings to maximize the patient’s awareness, adjustment to injury, and overall cognitive functioning.

Rehabilitation nurses and nurse’s aides address a patient’s needs in relation to safety, self-care, medication administration, proper nutrition, dressing, bowel and bladder functions, and mobility.

Physical therapists evaluate and intervene to enhance a patient’s independence with mobility tasks including ambulation and transfers. This often involves treating weakness and range of motion restriction issues. They also often address cognitive barriers to safe mobility.

Occupational therapists evaluate and intervene to decrease difficulties identified in the performance of basic activities of daily living (ADLs) such as feeding, dressing, bathing, and personal grooming. Occupational therapists may also address sensory, perceptual, and cognitive deficits that can interfere with the completion of higher level ADLs such as preparing meals, managing household chores, managing childcare responsibilities, and handling finances.

Speech–language pathology therapists evaluate the communication and cognitive abilities of a patient after a TBI. Most speech–language pathology therapists will also evaluate a patient’s swallow function and provide treatment to improve swallow safety as needed.

Recreational/art therapists identify areas of leisure and social interest for patients and design social and leisure programs to increase their independence, while providing a healthy outlet for expression. Often, with input from other team members, therapeutic activities are selected to increase awareness of cognitive and behavioral challenges, which can impact social functioning.

Vocational counselors assist a patient with transition back into the workforce or school once the
patient is deemed safe and ready for return to these activities by the rehabilitation team. If necessary, the vocational counselor may assist the patient to find alternative employment options if acquired physical or cognitive deficits prohibit return to a prior profession or occupation.

Social workers/case managers work as part of both inpatient and outpatient teams. On the inpatient unit, they offer supportive counseling to patients and families, address financial and insurance issues related to the inpatient stay, and assist with plans regarding posthospital care. In the outpatient setting, they serve as liaisons between the rehabilitation program, insurance carriers, disability offices, and other community resources.

Patients and their families are key members of the rehabilitation team as well. (For the purposes required here, family refers to any person who is involved in the support or care of the patient, whether related to the patient or not.) Family members provide direct care and emotional support as well as insight into the patient’s unique social history and behaviors. Although it is not always possible to engage the patient actively, especially early in the recovery course after a TBI, when the patient and family are invested in the rehabilitation program, the effectiveness of a treatment program improves greatly.

### INPATIENT TBI REHABILITATION

Once an individual with moderate to severe TBI-related functional, cognitive, and behavioral problems has achieved medical stability in an acute care hospital setting, the patient is typically transferred to an inpatient TBI rehabilitation program. These TBI rehabilitation units can be embedded within a larger medical center or within a freestanding rehabilitation facility. Usually, acute inpatient TBI rehabilitation is the most appropriate setting for initial rehabilitation management following moderate to severe injury. To be eligible for acute inpatient rehabilitation, patients must be able to engage in and benefit from 3 total hours of therapy daily; this must consist of both physical and occupational therapy but may include speech therapy as well. In addition, to be eligible for rehabilitation at all, most health insurers in the United States require the patient to have residual physical impairments that would benefit from continued physical rehabilitation. These conditions for coverage do not recognize that cognitive and behavioral dysfunction alone can result in functional limitations as significant as those caused by physical impairments. They also tend to ignore the benefits that acute inpatient TBI rehabilitation offer in addressing the medical complications of TBI early on. Furthermore, most families (assuming the patient has a social support system at all), home care agencies, and subacute rehabilitation facilities are not equipped to manage the significant agitation and behavioral problems that may be present early on after a TBI.

In TBI inpatient rehabilitation units, the patient’s functional, cognitive, and neurobehavioral impairments are addressed by the team. Communication among the different team members, family, and patient is emphasized because this approach has been shown to yield the most effective treatment after a TBI (Kosmidis, 2007). The Rancho Los Amigos Levels of Cognitive Functioning Scale, described earlier in this chapter (see Table 4.2), is often used by the interdisciplinary inpatient rehabilitation team to facilitate rapid identification of the patient’s level of postinjury cognitive and neurobehavioral functioning (Leon-Carrion, 2006) and implement treatment programming appropriate to that level of functioning.

### TABLE 4.2

<table>
<thead>
<tr>
<th>Level</th>
<th>Behaviors Exhibited</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No response</td>
</tr>
<tr>
<td>II</td>
<td>Generalized response to stimulation</td>
</tr>
<tr>
<td>III</td>
<td>Localized response to stimulation</td>
</tr>
<tr>
<td>IV</td>
<td>Confused and agitated behavior</td>
</tr>
<tr>
<td>V</td>
<td>Confused with inappropriate behavior (nonagitated)</td>
</tr>
<tr>
<td>VI</td>
<td>Confused but appropriate behavior</td>
</tr>
<tr>
<td>VII</td>
<td>Automatic and appropriate behavior</td>
</tr>
<tr>
<td>VIII</td>
<td>Purposeful and appropriate behavior</td>
</tr>
</tbody>
</table>

Source: Adapted from Hagen, Malkmus, and Durham (1979).
Through the course of their stay, the team establishes a plan that the patients and families can eventually carry out on their own to manage the patient’s medical, cognitive, and emotional issues after discharge from the unit. At the point of admission to inpatient rehabilitation, each member of the rehabilitation team completes an initial assessment of each patient’s medical issues and physical and cognitive functioning to develop a plan of treatment. Collectively, the team determines each patient’s functional level, motivation, and ability to engage in treatment. They then implement the treatment plan with the goal of maximizing the patient’s medical stability, participation in therapy, safety awareness, and functional independence. As patients progress through their rehabilitation stay, team members discuss their progress within their programs on a regular basis and try to address any problematic issues that develop. Goals are adjusted as needed. Findings from these evaluations are shared with family members and patients if appropriate. Although each patient presents with a unique combination of challenges, some generalizations can be made, and these approaches are described in the following.

**Altered Levels of Consciousness**

For patients admitted to acute inpatient rehabilitation in a vegetative or minimally conscious state (Rancho Los Amigos levels II–III), enhancing arousal and responsiveness become the primary goals of rehabilitation interventions. In combination with medications prescribed by the physician, the team will initiate a stimulation program to enhance the patient’s level of arousal. The JFK CRS-R is frequently used on inpatient TBI units to help guide programmatic interventions for patients at these levels (Giacino et al., 2002). Using the CRS-R, the team plans interventions utilizing all sensory modalities. In addition, the rehabilitation team will emphasize prevention of contractures and skin breakdown. Families are instructed on how best to communicate with their loved one and how to avoid overstimulating the patient. The amount and variety of stimulation provided increases as the patient improves.

**Agitation and Behavioral Management**

For patients with a Rancho Los Amigos IV–V level, the primary target of rehabilitation interventions is the treatment of inappropriate behaviors. During this phase of recovery, individuals typically present with psychomotor restlessness, agitation, and aggressive behaviors such as kicking and hitting. The overarching goal in treatment is to maintain patient safety while at the same time facilitate the ability to self-regulate behavior. Scales such as the Agitated Behavior Scale may be used to assess the degree of behavioral dysregulation and track the efficacy of rehabilitation treatment efforts (Bogner, 2000; Corrigan, 1989). The use of behavior modification strategies and environmental modifications, such as limiting the number of visitors a patient receives, have proven beneficial in reducing agitation in TBI patients (Herbel, Schermerhorn, & Howard, 1990). Often in this phase, pharmacological agents need to be prescribed by the physician in order to manage confusion, psychomotor restlessness, and/or aggression.

**Cognitive Impairments**

Patients may present with impaired orientation and significant cognitive impairments, which can limit their safety awareness and ability to complete ADLs. In TBI recovery, the GOAT is frequently used to determine when a patient is demonstrating consistent orientation to place and time. Cognitive impairments may include reduced orientation to place and time, attention, information processing speed, memory, language skills, visuospatial skills, and abstract reasoning. These problems can be further exacerbated by emerging symptoms of depression and anxiety in the patient. Family members may feel relief that their loved one has survived a brain injury, but increased confusion or sadness may result when the cognitive and behavioral impairments become more apparent. This makes ongoing supportive services for families important. Education of the family and patient now progresses to detailed discussions of cognitive and behavioral changes after a TBI. Based typically on a brief neuropsychological assessment, treatment planning by the team is directed at maximizing cognitive strengths while trying to compensate for cognitive weaknesses using compensatory strategies. A memory book involving a calendar and a to-do list is typically implemented to address memory, orientation, and planning deficits. The physician may prescribe medications to try to facilitate cognitive recovery and address depression and anxiety issues as well.
Community Reentry and Transitions of Care

Patients with higher Rancho Los Amigos levels (VI–VII) may be able to follow a structured schedule and perform routine self-care tasks with minimal assistance or supervision. These patients continue to benefit from inpatient rehabilitation to increase their awareness of how residual moderate to mild cognitive impairments will impact functioning in the community. Their time in therapy allows for practicing of compensatory techniques needed for community living. The interdisciplinary goals also focus on having patients become involved in the completion of more complex cognitive and linguistic tasks, while maximizing their physical mobility and independence in ADLs. At this phase of TBI recovery, the risk of depression and anxiety increases due to increasing self-awareness of deficits (Hibbard, Uysal, Kepler, Bogdany, & Silver, 1998; Malec, Testa, Rush, Brown, & Moessner, 2007). The physician considers medications to treat these issues to facilitate cognitive recovery. The neuropsychologist closely monitors the patient’s and family’s ongoing emotional adjustment.

Once a patient remains medically stable and has progressed to a level of functional independence (i.e., able to perform most ADLs independently, can live relatively independently and safely in the community, and has an adequate support network to return to the community), the patient is ready for discharge back to the community. Careful patient and family education about discharge plans and needed follow-up appointments is important as the patient may still have problems with organizational skills. If patients are not completely independent or safe on their own, the team may still plan for a discharge to home if appropriate family supervision and follow-up outpatient services can be arranged. In these cases, family education is crucial as patients may have poor awareness of their deficits and limited compliance with instructions regarding maintaining safe function. If the patient does not reach independence in a timely manner and is unsuitable for return home with family support but remains medically stable, placement in a subacute rehabilitation facility is an option with most TBI patients best suited for TBI-specific subacute rehabilitation facilities. Regardless of the discharge plan, families are provided with recommendations on how to best care for the patient going forward, with emphasis placed on the importance of a structured daily routine, safety maintenance, and appropriate environmental accommodations.

MILD TBI AND OUTPATIENT REHABILITATION

Although moderate to severe TBI patients with significant residual functional, cognitive, and behavioral deficits may return home with substantial family support and continue their rehabilitation as outpatients, patients with mild TBI or those with significant recovery of cognitive functioning after their TBI represent by far the greater proportion of the patients seen for TBI rehabilitation in the outpatient setting. Approximately 5% to 15% of individuals with documented mild TBIs remain symptomatic for their entire lives (Alexander, 1995; Cassidy et al., 2004; Iverson, 2005), with many of these individuals eventually seen by outpatient TBI services. Mild TBI has been called the “invisible injury” because the majority of individuals present without noticeable physical deficits or obvious cognitive and behavioral issues at first glance. However, upon closer examination, they often have difficulty across cognitive, behavioral, and emotional domains of functioning. Ongoing physical deficits, especially balance impairments, may also be seen. Indeed, individuals with mild TBI typically present with a growing concern about how their newly acquired cognitive and behavioral changes after TBI are impacting their former roles and their current safety in the community. Often these individuals are able to function independently in the community with minimal support from family or friends, but are unable to resume the former threads of their life as related to work and relationships. Sometimes, cognitive and physical symptoms only emerge after the person with a mild TBI has attempted to return to these former life activities and roles. In many cases, it takes rejection or failure with these former relationships and roles for the patient to seek treatment.

However, even after experiencing rejection or failure, the individual may fail to connect these new difficulties with a prior mild TBI. The variable nature of mild TBI symptoms and the time after the injury when these symptoms become problematic may result in the person never seeking treatment or seeking inappropriate treatment. Those who
are able to function marginally in society may be labeled as lazy or malingering. For these reasons, the CDC has prepared an online toolkit to educate the professional community about mild TBI, improve the diagnosis of mild TBI symptoms, minimize the risk of misdiagnosis, and help physicians educate patients about mild TBI and its potential long-term sequelae.

Most patients with TBI seeking outpatient rehabilitation services present with a wide array of physical (i.e., increased fatigue, decreased motor dexterity and speed, loss of the sense of smell, dizziness, visual disturbances), cognitive (i.e., reduced attention capacity, disturbances in memory and executive functioning), and emotional problems (i.e., depression, anxiety, impulsivity, restlessness, aggression, emotional lability, decreased initiation, altered libido). A focused outpatient program is typically implemented to improve the patient’s overall function and quality of life while attempting to maintain maximal involvement in work/school and family roles each step of the way. However, often a delay in return to work or school is needed so that the patient is cognitively and emotionally ready to resume these roles. The goal is for patients to incorporate compensation strategies into their lives at the same time as they are trying to improve their cognitive skills. After completing their initial treatment course, it is not unusual for an individual to return briefly for further counseling in response to a significant life change such as the birth of a child, loss of a job, new responsibilities at work, or relationship changes.

During the outpatient treatment course, sessions are scheduled with the patient and family members together at times to address interpersonal issues. These may include issues related to adjusting to new family roles, changes in relationships, including sexual interactions between the patient and significant other, and concerns over the family’s involvement in the patient’s life (whether it is too much or too little). At other times, group sessions may be planned with other patients to address issues with social interactions and group dynamics. As in inpatient settings, the initial treatment plan evolves out of discipline-specific assessments and team decisions regarding the appropriate approach and interventions for each patient.

Neuropsychologists initiate an in-depth neuropsychological evaluation to identify the cognitive and behavioral strengths and weaknesses of each patient. The neuropsychological evaluation includes a review of medical records, comprehensive clinical interviews with the patient and significant others, and administration of a wide array of neuropsychological tests to assess attention and concentration (simple, complex, divided, and sustained), short- and long-term memory (for both visual and verbal material), language and verbal fluency abilities, information processing, and executive functioning (planning, sequencing, organization, and abstraction). Mood, personality characteristics, and behavioral issues are evaluated as well. Test performance is interpreted within the context of each patient’s prior level of functioning, which is influenced by education, occupation, and age at the time of injury. In select cases, such as for those patients showing a history of pre-TBI superior intellectual abilities, exhibiting more subtle deficits, or attempting to return to academic pursuits or a high-level job, an additional focused assessment is indicated. The results of the neuropsychological evaluation are shared with the patient, appropriate family, and treatment team. Recommendations for psychology interventions based on these findings typically include cognitive remediation, individual psychotherapy, family therapy, and/or group therapy.

Cognitive remediation is aimed at identifying cognitive issues and trying to address them through retraining exercises and compensation strategies. Overall goals of cognitive remediation include increasing awareness of strengths and weaknesses, improving attention and concentration, learning to use compensatory strategies to minimize the functional impact of deficits, improving basic problem-solving skills, and enhancing social pragmatics (i.e., giving and receiving feedback, improving social skills). Cognitive therapy can be rendered simultaneously by several disciplines including neuropsychologists, occupational therapists, speech therapists, and/or vocational rehabilitation counselors with each discipline emphasizing a different aspect of retraining to increase a patient’s functional, behavioral, and emotional well-being. Through communication and teamwork, cognitive remediation by the rehabilitation team can be much more effective than by one discipline alone. Without
focused cognitive interventions, the patient with a mild to moderate TBI may repeatedly reexperience failures in everyday functioning. Repeated failures in valued aspects of daily functioning, such as at work and in relationships, can lead to a downward spiral in both cognitive and emotional functioning and often results in increased depression, anxiety, or emotional dyscontrol. Medications to facilitate cognitive recovery such as neurostimulants, anti-anxiety, antidepressant, or mood-stabilizing medications may have a role in outpatient management as an adjunct to these nonpharmacological therapies. These medications are overseen by the treating physician.

Social workers, case managers, vocational counselors, and rehabilitation counselors all can be very helpful in facilitating patients’ transition back into life roles at home, work, school, and even with leisure activities. In the most effective programs, these members of the treatment team work closely with the therapists to optimize the appropriate services, supportive counseling, and education for their patients and families.

Psychotherapy is a vital component of treatment for those with mild to moderate TBI. The neuropsychologist traditionally addresses these issues with both the patient and the family.

Many patients struggle with disparities between “how they functioned before the injury” and “how they are functioning postinjury.” This discrepancy is a major focus of therapeutic treatment, and patients are helped with dealing with loss, adjusting to permanent alterations in self, and managing depression and anxiety. Individuals with mild TBI may be unaware of subtle changes in their cognitive functioning and/or behavior. Education, direct feedback, and feedback from others are often utilized to help increase their awareness. Behavioral changes are commonly experienced after a mild TBI. Patients are taught behavioral management techniques to minimize dyscontrol episodes.

Physical therapy is a common referral for the management of balance impairment, vestibular symptoms, and neck pain after mild TBI. Balance impairment, which is common after mild TBI, can remain for an extended period of time and puts patients at greater risk for falls and further brain injuries. Outpatient physical therapy can be beneficial to improve these persistent balance deficits. Vestibular symptoms, including vertigo and dizziness, are frequently reported after mild TBI and can be quite distressing to the patient. They can be addressed with a specialized physical therapy program termed vestibular therapy. Physical therapy also plays a role in the treatment of concomitant myofascial neck pain that is especially common with whiplash-type injuries.

Individuals who have survived a catastrophic accident as the cause of their TBI, such as returning military servicemen and servicewomen, may present with additional challenges after their TBI such as PTSD. Erbes, Westermeyer, Engdahl, and Johnsen (2007) found that 12% of returning soldiers from the Afghanistan and Iraq conflicts met the criteria for PTSD, whereas Hibbard et al. (1998) reported that PTSD can be observed in approximately 17% of nonmilitary individuals after a TBI. Common symptoms of PTSD, such as increased irritability, trouble sleeping, and not resuming “normal” activities, are very similar to symptoms typical of mild TBI and can significantly impede recovery after a TBI if unrecognized and unaddressed. Counseling and therapy are essential to help patients identify and cope with symptoms of PTSD.

Medical management of TBI in the outpatient setting, regardless of its severity, may be lifelong. At any point after injury, appropriate medical monitoring and interventions may be necessary to address ongoing complications of TBI (discussed in an earlier section of this chapter). In addition to nonpharmacological management, medications are often necessary both in outpatient rehabilitation and after rehabilitation services have ended.

Other therapy disciplines may be involved during outpatient rehabilitation upon referral by the physician. Referrals are based on the presenting physical and functional complaints of the patient. Physical therapists may become involved with the patient who presents with issues of decreased mobility, weakness, and poor balance after a TBI. Many specialized physical therapy programs will also provide vestibular therapy to address complaints of post-TBI dizziness. Vision or eye movement dysfunction can occur after a mild TBI as well. In these situations, the physician may refer the patient to a neuro-ophthalmologist and/or a neuro-optometrist who specializes in the treatment of TBI-related vision disorders.
CONCLUSION

TBIs can be devastating and have widespread and far-reaching effects. A TBI can affect multiple facets of a person’s life, including his/her behavior, emotions, cognitive function, personality, physical appearance, and physical function. This can lead to functional failures and medical complications in the acute and long-term phases of TBI recovery and may result in long-standing and permanent disability. Treatment often necessitates addressing multiple problems over many years even after a mild TBI. The impact of a TBI often extends even further, changing family dynamics, altering social interactions, and placing a financial burden on the family and society. For these reasons, it is important to address the needs of those with a TBI and the family members who support them from the initial point of injury onward. This approach requires increased awareness regarding TBI within the medical community, society as a whole, the patient’s family, and, often most challengingly, the TBI patient.

Treatment following a TBI often consists of a combination of medical management of issues that arise through the life span after TBI, as well as specialized TBI rehabilitation interventions designed to optimize functional recovery. The goal of most treatment programs is to maintain medical stability while providing therapy and treatment to maximize functional ability and independence at each stage of recovery. Although it is unclear to what extent the brain actually heals versus to what extent it creates new pathways to try to restore function, there is no doubt that early and intensive clinical interventions are important for recovery and safety.

As with most other medical conditions, the best treatment for TBI is to prevent its occurrence. Prevention of TBI is especially important given that many of these injuries are avoidable. Increasing the use of helmets and better safety equipment in sports, developing better substance and alcohol abuse prevention programs, observing proper safety practices in motor vehicles such as avoiding reckless driving and wearing seat belts, removing tripping hazards and installing safety equipment in the homes of the elderly, implementing ideas to decrease TBI risk in children, such as including softer playground surfaces and providing education programs for both parents and children, and even simply paying closer attention to traffic laws when crossing the street are all simple yet effective ways to decrease the incidence of TBIs.

REFERENCES


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**ADDITIONAL READINGS**


CHAPTER 36

Quality and Quality Improvement in Rehabilitation

Dale C. Strasser

INTRODUCTION

Quality in health care refers to a systems approach to evaluating and improving the health of the individuals served and is closely linked to quality improvement (QI) as an ongoing process of problem identification, intervention, evaluation, and further refinements in service delivery (Deming, 1986; Plsek, 1999; Taylor et al., 2014). QI strives for measureable improvements in services and health status of targeted patient groups (U.S. Department of Health and Human Services, Health Resources and Services Administration [DHHS, HRSA], 2011). In defining quality, the Institute of Medicine (IOM) emphasizes the linkage between improved services and desired health outcomes of individuals and populations (IOM, 2015). The systems approach highlights the complex interplay of the diverse components of service delivery and strives for solutions at the systems and organizational levels with a corresponding de-emphasis on a punitive approach directed at specific individuals.

The quality movement arose with the awareness of wide variations in clinical outcomes, alarming rates of medical errors, and inappropriate and costly care and was spurred by two influential reports from the IOM—To Err Is Human: Building a Safer Health System (IOM, 1999) and Crossing the Quality Chasm: A New Health System for the 21st Century (IOM, 2001). Significant variations in health care services have been well documented in various areas including stroke rehabilitation, brain injury outcomes, and the management of acute myocardial infarctions, hip fractures, colon cancer, diabetes, and depression, along with surgical procedures such as coronary artery bypass graft, hysterectomies, and spinal procedures. To update the earlier IOM findings, James (2013) conducted a comprehensive review of current findings and concluded that medical errors result in at least 210,000 deaths per year and possibly as many as 400,000 deaths per year. Furthermore, he finds that serious, but not fatal, harm from medical errors is even 10 to 20 times higher. Clearly, there is more room for improvement.

Variations in rehabilitation outcomes have been well documented and are summarized in a recent publication (Centers for Medicare & Medicaid Services [CMS], 2015; CMS, Center for Clinical Standards and Quality [CCSQ], 2015, p. 30). Risk-adjusted rehabilitation functional outcomes vary by insurance type, geographic region, and race/ethnicity (Reistetter et al., 2014). Our work in the Veterans Affairs (VA) Rehabilitation Teams Project found that characteristics of team functioning, such as team cohesiveness, physician engagement, and patient-centered goals all correlated with stroke rehabilitation outcomes (Strasser et al., 2005). The variations in patient outcomes, high rates of medical errors, and health care costs imply that changes in service delivery could lessen these disparities and improve the overall quality of care.

Issues of communication, care coordination, resource utilization, and the provision of patient-centered care have emerged as common themes across areas in quality (e.g., medical errors, patient satisfaction, poor outcomes, and inappropriate care). A team approach to QI is recommended to address such complex issues along with a plea for a health care culture to promote communication and care coordination. These themes should not be foreign to rehabilitation providers, given the similarities to core rehabilitation principles of function, a biopsychosocial model and interdisciplinary team treatment.

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Health care quality is a difficult topic for health professionals and their patients to grasp. At one level, it seems fairly straightforward. Issues of medical errors, significant variations in patient outcomes, and inappropriate and costly care demand attention. The challenges to utilize these insights and improve health quality arise from the complexities and contradictions within health care delivery and the competing perspectives of what constitutes quality. Although QI is touted as a less punitive method than earlier approaches, which tended to focus blame on individuals, many rehabilitation professionals experience quality as heavy-handed and threatening. With the increasing linkage of quality indicators to funding and accreditation, it is easy to see how clinicians and hospital leaders also experience quality as punitive. “Quality” is further complicated by differing usages of the word in usual conversation and its connotation in health care and engineering. This section provides an overview of health care quality and QI and offers a framework for quality in rehabilitation medicine.

In contrast to the usual connotation of quality as a trait or attribute (e.g., “red” shirt, “fertile” soil) or as a judgement on this attribute (e.g., “high-quality” product, “low-quality” construction), health care quality refers to a systems approach to improving health care outcomes. Early proponents of health care quality built on successes in engineering and manufacturing, including those associated with W. Edwards Deming. Principles of systems engineering were credited with dramatic improvements in airline and automobile safety in the 1960s and 1970s, with an emphasis on the flow of manufacturing processes. Steps in the process amenable to change were articulated (e.g., manufacturing design and human–machine interface); changes were implemented (e.g., construction design and safety belts); results analyzed (e.g., automobile fatalities and airplane crashes); and interventions refined in an ongoing process of continuous QI.

The “Plan, Do, Study, Act” cycle of Deming and Shewhart (Figure 36.1; Deming, 1986; Plsek, 1999; Taylor et al., 2014) is commonly applied to a host of health care service delivery issues including medication errors, hospital falls, pressure sores, and adherence to post-myocardial infarction treatment recommendations. Interventions depend on the particular issues addressed and the specific settings. Interventions to address medication errors, for example, may include adoption of a standardized patient handoff system across shifts and services, refinements to the medical reconciliation process, and scanner technologies for patient identification. Initiatives to reduce hospital falls could include bed alarms, call button response time, and fall risk assessment tools. The process repeats itself, following each cycle at least until the desired goals are achieved. The iterative nature of QI resembles the feedback and feed-forward systems familiar to clinicians through physiology.

Pivotal in the development of quality and QI in health care is the Structure–Process–Outcomes (SPO) model (Figure 36.2; Donabedian, 1980, 1988). Structure encompasses the organizational and physical characteristics of services such as staffing levels, academic affiliations, for-profit status, dedicated disease-specific units, urban versus rural location, and so forth. Process is the what and how of services such as the adherence to recommended guidelines, the appropriate use of antibiotics, and swallowing evaluations for stroke patients. Outcomes are customarily thought of in terms of patient outcomes (survival, functional status, postacute hospital services, etc.) and resource utilization. The Donabedian model provides a useful framework for understanding and measuring the components of health care service delivery. Jesus and Hoeing (2015) and others have adapted
and expanded upon this model to rehabilitation in postacute care (PAC) settings.

**Structure:** I prefer *Structure* as bolded and/or italicized given its’ role in the tripartite Donabedian Model. Structural characteristics of rehabilitation services affect outcomes. For example, the degree to which the physical facility and organizational structure promote functional independence of patients, family and caregiver education, discharge planning, and the interdisciplinary collaboration is a potential quality measure. Examination of the influences of space and design on rehabilitation process and outcomes brings valuable insights on potential and modifiable determinants of stroke rehabilitation effectiveness (Connell, 1997). Likewise, the organization of clinical services such as discipline-specific units (e.g., occupational therapists [OTs], speech-language pathologists) versus patient diagnostic categories (e.g., stroke or spinal cord injury unit) influences interdisciplinary collaboration among health care professionals. Generally, discrete, measurable structural variables have proven more difficult to link to changes in patient outcomes than process measures.

**Process:** I prefer *Process* as bolded and/or italicized given its’ role in the tripartite Donabedian Model. The process of rehabilitation refers to how services are delivered and include the “active ingredients of care.” An interdisciplinary team of rehabilitation professionals deliver coordinated care to address the multifaceted determinants of function. In this respect, rehabilitation units resemble educational environments as much as they do traditional medical settings. As in a school setting, positive outcomes occur when a patient and his or her family demonstrate new skills and functional abilities. Outcomes are measured through the demonstration of specific actions performed by the patient. In other health care settings, positive outcomes are seen in more passive terms such as recovery from an infection or survival of a myocardial infarction. Recent work by Jesus and Hoenig (2015) offers an innovative and thought-provoking view on rehabilitation quality of care. Their work integrates key attributes of rehabilitation, such as interdisciplinary team treatments and a biopsychosocial orientation, with the Donabedian SPO framework to offer a rehabilitation-specific conceptual model and framework for rehabilitation quality of care across the postacute rehabilitation continuum.

**Outcomes:** I prefer *Outcomes* as bolded and/or italicized given its’ role in the tripartite Donabedian Model. Outcomes of medical rehabilitation are commonly thought of in terms of functional improvement, rehabilitation hospital discharge destination, and resource utilization. The primary outcome of function is customarily subdivided into categories. Activities of daily living (ADL) include basic hygiene, dressing, toileting, and self-care and are closely associated with bowel and bladder continence. Mobility includes the type (e.g., walking, wheelchair), the level of assistance (e.g., minimal, moderate), endurance, and terrain (e.g., stairs, uneven surfaces), cognition (including safety), communication, and swallowing. Rehabilitation hospital discharge is usually framed in terms of community settings (with or without additional support), skilled nursing facilities (SNFs or subacute rehabilitation), or acute hospital transfer. In an era of increasing concerns on the health care cost, resource utilization is a closely monitored quality measure, commonly defined as value or costs divided by patient outcomes. Rehabilitation length of stay (LOS) is a useful surrogate for resource utilization as costs of services correlate closely with LOS. Clinicians are familiar with the Functional Independence Measure (FIM®) efficiency measures (FIM change divided by LOS; Granger, Deutsch, Russell, Black, & Ottenbacher, 2007; Granger &
Fiedler, 1997). In addition, criteria for admission to an acute inpatient rehabilitation facility (IRF) have become more restricted in favor of the less expensive SNF rehabilitation option.

**FEDERAL STANDARDS AND THE MANDATED QUALITY REPORTING PROGRAM**

With the passage of the Affordable Care Act (ACA) in 2011, interest in health care QI continues to grow across a spectrum of stakeholders—payers, clinicians, consumers, and regulatory agencies. As reported by the National Healthcare Quality and Disparities Report (NHQDR), there has been significant progress in health care quality as evidenced by documented progress in each of the six of the priority areas of the Agency for Healthcare Research and Quality (AHRQ, 2015; Berger, n.d.). Still, major deficiencies exist.

CMS declares, “Driving quality is a core function of CMS” (CMS, 2016). CMS links quality to payments. Specifically, CMS proposes to tie Medicare payments to quality or value through alternative payment models—30% by the end of 2016; 50% by the end of 2018; and 85% of all Medicare Fee-for-Service (FFS) payments tied to quality or value by the end of 2016 and 90% by the end of 2018.

As part of the ACA, the AHRQ created the National Strategy for Quality Improvement in Health Care (National Strategy; Berger, n.d.). Established in March 2011, the National Strategy has three key aims and six priorities to guide QI efforts at the local, regional, and national levels (AHRQ NQS, 2011; 2014). The three key aims can be summarized as:

1. Making health care more patient centered, reliable, accessible, and safe
2. Addressing behavioral, social, and environmental determinants of health through proven interventions
3. Reducing the health care costs for individuals, families, employers, and government

The six priorities of the National Strategy are

1. Reducing harm in the delivery of care
2. Promoting patient and family engagement in care
3. Improving effective communication and care coordination
4. Achieving effective prevention and treatment for the leading causes of mortality, starting with cardiovascular
5. Promoting best practices to enable healthy living
6. Promoting health care delivery models for more affordable services

In January 2002, the CMS implemented a congressional mandate that fundamentally changed the funding of inpatient rehabilitation services from a cost-based system to a prospective payment system (PPS) supported by Medicare Part A. Although the earlier system paid hospitals proportional to their reported cost, the PPS reimbursed hospitals based on severity-adjusted averages. With the newer PPS, there were clear incentives for hospitals to deliver comparable services at lower costs. The most obvious methods to reduce costs are to lower acute inpatient rehabilitation LOS or provide services in lower intensity subacute rehabilitation settings in SNFs. Physician reimbursement under Medicare Part B did not undergo such a dramatic shift. One can speculate whether the differing payment approaches (hospitals [part A] vs. physicians [part B]) affects the intensity of responses among different rehabilitation providers and entities.

The ACA directed the Secretary of DHHS to establish the IRF Quality Reporting Program (QRP), which is a component of the Standardized Post-Acute (PAC) Assessment Data for Quality, Payment, and Discharge Planning report (CMS; CCSQ, 2015). This report details the specific measures across the three PAC settings providing inpatient services (SNFs, IRFs; and long-term acute care hospitals or LTACHs; CMS; CCSQ, 2015). Note, the term LTACH is sometimes used in reference to LTCH. Quality measures adopted by the Final Rule: IRF FY 2016 applicable to acute inpatient rehabilitation services are:

1. Unplanned readmissions—30 days after discharge from IRFs
2. New or worsened pressure ulcers
3. Functional outcome—change and discharge score in self-care
4. Functional outcome—change and discharge score in mobility

The IRF QRP occurs within the broader context of PAC services, which also includes inpatient...
care provided in SNFs and LTCHs. Home Health Services (HH), outpatient rehabilitation services, and durable medical equipment (DME) are also within the PAC grouping. To address the stated quality aims and priorities within medical rehabilitation, patient outcomes must be analyzed across settings of rehabilitation services to guide service delivery changes in a rational and effective manner. Risk-adjusted measures of costs, value, functional gains, and the impact on quality of life are required to address quality concerns. The need for standardized terminology and assessment items lead to the Continuity Assessment Record and Evaluation (CARE) Item Set to allow comparisons across the PAC settings (Table 36.1; CMS, 2015).

Developed under contract from CMS and based on findings of a Medicare-sponsored clinical demonstration project, the CARE Item Set targets a range of measures that document variations in a patient’s level of care needs including factors related to treatment and staffing patterns such as predictors of physician, nursing, and therapy intensity. This tool is designed to measure outcomes in physical and medical treatments while controlling for factors that affect outcomes, such as cognitive impairments and social and environmental factors. Four of the 25-page CARE Item Set measure function and are grouped into Self Care (6 items), Functional Mobility (6 items), and, for patients needing further PAC services, Supplemental

### Table 36.1

**The Continuity Assessment Record and Evaluation (CARE) Functional Measures**

<table>
<thead>
<tr>
<th>A. Core self-care (all patients)</th>
<th>Safety and quality of performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A2. Tube feeding</td>
<td>5. Set-up or clean-up assistance</td>
</tr>
<tr>
<td>A3. Oral hygiene</td>
<td>4. Supervisions or touching assistance</td>
</tr>
<tr>
<td>A4. Toilet hygiene</td>
<td>3. Partial/moderate assistance</td>
</tr>
<tr>
<td>A5. Upper body dressing</td>
<td>2. Substantial/maximal assistance</td>
</tr>
<tr>
<td>A6. Lower body dressing</td>
<td>1. Dependent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Core functional mobility (all patients)</th>
<th>Reasons for not assessing</th>
</tr>
</thead>
<tbody>
<tr>
<td>B1. Lying to sitting on side of bed</td>
<td>M. Medical</td>
</tr>
<tr>
<td>B2. Sit to stand</td>
<td>S. Safety concerns</td>
</tr>
<tr>
<td>B3. Chair-/bed-to-chair transfer</td>
<td>A. Attempted, but not completed</td>
</tr>
<tr>
<td>B4. Toilet transfer</td>
<td>N. Not applicable</td>
</tr>
<tr>
<td>B5. Primary mobility wheelchair vs. walk (Subcategories on distance)</td>
<td>P. Patient refused</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>C. Supplemental functional ability (further postacute care services anticipated)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>C1. Wash upper body</td>
<td></td>
</tr>
<tr>
<td>C2. Shower/bathe self</td>
<td></td>
</tr>
<tr>
<td>C3. Roll left and right</td>
<td></td>
</tr>
<tr>
<td>C4. Sit to lying</td>
<td></td>
</tr>
<tr>
<td>C5. Picking up object</td>
<td></td>
</tr>
<tr>
<td>C6. Putting on/taking off footwear</td>
<td></td>
</tr>
<tr>
<td>C7. Primary mobility wheelchair vs. walk (Subcategories on distance)</td>
<td></td>
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<tr>
<td>C8. Telephone—answering</td>
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<tr>
<td>C9. Telephone—placing call</td>
<td></td>
</tr>
<tr>
<td>C10. Medication management—oral</td>
<td></td>
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<tr>
<td>C11. Medication management—inhalant/mist</td>
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<tr>
<td>C12. Medication management—injectable</td>
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<tr>
<td>C13. Make light meal</td>
<td></td>
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<tr>
<td>C14. Wipe down surface</td>
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<tr>
<td>C15. Light shopping</td>
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<tr>
<td>C16. Laundry</td>
<td></td>
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<tr>
<td>C17. Use public transportation</td>
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*CARE Item Set targets a range of measures that document variations in a patient’s level of care needs including factors related to treatment and staffing patterns such as predictors of physician, nursing, and therapy intensity.*

*This tool is designed to measure outcomes in physical and medical treatments while controlling for factors that affect outcomes, such as cognitive impairments and social and environmental factors.*

*Four of the 25-page CARE Item Set measure function and are grouped into Self Care (6 items), Functional Mobility (6 items), and, for patients needing further PAC services, Supplemental.*

---

**Source:** Care Tool Institutional Admission, Centers for Medicare and Medicaid Services.
Activities (17 items). Although many of the items or similar information is already collected in the PAC settings, the required new CMS reporting items came online in 2016 (LTACHs—4/1/2016; IRFs and SNFs—10/1/2016).

PAC services account for not only a significant portion of health care expenditures in the United States, but perhaps more importantly, an even higher amount of increases in health care costs (Strasser, in press). PAC accounts for 40% of the growth of CMS expenses, which explains the close scrutiny of all PAC services. Medicare payments to PAC providers reached $59 billion in 2013, more than doubling the costs since 2001. Proposed solutions include bundling of services and payment neutrality across PAC sites (SNFs, IRFs, LTCHs). A predetermined amount of funds per event (e.g., hip fracture, stroke, pneumonia) is allocated (or bundled), and a health care system has the flexibility to utilize the resources as deemed best. Comparable payments across settings (e.g., SNF vs. IRF) characterize payment neutrality.

There is widespread acknowledgment that costs must be contained and there are correspondingly divergent perspectives on how to accomplish the goal. Payors, health care service industries, professional organizations, patient advocates, and regulators have valid, unique, and biased perspectives. Although the issue of unintended consequences of well-intentioned QI efforts is discussed later in this chapter, one suspects that an underlying theme of these missteps arises when QI efforts from one stakeholder are initiated, which do not adequately account for other factors.

The dizzying array of quality concepts and acronyms baffle many providers (see Table 36.2). A common and understandable response is to ignore or deny the process and concentrate on the immediate issues that impact your work. Health care professionals and others should be reminded that these CMS and related activities will profoundly impact the who, what, where, and how of resource allocation. Furthermore, these CMS changes will likely succeed in improving the quality of rehabilitation services, at least as it is currently measured. Although acknowledging a possible self-interest, rehabilitation providers are encouraged to understand, critique, and participate in the process.

“It does not count if it isn’t counted.” Variations of this mantra abound in health care and in rehabilitation. The idea behind this sentiment is sobering, given the challenges to understanding and measuring the inner workings of rehabilitation. Some fear that our inability to measure the determinants of rehabilitation quality may relegate the field to the proverbial trash can. And clearly as health care resources become more constrained, rehabilitation professionals must justify their interventions. For busy clinicians, gathering current findings to support care improvements, along with conducting

TABLE 36.2

<table>
<thead>
<tr>
<th>ABBREVIATIONS</th>
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<tr>
<td>ACA—Affordable Care Act</td>
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<td>AHRQ—Agency for Healthcare Research and Quality</td>
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<td>AMRPA—American Medical Rehabilitation Providers Association</td>
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<td>ARA—Applied Research Associates, an affiliate of AMRPA</td>
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<td>BPCI—Bundled Payments for Care Improvement Initiative</td>
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<td>CARE—Continuity Assessment Record and Evaluation</td>
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<td>DHHS—Department of Health and Human Services (Federal Department)</td>
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<td>CMS—Centers for Medicare &amp; Medicaid Services</td>
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<td>DME—durable medical equipment</td>
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<td>HH—home health services</td>
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<tr>
<td>IRF—inpatient rehabilitation facility</td>
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<tr>
<td>LTCH—Long Term Care Hospitals.</td>
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<tr>
<td>MDS—Minimum Data Set (used in nursing homes and SNFs),</td>
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<td>NHQDR—National Healthcare Quality and Disparities Report</td>
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<td>NQF—National Quality Forum</td>
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<td>OASIS—Outcome and Assessment Information Set (used in home health)</td>
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<td>PAC—postacute care</td>
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<td>PAI—Patient Assessment Instrument (for use in IRFs)</td>
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<tr>
<td>PM&amp;R—Physical Medicine and Rehabilitation</td>
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<td>PPS—prospective payment system</td>
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<td>RTE—rehabilitation team effectiveness</td>
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<td>RTI—Research Triangle Institute (under CMS contract)</td>
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<tr>
<td>SNF—skilled nursing facility (also called subacute rehab)</td>
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<td>TEP—Technical Expert Panel</td>
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primary research in treatment effectiveness, is a daunting task.

As “beauty lies in the eyes of the beholder,” so are the values and objectives of quality. Inherent within this orientation is the fact that individual players within the system such as payors, regulators, individual providers, and professional groups have valid and distinct insights, but they rarely have a comprehensive grasp of the entire system. The image of blindfolded individuals touching a large elephant captures a fundamental challenge of achieving high-quality health services.

**ACUTE (IRF) VERSUS SUBACUTE (SNF)—GROUND ZERO IN A “REHAB QUALITY” DEBATE?**

Rehabilitation professionals and other stakeholders are concerned about the potential deleterious effects of either of the two main CMS proposals discussed—bundling or payment neutrality—as they could precipitate an inappropriate shift from IRFs to SNFs. Patients treated in SNFs stay longer with lower intensity of professional services and per diem costs than patients treated in IRF settings. Geriatricians or other primary care physicians provide medical oversight in SNFs with a minimum of a monthly visit. In contrast, physicians with documented rehabilitation expertise, usually in physical medicine and rehabilitation (PM&R), provide medical management in IRFs, which includes daily physician visits and weekly team conferences. Comparisons of outcomes have been challenging because of the different but overlapping types of patients served and the lack of common functional outcome measures between the two settings. In addition, influential trade organizations for the respective entities advocate for their constituencies, creating added challenges to meaningful outcome comparisons. Organizations representing SNFs versus IRFs can draw very different conclusions from the same data set. The primary impetus for the CARE Item Set described earlier is the standardization of key measurements for more accurate comparisons.

IRFs and SNFs serve different populations with distinct services. The criterion for admission to an SNF is a need for skilled level of services, which can be provided by either nursing, physical therapists (PTs), or OTs. The per diem cost of SNFs is approximately one third to half of that of IRFs, and the use of skilled rehabilitation therapies is not required for SNF services. In contrast, IRF admission criteria include the patient’s ability to participate in a minimum of 3 hours of therapy services a day, justification for two of three rehabilitation therapies (i.e., PT, OT, Speech Language Pathology [SLP]), and the need for ongoing medical and nursing services. Furthermore, CMS stipulates that a minimum of 60% of the patients fall into 1 of 13 diagnostic categories (such as stroke, Parkinson’s disease, or brain injury). Hence, services provided in IRF settings are more intensive (medical, nursing, and therapies), more focused on specific diagnostic categories, and with more effort devoted to care coordination. IRFs have shorter LOS at significantly higher per diem costs and total costs.

As clinicians are all too familiar, the dichotomy of SNFs and IRFs can be problematic for individual patients who do not fit well into either category. For example, a medically complex patient may benefit from daily physician and nursing monitoring along with the proximity to other medical specialists in IRFs but lack the physical endurance for this level of therapies. A medically tenuous patient may not be accepted in SNF or IRF settings and still not meet the criteria for LTACH. Also even within particular settings, the interpretation of admission criteria varies. The wide variations in services and outcomes found particularly in SNFs, but also across other PAC settings, further complicate acute care hospital discharge planning. SNF bed availability seems to be inversely related to the perceived quality and reputation of a particular facility; better SNFs have fewer available beds! With pressure to take the first available opening, acute hospital discharge planners are placed in an uncomfortable situation. Likewise, IRFs vary in their knowledge and skills in managing the frail, elderly patient. And finally, there are patients who would likely benefit from IRF service intensity after a period of convalesce with an SNF level of exercise and mobilization. However, planned transitions from SNF to IRF are uncommon and reflect the financial disincentives for the SNF.

The evidence, which does exist, supports the superiority of IRFs versus SNFs for stroke, hip fracture, and other patient groups in the 13 diagnostic group categories mandated by CMS (Deutsch et al., 2006; Strasser, in press, p. 13). In a study commissioned by the ARA Research Institute, an affiliate of AMRPA, Dobson DaVanzo & Associates, LLC,
examined the outcomes of comparable patients treated in IRFs and SNFs (Dobson DaVanzo & Associates, July 10, 2014; Dobson DaVanzo & Associates, 2014). As an industry-sponsored study, which has not been published in peer-reviewed journals, readers are advised to examine the methods closely (see URL in reference). Still, given the methodological rigor and consistency with findings from other published work, the study merits a discussion.

Cross-sectional and longitudinal analyses were applied to over 100,000 matched pairs of patients treated between 2005 and 2009 (89.6% of IRF patients and 19.6% of SNF patients). The study documented a proportional shift of elective joint replacement patients from IRFs to SNFs. During this time period, the cross-sectional analyses found a shift to IRFs for patients with stroke, brain injury, major medical complexity, and neurological disorder. Compared to the SNF patients, IRF patients had better clinical outcomes in five of six measures in the longitudinal analysis. The sixth measure was hospital readmission, and IRF patients had fewer hospital readmissions than SNF patients for amputation, brain injury, hip fracture, major medical complexity, and pain syndrome (see Table 36.3 for one subgroup analysis—hip fracture).

The process of rehabilitation has been called a black box because of the limited knowledge on how processes influence outcomes. Nevertheless, extensive evidence exists to support the team approach in rehabilitation (Langhorne & Dennis, 2004). Over the past 25 years, Judy Falconer and I have developed and tested a model of rehabilitation team effectiveness (RTE) and have shown that team functioning can be measured in a valid and reliable manner and that measured attributes of team functioning predict clinically relevant outcomes (Smits, Bowden, Falconer, & Strasser, 2014; Strasser et al., 2005). Furthermore, rehabilitation providers are responsive to staff training interventions to improve team function (Stevens, Strasser, Uomoto, Bowen, & Falconer, 2007), and in a cluster randomized clinical trial, the staff training and improved team functioning were associated with improved patient outcomes (Strasser et al., 2008). Subsequent exploratory analysis revealed that measures of team functioning correlated with patient outcomes consistent with the Team Effectiveness Model (TEM) over a 1-year period (Strasser, Burridge, Falconer, Uomoto, & Herrin, 2014). Specifically, increases in team functioning measures correlated with gains in the proportion of patients discharged to the community (teamness and team effectiveness) and decreased in the patients’ LOS (physician engagement). Although this work was exploratory and merits further confirmation, it suggests that measures of team functioning could be used as process and performance measures in QI.

The TEM is a systems model of rehabilitation treatment effectiveness. In this model, rehabilitation team functioning consists of inputs, transformational processes, and outcomes (Smits et al., 2014; Strasser & Falconer, 1997a, 1997b). The system inputs include organizational characteristics (such as hospital culture), treatment/technology (specifics of therapy), and participants (patients, families, and staff). The model postulates that team functioning plays a central role as a transformational variable between inputs (structural elements) and patient outcomes. Team functioning consists of team relations (social climate and professional networks) and team actions (team leadership and managerial practices). The primary outcomes are functional gain, discharge destination, and LOS. This model guided the comprehensive study of stroke rehabilitation outcomes and VA rehabilitation teams referenced earlier (Strasser et al., 2005, 2008). In addition, other research supports the use of process measures to understand rehabilitation outcomes (DeJong, Horn, Conroy, Nichols, & Healton, 2005; Duncan et al., 2002).

Smits et al. (2014) examined this body of work in the context of contemporary ideas of medical

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<th>TABLE 36.3</th>
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<tr>
<td>ACUTE (IRF) VERSUS SUBACUTE (SNF) HIP FRACTURE</td>
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<tr>
<td>PATIENT OUTCOMES OVER A 2-YEAR PERIOD</td>
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<tr>
<td>(P &lt; .0001; N = 20,970)</td>
</tr>
<tr>
<td>• 13.3 vs. 32.7 days’ length of stay</td>
</tr>
<tr>
<td>• 8.3 % lower mortality rate</td>
</tr>
<tr>
<td>• 55.1-day increase in average days alive</td>
</tr>
<tr>
<td>• 53.1 fewer hospital readmissions per 1,000 patients per year</td>
</tr>
<tr>
<td>• 52.8 more days residing at home</td>
</tr>
<tr>
<td>• Cost $9.77 more per day (2-year period)</td>
</tr>
</tbody>
</table>

Source: Dobson DaVanco & Associates (2014).
leadership and rehabilitation teams. Four practical observations emerged from this work: (a) Models depicting the patient care–teamwork nexus provide a mental map, a common language, a structure to facilitate the collection and interpretation of data, and a decision framework for the continuous improvement of services; (b) team functioning focuses the shared experience and multiple perspectives of a rehab team; (c) leadership integrates and focuses team expertise; and (d) performance feedback is essential for learning and iterative improvements. In terms of leadership development and team functioning improvement interventions, they offer three observations: (a) Expectations and preparations matter; (b) an intervention should model the model; and (c) reinforcements of information gained and actions taken promote successful interventions. Hence, the conclusion by Smits et al. (2014) provides helpful insights on how to incorporate the team service delivery model into medical leadership development and into rehabilitation QI.

**THE QUALITY PARADOX—GETTING BEYOND MISHAPS AND UNINTENDED CONSEQUENCES**

Clinicians experience a paradox about quality and QI efforts. We endorse the idea but see organizational efforts to improve quality as a distraction from our own clinical experience (Casalino, 1999). Quality issues are presented at the macrolevel of medical errors and appropriateness of services. Clinicians treat individual patients at the microlevel, where patient-specific issues dominate in the context of community norms and financial considerations.

Many clinicians use the term “quality” in reference to a particular trait or characteristic of an entity (such as a restaurant) or a person. In contrast, its use in health service research refers to the extent to which health services can be associated with patient outcomes. Operationally, quality is linked to system issues of process improvement where hospital leadership identifies a problem, implements intervention, monitors the effect, and modifies the intervention based on the data collected. Clinicians may view the specific issue selected as tangential to their concerns with individual patients. Hence, the health care approach to quality, the relevance of the identified issue, and the associated terminology may not resonate with busy clinicians treating individual patients. Clinicians have multiple and diverse demands on their time. When presented with yet another time request, many of us will look for ways to minimize the perceived intrusion on our work.

Quality initiatives can have unintended consequences of worsening of quality of care (Casalino, 1999; Walter, Davidowitz, Heineken, & Covinsky, 2004; Werner & Asch, 2005; Werner & Asch, 2007). An emerging literature, both research and expert commentary, reveals evidence of mishaps and unintended consequences associated with QI efforts. In a randomized trial comparing the implementation of electronic health records and quality information feedback, with and without financial incentives, Ryan et al. (2014) found that although physicians performed higher on incentivized measures, they performed lower on the unincentivized measures. In a similar vein, Ganz et al. (2007) used masked conditions (conditions not targeted by the intervention) to determine whether a practice redesign, which improved care for the targeted areas of falls, incontinence, and cognitive impairment, also affected the quality of care in nine masked conditions. Although two of the three targeted interventions showed improvement, none of the masked conditions in either study arm showed significant changes. These studies and others reinforce concerns about unintended consequences and the common lack of generalizability, particularly from mandated QI initiatives.

Much goes on in a patient–physician encounter and quality measures only capture a small fraction of the variables. By directing attention to a few easily measurable aspects, the subtext is that the rest of the patient encounter is not important. The proverbial baby is thrown out with the bathwater.

A disconnect between how issues are defined at the organizational level and how they are experienced by hands-on providers hampers QI. The diverging perspectives of hands-on clinicians versus regulatory agencies typify this paradox. On the one hand, clinician arrogance and naïveté inhibit the recognition of the contribution of one’s own actions to the problem, whereas on the other hand, directives from regulatory agencies and hospital leadership can be out of step with what is feasible in given situations, leading to “chart” compliance without substantive change. As a clinician, if I see limited utility of quality measures in patient care...
activities, I am not likely to devote much effort into the accuracy of data collection or the use of the reports generated from the data.

The resolution of this quality paradox will involve a multipronged effort among clinicians, hospital organizations, and accrediting and regulatory agencies. Quality initiatives should be relevant to the day-to-day experience of clinicians and framed such that clinicians see their clinical work as more effective when merged with quality. Physicians and other rehabilitation professionals will adopt quality approaches more readily if the approach produces better outcomes or makes it easier to do their job. Hands-on clinician engagement in developing quality initiatives is more likely to produce feasible programs. Likewise, by avoiding or at least limiting “unfunded mandates,” regulatory agencies and hospital leadership improve the chances that effective interventions will be adopted. A clinician-centered cost–benefit analysis of proposed quality programs should produce more effective initiatives.

In a national study of process improvement, we asked rehabilitation team leaders at 16 Veterans Affairs hospitals to learn the basics of team functioning and to utilize this knowledge in clinical practice (Stevens et al., 2007). In general, we found that clinicians incorporate new approaches in their busy clinical practice if they experience the effort as improving patient outcomes or in making them more effective clinicians. The crucial issue is whether the quality initiative improves the patient outcomes of individual providers. Effective QI initiatives should be woven into the fabric of clinical care.

### SUGGESTED ACTIVITIES TO IMPROVE QUALITY

Quality initiatives most likely to succeed are those generated by the hands-on clinical staff, which directly address local barriers to optimal care and for which there is sufficient administration support to carry the project to fruition. Based on the author’s own clinical experience and a review of the literature, examples of relevant areas are offered in Tables 36.4 and 36.5. Table 36.4 highlights interdisciplinary topics in the categories of specific patient issues (e.g., bladder management and sleep hygiene), processes of care (e.g., team conference attendance by direct clinical providers), and staff training–information feedback (e.g., use of a patient-centered structure for team conference such as the Siebens Domain Management Model [SDMM®]). Table 36.5 offers examples that are more likely to be physician driven in the categories of medication management (rational prescribing) and patient safety (e.g., optimal arrival time on unit). Common recommendations among quality specialists are regular case discussions among peers, as such discussions improve quality. In

### TABLE 36.4

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<tr>
<th>QUALITY IMPROVEMENT—EXAMPLES OF INTERDISCIPLINARY TEAM ACTIVITIES</th>
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<tr>
<td><strong>Patient-specific areas</strong></td>
</tr>
<tr>
<td>- Sleep hygiene</td>
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<tr>
<td>- Patient and family engagement in goal setting</td>
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<tr>
<td>- Pain management (nonpharmacological)</td>
</tr>
<tr>
<td>- Bowel and bladder management</td>
</tr>
<tr>
<td><strong>Processes of care areas</strong></td>
</tr>
<tr>
<td>- Team conference attendance</td>
</tr>
<tr>
<td>- Regular case discussions among peers</td>
</tr>
<tr>
<td>- Nursing involvement in rehabilitation process</td>
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<tr>
<td>- Therapy involvement in medical and nursing issues</td>
</tr>
<tr>
<td><strong>Staff training and information feedback</strong></td>
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<tr>
<td>- Staff training to improve team effectiveness*</td>
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<tr>
<td>- A patient-centered structure to rehabilitation team meetings**</td>
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<tr>
<td>- Processes of care and outcomes information feedback</td>
</tr>
<tr>
<td>- Use of conceptual model and systems framework***</td>
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*Stevens et al. (2007); Strasser et al. (2008).


Also, SDMM Communication Card at www.siebenspcc.com.

***Smits et al. (2014); Siebens (2011).

### TABLE 36.5

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<tr>
<th>QUALITY IMPROVEMENT—EXAMPLES OF PHYSICIAN-INITIATED ACTIVITIES</th>
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<tbody>
<tr>
<td><strong>Medication management</strong></td>
</tr>
<tr>
<td>- Rational prescribing and polypharmacy*</td>
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<tr>
<td>- Reduction of opioid medication</td>
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<tr>
<td>- Medical reconciliation—admission and postacute care</td>
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<tr>
<td><strong>Patient safety</strong></td>
</tr>
<tr>
<td>- Preadmission evaluations and medical stability</td>
</tr>
<tr>
<td>- Optimization of arrival time and day of week for patient care</td>
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<tr>
<td>- Postdischarge care coordination</td>
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Source: Zhukalin, Williams, Reed, and Strasser (2016);

rehabilitation, clinical experience suggests that the role of nursing is less clearly defined and demonstrates wider variations than other core disciplines on rehabilitation teams. Activities to integrate nursing into the rehabilitation treatment process should improve quality, including carryover of skills learned in therapy to the nursing unit, and engagement of the patient and caregivers.

CONCLUSIONS

QI is an iterative process of “plan, do, check, act” to address shortcomings in health services delivery (Deming, 1986; Plsek, 1999; Taylor et al., 2014). Although this systems approach shares attributes with the physiological feedback loops familiar to health care professionals, quality and QI can seem foreign to busy clinicians providing services to individual patients. We have a hard time looking at ourselves and at the impact of the services we deliver. For example, in prescribing an antibiotic, a clinician can forget that he or she may be contributing to the emergence of resistant bacteria, or that an aggressive approach to rehabilitation therapy services in one setting may limit the availability of services in another. Frankly, it is hard to know the downstream impact and unintended consequences of specific actions. Clinicians need to stay abreast of these messy issues so they can incorporate new insights, change practices when indicated, advocate in those areas they know best, and perhaps most importantly, participate in the dialogue.

ACKNOWLEDGMENT

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