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GERIATRIC REHABILITATION

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Rehabilitation focuses on enhancing function and minimizing disability by means of various therapeutic interventions. Goals include optimizing quality of life and functional independence. Geriatric rehabilitation addresses not only impairments stemming from acute events, such as stroke or hip fracture, but also the deleterious effects of chronic diseases and gradually progressive disability. A better scientific understanding of rehabilitation care and efficacy is warranted, not only for improving the care of patients but also in forming optimal health care policy. For example, a critical current debate concerns which patients benefit from inpatient rehabilitation facility (IRF) care and which benefit more from skilled nursing facility (SNF) care. Evidence to help answer this question is limited. Another issue concerns the assessments and treatments that need to be done, and paid for, during the progressive disability trajectory experienced by many older adults. These issues point to the need for better definitions of rehabilitation treatments, improved measurement of treatment efficacy, and optimal timing and settings for treatments.

We are recommending no changes in the Key Questions for geriatric rehabilitation that were posed in *New Frontiers in Geriatric Research*. [1,2] However, as we note in the section Progress in the Key Research Questions in Geriatric Rehabilitation, major studies evaluating ways to prevent or reduce functional decline in older persons suggest fruitful avenues for further research addressing one of these important issues.

This chapter also summarizes recent progress in research addressing the 29 agenda items for geriatric rehabilitation from *New Frontiers*, that is, reports published between 2000 and 2005. Given the growth of research in this field, only selected contributions could be included for review. Brief summary statements have been made about each report cited, and readers are encouraged to look at articles of interest as a check on the conclusions we have drawn from them.

In the final section of the chapter, New Horizons in Geriatric Rehabilitation, we recommend new areas for research not covered in *New Frontiers*, discussing recent relevant reports and adding six new items to the rehabilitation research agenda.

METHODS

A literature search was conducted on the National Library of Medicine's PubMed database covering articles published in journals from January 2000 to June 2005. This search combined MeSH headings denoting advanced age (aged, geriatric, or 65 or older) with the terms *rehabilitation, rehabilitation nursing,* or *physical medicine and rehabilitation.* Also, references cited in these articles and pertinent rehabilitation texts were reviewed. Articles were chosen for inclusion herein on the basis of two criteria: the strength of their methodology and the relevance of the topic to improving the clinical care and knowledge base of geriatric rehabilitation.

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PROGRESS IN KEY RESEARCH QUESTIONS IN GERIATRIC REHABILITATION

See *New Frontiers,* pp. 359–361.

***Rehab KQ1*: What is the process in elderly persons underlying the development of disability and the factors influencing the disablement process?**

New Research Addressing This Key Question: Several major studies have evaluated approaches to decrease mortality, hospitalization, and functional decline in older patients. A British study tested geriatric assessments—of all older patients in a practice or of a group targeted on the basis of symptoms and problems—and two management strategies in 106 general practices in the United Kingdom including 33,326 patients aged 75 or older (mean age 81.4 years). In one comprehensive study testing geriatric assessment through brief questionnaires followed by more detailed assessments (either of all patients or of a targeted group), no significant differences were found to have been achieved in mortality, hospitalization, or nursing home admission. There were only very small benefits in mobility and morale, which were probably not clinically significant, but there was a small, likely clinically meaningful improvement in social interaction. [3] However, a meta-analysis of 18 trials involving 13,447 community-dwelling persons aged 65 years and older was able to demonstrate prevention of functional decline. This occurred, however, only in younger people, in those with a lower mortality risk, and in those who received a multidimensional geriatric assessment in the home and in-home follow-up visits. Interventions included primary prevention (eg, immunizations and exercise recommendations), secondary prevention (eg, detection of untreated problems), and tertiary prevention (eg, improvement of medication use). These results indicate that targeting interventions earlier, before advanced age or increased risk of mortality, can prevent functional decline. [4] More work is needed to research cost-effective strategies to implement these approaches.

Modification of This Key Question in Light of New Research: We recommend keeping Rehab KQ1 unchanged. The studies cited add new insights into this very important issue, and further research along these lines would be valuable.

***Rehab KQ2*: What are the costs and benefits of targeting treatment at differing aspects of the disablement process in elderly persons?**

New Research Addressing This Key Question: We are not able to comment, on the basis of our literature review, on this important and complex issue. Now that much is known about the development of disability, perhaps more extensive work on the costs and benefits of interventions will be feasible.

Modification of This Key Question in Light of New Research: We recommend keeping Rehab KQ2 unchanged.

***Rehab KQ3*: What are the relative merits of diverse rehabilitative treatments targeted at similar aspects of the disablement process in elderly patients?**

New Research Addressing This Key Question: As with Rehab KQ2, we cannot comment yet on the relative merits of different treatments for similar disabling factors.

Modification of This Key Question in Light of New Research: We recommend keeping Rehab KQ3 unchanged.

PROGRESS IN THE THEORETICAL UNDERPINNINGS FOR GERIATRIC REHABILITATION

See *New Frontiers,* pp. 339–343. For discussion of three new items for the research agenda, see the theoretical underpinnings subsection in New Horizons in Geriatric Rehabilitation at the end of the chapter.

Rehabilitation for older adults has received substantial attention in the past 5 years as the cadre of researchers focusing on the older population has grown. In addition, a major policy change by Medicare in 2002 whereby inpatient rehabilitation facilities came under the prospective payment system forced the rehabilitation community to focus more on the study of cost-effective interventions for disability. The treatment of acute-onset moderate or severe disability is challenged with changing reimbursement policies. Fortunately, the field has some standard outcome measures that are being used to help evaluate the cost-effectiveness of care. However, measuring the costs of not rehabilitating patients appropriately is not as easy as measuring the costs of not treating acute illnesses. Moreover, many older adults experience gradually progressive disability, making it hard to identify optimal timing and types of rehabilitation.

Interventions used in geriatric rehabilitation include exercise, adaptive techniques and equipment, assistive technology, physical modalities, orthotic and prosthetic devices, and psychologic and social interventions. A detailed review of only the two most commonly used interventions, exercise and assistive technology, is provided herein. Key rehabilitation personnel who assess patients and use these interventions include rehabilitation nurses, physical therapists (PTs), occupational therapists (OTs), speech language pathologists, rehabilitation psychologists, therapeutic recreation therapists, as well as others, such as social workers, case managers, pharmacists, and dietitians.

Exercise programs are used to increase joint flexibility, muscular strength, and aerobic endurance, but exercises may be used for more specific purposes, such as preserving bone density through weight bearing, reducing joint pain through strengthening of the surrounding muscles, and increasing coordination after a stroke. Different types of exercises have varying levels of data supporting their efficacy for specific conditions.

Adaptive techniques involve modifying a task so that it can be performed despite physical limitations. Adaptive techniques often are combined with assistive technology. Their combined use enables the person to interact more favorably with the environment. Rehabilitation specialists often make recommendations about which devices will be most helpful in improving function and facilitating independence.

Physical modalities use physical processes to treat impairments. For example, ultrasound providing deep heat, transcutaneous electrical nerve stimulation, whirlpool, massage, and applications of heat or cold are modalities that are used routinely during therapies. Research data on the efficacy of many physical modalities is limited.

Orthotic devices are externally applied and act to support the musculoskeletal system. Examples are inserts or specially adapted shoes for arthritic problems of the feet, splinting

and padding for overuse syndromes such as carpal tunnel syndrome, and bracing to support an unstable or weak joint, such as an ankle-foot orthosis used after a stroke. Prosthetics are devices that act to substitute or replace a missing body part. Examples include below-knee leg prosthesis or below-elbow prosthesis.

Psychologic assessments and interventions assist patients' coping and adaptation. Social interventions assist family members in dealing with losses and adapting to the new needs of the family member who now has a disability.

***Rehab 1 (Level B)*: The first step required, in support of all other recommended research efforts, is to develop uniform terminology, so that multisite research consortia can be formed to allow faster progress, as was done in the field of cancer research over the past 50 years.**

New Research Addressing This Question: An increasing number of papers have discussed rehabilitation research in relation to the International Classification of Functioning, Disability and Health (ICF). [5] What has been groundbreaking in this classification is that patients' functioning is now seen as being associated with, and not merely as a consequence of, a health condition. Functioning and health are also considered not only in association with an underlying health condition, but also in association with personal and environmental factors. All aspects of patient experience, including body function and structures as well as personal and environmental factors, are covered. This bio-psycho-social view is not new to a number of medical fields, such as rehabilitation and prevention. What is new is that we now have a globally agreed-on, etiologically neutral framework and a classification both on the individual and population levels. [6]

To date, much of the work in using the ICF has been to identify core sets of components that are to be measured across and within certain general diagnostic categories like chronic conditions and musculoskeletal disorders. [7,8] These approaches should lead to new research insights, since theoretical models have been the basis of this practical classification system of relevant patient and environmental variables.

Disability, like any human condition, is an extremely complex, multifaceted phenomenon, and standard terminology depends, to some extent, on underlying assumptions and models. See the discussion of the Health Environmental Integration model under Rehab 10.

One taxonomy of rehabilitation interventions has been developed by DeJong et al. [9] The authors used an experience-driven, bottom-up, inductive approach led by front-line opinion and scientific evidence to develop a taxonomy of physical therapy, occupational therapy, speech therapy, nursing, and social work or case management interventions during inpatient rehabilitation. These were then used to collect data about the process of care as part of a major study on the "black box" of rehabilitation in stroke (see Rehab 11). [10] This work contributes significantly to the ongoing development of uniform terminology.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

***Rehab 2 (Levels B, A)*: Hypothesis-testing research is needed to determine the costs and benefits of treatment that is targeted generically at the disability versus treatment that addresses the underlying diseases and impairments.**

New Research Addressing This Question: Our literature review yielded no papers that studied a specific disabling condition and compared disability-level treatments with treatments of the underlying disease and impairment.

Modification of This Question in Light of New Research: This is an important issue. For example, situations occur in which clinicians want to help a patient with trouble walking because of an arthritic, deformed, mildly painful spine. An assistive device, like a rollator, could well get the patient walking more easily and safely and at very low cost. However, should more diagnostic work and more specific treatment target the chronic back condition, believed to be osteoarthritis? We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

Rehab 3 (Level B): **If it is important to individualize treatment on the basis of underlying cause (see Rehab 2), then additional research will be needed to identify the most efficient diagnostic methods to distinguish among causes of disability, with an eye to identifying characteristics that may affect treatment planning and outcomes. For example, a sudden acute event may need condition-specific treatment, whereas a slow decline in function may be amenable to treatment at the level of disability.**

New Research Addressing This Question: Our literature review did not identify any studies addressing the efficiency of diagnosing the cause of disability.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

Rehab 4 (Level B): **Mechanistic studies are needed on the physiologic processes underlying geriatric disability and on the potential effect of the biology of aging on response to rehabilitation, particularly for sarcopenia and recovery from acute illness.**

New Research Addressing This Question: One study, though not a physiologic study, clearly showed that the overall process of hospitalization caused permanent decline in activities of daily living (ADL) function in 10% of disabled women at 6 months after hospitalization and beyond. [11] This was after controlling for other factors, such as the illnesses themselves and the effects of aging per se, known to be associated with hospital-related functional decline. Another study contributes to earlier research documenting functional decline in relation to hospitalizations for conditions not known to cause sudden disability. [12] These reports contribute to the growing literature on predictors of the functional decline after hospitalizations. [13]

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed. Additional work will be needed to determine what aspects of hospitalization have these detrimental effects and to identify cost-effective interventions.

Rehab 5 (Levels B, A): **Hypothesis-generating research followed by hypothesis-testing research is needed to better define the point in the disablement process when treatment is optimally instituted and**

whether or not optimal timing differs according to the disablement process (catastrophic versus progressive) or the underlying condition.

New Research Addressing This Question: Bean et al have shown that residents in SNFs, like community-dwelling persons, who develop impairments in the range of motion and strength of any limb experience a concurrent step-wise loss in ADLs. [14]

In older adults living in the community, disability can have a waxing-waning course. [15] Understanding this is necessary in the design of research strategies and in targeting clinical interventions. Ongoing epidemiologic studies are clarifying the natural history of, and risk factors for, progressive and catastrophic disability. In elegant work from the Women's Health and Aging Study, measures of lower- and upper-extremity function, excepting grip strength, significantly predicted the onset of progressive ADL disability. However, only walking speed was found to be significantly associated with the onset of catastrophic ADL disability. Overall, progressive disability was easier to predict than catastrophic disability. [16]

In a 4-year longitudinal study, the disabling consequences of depression were described. Rapid declines in function occurred if depressive symptoms remained persistently elevated. [17] These results demonstrate the importance of further research to help clinicians better distinguish temporary and more permanent depression and use appropriate interventions in each case.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

***Rehab 6 (Level B)*: A longitudinal, nationally representative cohort study is needed to define the disabling impact of different diseases and conditions at the societal level, stratified by age group and major categories of interest to geriatrics (eg, nursing home residents versus community dwellers). This information will allow better prioritization of research endeavors in geriatric rehabilitation.**

New Research Addressing This Question: Trends in disability in older adults have been systematically reviewed and show the encouraging news that disability rates are declining about 2% per year. [18,19] The US Census Bureau report *65+ in the United States: 2005* also confirms that older adults today differ markedly from prior generations. [20] The percentage of people aged 65 years and older who report "a substantial limitation in a major life activity" fell from 26.2% in 1982 to 19.7% in 1999. Poverty levels have decreased from 35% of people aged 65 and older living in poverty in 1959 to 10% in 2003. Very worrisome, however, are the effects of the increase in divorce rates among older Americans, as well as increasing obesity and the lack of decreased poverty across all population groups. Reasons for the drop in disability rates are not fully clear, though increased educational levels may play an important role. The increase in high school graduates among older adults is substantial—from 17% in 1950 to 71.5% in 2003.

The number of older adults will continue to increase; estimates are that 20% of Americans will be aged 65 years or older by 2030. Unfortunately, a substantial number of adults will nonetheless experience disability, requiring focused secondary and tertiary prevention efforts as well as appropriate rehabilitative care.

Large administrative databases, despite their limitations, and other large data sources, like the Medicare Current Beneficiary Survey, may be promising sources for rehabilitation outcomes research and for understanding the social impact of specific clinical conditions. [21] For example, 20% of the entire Medicare population has at least one health-related activity limitation. Medicare enrollees' health care costs increase as the number of activity limitations increases through greater frequency of all health care utilization events (eg, hospitalizations, outpatient visits) rather than an increase in the intensity or cost of those events. [22] A valid method has been developed for using ICD–9 codes to identify secondary conditions in Medicare patients. [23] This increases the ability to use Medicare administrative data to evaluate health care issues in a large population (as well as aspects of health care delivery).

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

***Rehab 7 (Level B)*: Observational and cohort studies are needed to identify the key social and environmental risk factors for current disability or progression into disability for the older patient, and the influence of these factors on rehabilitation outcomes.**

New Research Addressing This Question: Social relationships are intimately involved with multiple aspects of rehabilitation and living with disability. Under certain conditions, lack of social supports contributes to significant morbidity when certain illnesses occur. As described below, social supports have impact on outcomes from hip fractures and other conditions.

Progress is occurring in relation to the study of environments and their mitigating or exacerbating contributions to disablement. One barrier has been the difficulty of establishing appropriate measures of patients' environments. Promising new instruments are in development. These environmental taxonomies include physical, attitudinal, and policy factors. Different environmental levels include the micro (personal), meso (community, services), and macro (societal, systems) levels described in 1977 by Bronfenbrenner. [24,25] One new measure focuses on patient self-report of personal environments. [26] Eight physical environmental components affect older adults as they move around in their communities, and these components can contribute to varying levels of mobility disability. [27]

Preliminary studies are evaluating the adaptations that would be needed to different types of housing depending on the disability a person has and how that disability will change over time. For example, Lansley et al conclude that home environments can facilitate independence through appropriately selected adaptations and assistive technology. [28]

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda while separating the question into two parts, one focusing on social relationships and one on the physical environment.

***Rehab 8 (Level B)*: Cross-sectional studies and longitudinal cohort studies of the relations between caregiving and outcomes are needed.**

New Research Addressing This Question: Special considerations can arise in goal setting for any rehabilitation patient who requires significant family involvement—either because of cognitive impairment or significant needs for physical help, or both. In these

situations, family goals are important perspectives to consider. In one assessment of an outpatient geriatric setting, low agreement was found in treatment goals between physicians and the family caregivers. [29] It is important to assess whether a similar discordance occurs in rehabilitation settings that take care of frail older patients.

Research on caregivers for patients with chronic, progressive cognitive impairment, like dementia, is substantial, and its review is beyond the scope of this chapter. However, documented outcomes for family caregivers of stroke patients have shown mental distress similar to that experienced by the caregivers of Alzheimer's disease patients when caregiver burdens are similar. [30] Some level of family conflict was reported by 66% of caregivers of stroke survivors 3 to 9 months following the stroke. In 32% of families, general family functioning was measured as ineffective. The caregiver's mental health was poorer when stroke survivors had significant motor and memory or behavior problems. [31] Newer stroke therapies, as well as chronic disabilities, all put burdens of care on families. Increased understanding of these burdens as well as interventions to alleviate some of the problems are required.

A better understanding of caregivers' experiences is needed, since they involve so much more than simple support of ADLs and instrumental ADLs. Navigating the health care systems and providing emotional support are among the many demanding tasks assumed by caregivers. [32] Research is needed on these dimensions so that rehabilitation programs can identify interventions that help offset the demands of caregiving. In a survey of caregiving in the United States, about 75% of caregivers were for individuals aged 50 years and over, and contrary to expectations, 40% of caregivers were men. [33]

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

***Rehab 9 (Level B)*: Adequate investigation of such factors as coping strategies, attitudes, and the cost versus the benefits of assistive technology and improved access will require both qualitative and quantitative research, and considerable work is needed to develop methods for combining the results of both these research traditions.**

New Research Addressing This Question: A classic study, described in *When Walking Fails* by Lisa Iezzoni, MD, represents rigorous research that synthesizes the qualitative and quantitative approaches needed to cover the multiple dimensions of mobility problems faced by adults with chronic conditions. Iezzoni describes situations involving both younger and older adults; many themes apply to both groups. Through her work she inspires individuals to lead full lives despite mobility problems. [34] Specific research needs regarding health care delivery and access to appropriate services become clear on reading this superb report.

Functional health as people age can be better when self-perceptions are better. [35] Negative self-perceptions can interfere with healthy behaviors, such as the initiation of exercise. [36] Research in both these areas—improving self-perceptions and behavioral change for exercise—is needed and will likely require qualitative and quantitative approaches.

Psychologic conditions are common comorbidities during rehabilitation. As part of a study on psychiatric disorders and psychosocial burden in rehabilitation patients, 205 of 910 patients with musculoskeletal conditions who were receiving inpatient rehabilitation

were interviewed. Prevalence rates for psychologic problems were 31.1% for these patients during the first 4 weeks of the survey. The most prevalent conditions were anxiety, affective disorders, and substance-related problems. [37] Research will need to clarify which psychologic interventions during rehabilitation might help achieve better outcomes.

Modification of This Question in Light of New Research: We recommend that this question be kept without change on the research agenda. Qualitative research is needed to generate hypotheses on the nature of older patients' experiences during rehabilitation, including their perceptions of access to services (see also the research described under Rehab 22). Such work needs to explore treatment approaches that relieve suffering when possible, including evaluations and interventions for patients' coping styles and self-management abilities.

Rehab 10 (Levels B, A): Research is needed to articulate a clear theory or model of rehabilitation treatment that can then be tested.

New Research Addressing This Question: We are unaware of any new theory or model of rehabilitation treatment per se. However, one next-generation health model may serve as the basis for a model of rehabilitation treatment. In the Health Environmental Integration model, the health of any person depends on the health of the environment along with other factors. [38] Figure 12.1 depicts the four interlocking spheres of health environmental integration—the body, the mind, the physical environment, and the social environment. Stineman refers to this model as an eco-biopsychosocial model. It was built within the framework of the World Health Organization medical and disablement models and adds concepts from other biomedical, biopsychosocial, and disablement models, from organic unity theory, and from the concept of health-related quality of life. This synthesis includes models mentioned in *New Frontiers* and provides an understandable framework from which to study patients with disabilities and the care they receive in rehabilitation. [1,38]

One empiric, practical model to guide rehabilitation planning and teamwork is the Siebens Domain Management Model. This model organizes patients' health-related problems into four domains: medical and surgical issues; mental status, emotions, and coping

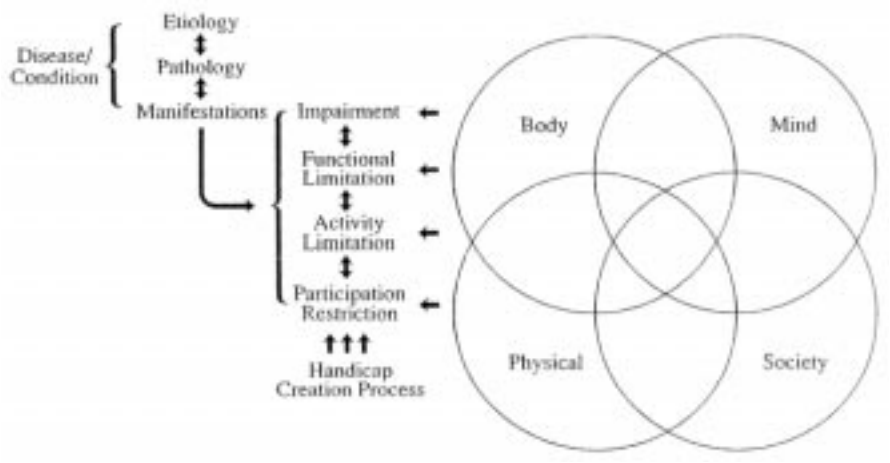

Figure 12.1—Spheres of health environmental integration. (Source: Stineman MG. A model of health environmental integration. Top Stroke Rehabil 2001;8:34–45. Reprinted with permission.)

issues; physical function issues; and living environment issues. [39,40] Errors in the management of patients with disability can occur from the lack of critical information in any one of these four domains. [41]

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

Rehab 11 (Level B): Research is needed to delineate the components of the rehabilitation "black box" (eg, the dosage of rehabilitation).

New Research Addressing This Question: Several studies focusing on stroke have started to examine in detail the "black box" of rehabilitation. For example, Bode et al analyze the type of therapy received. In general, they found that OTs spent more time in impairment-related activities, and PTs and speech language pathologists spent more time on function-related activities. More detail about the actual time spent for patients included 74% in OT, PT, and speech therapy, 10.6% in education (nursing), 7.2% in social work activities, 5% in therapeutic recreation, 2.2% in psychologic services, and 0.5% in chaplaincy activities. Overall, these amounts of therapy time were similar in the IRF and SNF units. However, this study was performed before the implementation of the prospective payment system. The level of impairment did not appear to contribute to the amount of therapy received. [42]

A major study has identified many of the components of IRF care processes, the "black box," and has related these to patient outcomes. In the Post-Stroke Rehabilitation Outcomes Project, seven IRFs participated, including one in New Zealand, and 1291 patients were studied. The study method, Practice-Based Evidence–Clinical Practice Improvement (PBE-CPI) developed by Susan Horn, has been used in numerous other studies, but this was the first time it was applied to a rehabilitation setting. [43] Detailed process factors were collected from chart review, and additional point-of-care forms were completed by clinicians about treatments. Patient factors were collected through detailed chart review by use of the Comprehensive Severity Index and standard abstraction of information deemed relevant by the study clinicians. Outcomes included length of stay, some specific laboratory indicators, and functional status measured by the Functional Independence Measure (FIM). A total of 141,511 forms were collected from all clinicians. This observational study revealed several interesting associations. Earlier onset of inpatient rehabilitation was associated with better functional outcomes, controlling for severity and initial functional status. [44] Detailed evaluation of physical and occupational therapies indicated that a majority of time was spent on gait training and impairment- or ADL-related activities, respectively. Little time was spent on community-level activities. [45,46] Speech and language pathology findings included better success in low- to mid-level functioning communicators if therapy included more cognitively and linguistically complex activities (problem solving and executive functioning skills). [47] Patients with severe strokes (case mix groups 108 to 114) receiving tube feeds for more than 25% of their inpatient stay were found to have better outcomes. [48] The use of newer atypical antipsychotics, newer selective serotonin-reuptake inhibitors, and narcotic analgesics was associated with significantly greater increase in motor FIM scores. [49] Overall, early onset of rehabilitation and early gait training (within the first 3 hours of therapy) as well as increased time spent on more complex activities were definitely associated with better functional outcomes, controlling

for multiple other variables. [50] All these reports contribute to our understanding of practice variation among sites. The findings challenge traditional rehabilitation thinking, that is, that therapies must focus on simpler activities before advancement to more complex ones can occur.

Modification of This Question in Light of New Research: We recommend keeping this question on the agenda. Continued research is needed to define the therapeutic components of rehabilitation programs. The promising research methodology of PBE-CPI should be evaluated further. Additionally, work to standardize the components of rehabilitation therapies that are determined to be good or best practices should be conducted to allow for future clinical trials.

PROGRESS IN THE COMPONENTS OF REHABILITATION

See *New Frontiers,* pp. 345–353. For discussion of two new items for the research agenda, see the components of rehabilitation subsection in New Horizons in Geriatric Rehabilitation at the end of the chapter.

In the chapter on the research agenda in geriatric rehabilitation in *New Frontiers*, the components of rehabilitation were divided into structure (setting, providers), process of care (interventions), and outcomes. This was based on Donabedian's model for studying quality of care. [51] The following questions refer to studies in these areas. Five years ago little was discussed about outcomes; however, more work on outcomes has occurred since then, research that is discussed at the end of this chapter (see the section New Horizons in Geriatric Rehabilitation).

***Rehab 12 (Levels B, A)*: Hypothesis-generating research followed by hypothesis-testing research is needed to identify the critical factors responsible for the more optimal outcomes seen in some settings.**

New Research Addressing This Question: The new research approach using Clinical Practice Improvement has led to insights in the rehabilitation process and will be helpful in studying different sites of care. This approach uses a practice-based evidence research method that collects detailed patient-based information, detailed clinical care delivery (process) information, and outcomes measures on large patient populations. [10,52] Analyses of these observational data identify associations among patient characteristics, treatment interventions, and specific outcomes. Findings can be tested in rigorous trials and used to improve care processes directly. Given the complexities and variations among patients requiring rehabilitation, the Clinical Practice Improvement approach is a promising research method.

Rehabilitation care spans multiple settings and offers varying intensity of treatment: from rehabilitation units in acute care hospitals or freestanding rehabilitation hospitals to subacute rehabilitation units in nursing homes to rehabilitation services offered by nursing homes or home health services to outpatient rehabilitation services. Medicare policy changes for acute inpatient rehabilitation facilities, SNFs, and home health services have led to changes in care delivery. These changes and the multiplicity of sites highlight the need for research to identify optimal care settings for different types of rehabilitation patients.

Acute inpatient rehabilitation offers approximately 3 hours of therapy per day, while SNFs offer an average of 1 hour per day. There have been few controlled studies comparing the efficacy of treatments of differing intensity for specific types of disabilities. Research on this topic has been difficult because IRFs report their outcomes using the FIM at admission and discharge, whereas SNFs report their outcomes using the Minimum Data Set assessed in a different time frame. Prospective randomized controlled trials on intensity of treatment are difficult because the patient populations that tend to go to IRFs and SNFs may not be similar.

One systematic Cochrane review covered the large topic of rehabilitation setting, "care home versus hospital and own home environments for rehabilitation of older people." No conclusions could be drawn as to optimal location for rehabilitation. Comparability between intervention and control groups was weak. [53] However, studies are being done on characteristics and outcomes of specific care settings.

Several descriptive studies of different rehabilitation care providers have been published between 2000 and 2005. Chen et al reported on subacute rehabilitation occurring in 1996 and 1997. Their results show that this type of care, offered in units in acute hospitals, rehabilitation hospitals, and SNFs, provided slightly different amounts of minutes of therapy per day and that functional gains occurred in the three diagnostic groups evaluated—stroke, orthopedic, and debility. Greater gains were weakly associated with more minutes of therapy and longer lengths of stay. This research documents outcomes under former cost-based reimbursement. [54]

Comparing the results of these earlier SNF units, often referred to as subacute units with daily reimbursements approaching IRF levels, with the results of current skilled nursing units would be interesting. One study in 2002 of patients admitted to SNFs did show a relationship between therapy intensity and rehabilitation outcomes. [55] One evaluation of hip fracture patient rehabilitation between March 2002 and June 2003 compared IRF outcomes with SNF outcomes, controlling for cognitive status, social supports, and other variables. Prefracture FIM scores were similar (85.0 ± 10.5 and 85.2 ± 8.0) for IRF ($n = 42$) and SNF ($n = 32$) patients, respectively. IRF lengths of stay were shorter (12.8 days versus 36.2 days), and IRF patients were more likely to reach 95% of their pre-fracture motor FIM score by 12 weeks. [56]

Leach et al have raised the possibility that the outcomes of rehabilitation for older orthopedic patients may be better for some patients in managed care than in fee-for-service systems. Lengths of stay can be shorter in managed care. Very few patients, however, were included in this analysis ($N = 34$). [57] A more recent study directly compared IRF and SNF outcomes for total joint replacement surgery. The study design was a retrospective chart review on 87 pairs of patients who were matched for age, gender, type of surgery, and FIM score at admission. Mean lengths of stay were shorter in the IRFs (10.3 ± 3.3 days versus 20 ± 10.8 days, $P < .005$), and a larger number of IRF patients were discharged to home (89.5% versus 79.1%, $P = .029$). The mean locomotion score and distance walked were greater as well for the IRF patients. [58] More studies will help clarify the respective strengths of SNF and IRF rehabilitation for joint replacements. One ongoing study that will include 2400 patients is using practice-based evidence and the Clinical Practice Improvement method. Results are expected in 2007. [59]

One special population requiring a unique rehabilitation approach is older patients with resolving acute medical or surgical conditions, multiple comorbidities, and severe

deconditioning. The term *slow stream rehabilitation* has been applied to programs caring for these patients, usually for several months. These patients can get discharged to their desired discharge locations, often to home. Predictors of successful discharge included higher initial level of functioning, good vision, and having sufficient help at home. [60] More research on these types of patients will be necessary to determine which ones will benefit from a long period of inpatient care and progressive rehabilitation and which patients are reaching end-stage disability for which purely compensatory management is appropriate.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

***Rehab 13 (Levels B, A)*: Hypothesis-generating research followed by hypothesis-testing research is needed to examine the effect of changes in Medicare reimbursement changes on access to rehabilitation and the quality of rehabilitative care.**

New Research Addressing This Question: One study examined nursing home rehabilitation services before and after the establishment of the prospective payment system in the state of Ohio. Rehabilitation services did decrease. The types of patients admitted to SNFs changed and included more patients with chronic medical and surgical conditions. The study found that patients less likely to receive any therapies before the prospective payment system was installed tended to get some therapies after it was in effect. [61]

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

***Rehab 14 (Level A)*: Randomized trials are needed to investigate the trade-offs of using less costly paraprofessionals to provide rehabilitation treatment, of using streamlined teams, and of using diverse strategies for team coordination and communication.**

New Research Addressing This Question: Rehabilitation providers during inpatient care work as a multidisciplinary team. Team functioning and contribution to care are being evaluated both within and beyond the field of rehabilitation medicine. In one study of stroke rehabilitation, three of ten measures of team functioning were found to be significantly associated with patient functional improvement—task orientation, order and organization, and utility of quality information. Patient length of stay was found to be associated with a single measure of team effectiveness. [62] With measures now available to assess team functioning, ongoing research will be able to assess team functioning and evaluate interventions to improve team effectiveness.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

***Rehab 15 (Levels B, A)*: Observational studies followed by randomized trials are needed to identify which conditions are best treated with a team approach (eg, disability resulting from multiple medical prob-**

lems or a condition like stroke that causes multiple physical impairments) versus which conditions are treated equally well by a single provider (eg, disability due to a single condition causing a limited physical impairment like osteoarthritis of the knee).

New Research Addressing This Question: Our literature review found no studies evaluating this issue directly.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

***Rehab 16 (Level A)*: Randomized controlled trials are needed to examine whether specific kinds of resistive exercise, modes of exercise delivery, and combinations of treatments (eg, psychosocial intervention plus exercise intervention) might enhance functional outcomes for older persons, and which functional outcomes are affected to the greatest extent.**

New Research Addressing This Question: A large number of studies of exercise have been reported since publication of *New Frontiers*. Description of these studies below is organized as follows: first, the benefits of exercise, and then according to the types of exercise studied—resistance, aerobic, balance, flexibility, and functionally based exercise.

There is substantial evidence that regular physical activity has a number of health benefits, especially for community-dwelling older adults with or without chronic conditions. [63] Physiologic changes associated with aging are similar to those seen with physical inactivity and can, in many instances, be ameliorated with exercise. At the physiologic level, exercise can improve aerobic capacity, increase maximal cardiac output, and reduce resting blood pressure. Exercise can also translate into improving functional performance, self-efficacy, and disability. Nevertheless, it should be noted that increasing physical activity and exercise do not always result in similar levels of increased function, as the relationship between degree of exercise and physical function may depend on baseline levels of function; those more deconditioned are able to benefit more from exercise than those already at high levels of function.

Strength training has been a focus of considerable research in geriatrics and is considered the most established means of enhancing and maintaining function in older adults. [64–73] This is due, in part, to the strong evidence that muscle mass and strength declines with age. Work has been done to characterize the underlying physiology behind the change in muscle mass, but the cause of age-related decline in muscle mass, *sarcopenia*, remains unclear. Much of the interest in resistive exercises has been generated because they have been shown to improve a number of physiologic parameters important to older persons, including insulin sensitivity, bone mineral density, aerobic capacity, and muscle strength. [74–78] Guidelines that correlate intensity of exercise and a particular level of function will be useful for further research. Musculoskeletal injuries can occur, as was shown in one study of high-intensity, home-based quadriceps resistance exercise in 243 frail older adults. [79]

Studies indicate that muscle power may correlate better than strength with mobility and function and thus may be a more sensitive indicator of a person's mobility and function. [80] Muscle power, which is the product of force times velocity, is different from muscle

strength, which is measured by the force exerted by the muscle. Muscle power seems to decline more than strength with advanced age, but power seems to be responsive to exercises that include velocity training. [81–83]

Aerobic capacity is decreased in older adults, but this age-associated impairment can be reversed through aerobic exercise. For example, Keysor and Jette report that 70% of studies of aerobic conditioning in older adults showed improvements in aerobic capacity, but the effect of aerobic exercise on body composition is less consistent. [84] Studies of aerobic exercise for specific conditions commonly seen in older adults have demonstrated beneficial effects. For example, a meta-analysis showed that aerobic exercise significantly reduces systolic and diastolic blood pressure in normotensive and hypertensive older adults. [85] Aerobic and weight-bearing exercise as a method of rehabilitation for coronary heart disease and increasing insulin sensitivity are additional examples. [86–88] Haykowsky et al reported that aerobic exercise training improves relative peak Vo_2 as much as strength training in older women, although aerobic exercise did not seem as effective as strength training for increasing muscle strength. [89] With regard to long-term outcomes, a small study found that benefits of 14 weeks of aerobic endurance training included improvements in Vo_2 max and body composition, but gains were reversed after 1 year. [90] It may be that, to optimally improve function, aerobic exercise should be combined with other forms of training. One study noted that an exercise program consisting of endurance, strength, balance, and flexibility training performed at a senior center had greater gains on performance tests than home-based training, although motivation and compliance as well as group support also may have influenced results. [91]

Balance exercises address multiple deficits, including muscular weakness, vestibular dysfunction, and neurologic abnormality. These exercises are increasingly important, given the clear association of poor balance, fear of falling, and actual falls. [92] Balance exercises appear to be most effective when performed as part of a comprehensive approach. For instance, Tai Chi has been demonstrated as efficacious in lessening the incidence of injurious falls, but the exact mechanism is unclear. Balance training in specific conditions, like idiopathic Parkinson's disease, can improve balance but is even more effective when combined with strength training. [93] For community-dwelling seniors, a minimally supervised home-based exercise program improved dynamic balance 33.8% $\pm$ 14.4% in exercisers versus 11.5% $\pm$ 23.7% in control persons. No differences occurred in strength, gait speed, or cardiovascular endurance. The authors, citing other studies as well, point out that meaningful improvements in functional performance, as measured by the Physical Performance Test, can occur through improvement in balance in the absence of increased motor strength. [94]

Another randomized controlled outpatient exercise study for community-dwelling seniors involved exercises classes three times a week for 6 months and home exercise, then classes just once a week during months 7 to 12 and home exercise, and then only home exercises during months 13 to 18. Although balance was improved at 12 months, this difference was lost by 18 months when participants were doing only the home exercise program. [91] This shows how easily gains from exercise can be lost. Further research will eventually help clarify the ideal, minimal amount of exercise necessary to maintain adequate balance as the body ages.

Isolated studies of flexibility in older adults remain limited. One creative line of re-

search has evaluated hip flexibility in relation to gait. Gait studies in older adults, in those who do and do not fall, are defining the contributions of static and dynamic hip range of motion in changing walking patterns as people age. Standing hip characteristics are similar in younger and older adults, but hip extension is decreased in older adults. The decrease in peak hip extension appears to be a mostly dynamic phenomenon. Subtle hip flexion contractures may contribute to the decrease. [95,96]

The limitations of just increasing range of motion in frail older people were demonstrated in one randomized controlled trial of exercise. Older volunteers, mean age 83 years, were randomized into an outpatient exercise program or a control home program that included only range-of-motion exercise. All the participants were identified as frail by scoring over 17 and under 33 on the Physical Performance Test. Range of motion improved in major joint groups in the control group, but there were no other benefits in overall function, balance, or walking. [97]

Recent data suggests that specific task-based training may lead to better function more effectively than specific exercises per se. The benefits of exercise are known to decline once the exercise is stopped. One randomized controlled trial therefore focused on training healthy older women by the use of exercises in movement patterns from daily activities. These included moving with a vertical component, moving with a horizontal component, carrying an object, and changing between lying, sitting, and standing positions. This program was compared with a resistance-exercise training group and with a control group that continued their usual daily activities. By the end of a 12-week training period, those who were functionally trained maintained better daily activity performance than did those in the control group. This gain persisted at 6 months after the training program ended as well. [98] The benefits from task training, in comparison with resistance training, depends on the type of patient and the goals. For example, task training on reaching for stroke survivors yielded better movements in more impaired persons, whereas those at a higher level benefited more from resistive exercise training. [99] The importance of task training, focusing on gait, in stroke rehabilitation has been highlighted by Horn et al and evaluated in relation to balance self-efficacy. [50,100] These types of research are beginning to sort out the complex relationships between functionally based task training and more specific exercise training.

A parallel to this concept of functionally based exercise for people with physical disabilities has been observed in able-bodied persons. Physiologic benefits can occur from changes in lifestyle physical activity. [101,102] A person does not necessarily have to participate in a structured, vigorous exercise program in order to become more fit. Thus, activity that is functionally based—be it during a rehabilitation program or part of regular physical activity—is beneficial.

Modification of This Question in Light of New Research: We recommend dividing this question into two sections—general exercise interventions involving the whole person and specific exercise interventions involving specific body systems (eg, muscle, tendons). It should remain on the research agenda.

***Rehab 17 (Level A)*: Randomized trials are needed on the health, functional, and quality-of-life benefits of aerobic exercise in older persons who are already disabled. The study population should be homogeneous with regard to amount and type of disability, and methodologic consideration should be given to how to deal with**

underlying medical conditions in the population and the differences they might produce in response to exercise. The outcome measures should be clearly specified; they might include physiologic parameters such as blood pressure, body composition, oxygen-carrying capacity, measures of physical function such as 6-minute walk distance, self-reported difficulty with activities of daily living, and measures of health-related quality of life like the Medical Outcomes Study 36-item Short Form 36 (SF 36).

New Research Addressing This Question: Exercise training was found to be effective in older adults with cognitive impairment and dementia in one meta-analytic review. [103] We found no reports of randomized controlled trials.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

Rehab 18 (Levels B, A): **Hypothesis-generating research (eg, databases, cohort studies, case series) followed by hypothesis-testing research is needed to examine the benefits of differing types of exercise for specific conditions.**

New Research Addressing This Question: Musculoskeletal rehabilitation studies need to compare exercise with other treatments, such as manual therapy or manipulation. For example, one small randomized controlled trial compared manipulation therapy with exercise therapy for painful osteoarthritis of the hip. After 5 weeks of therapy, twice a week, pain reduction was found to be greater with manual therapy than with exercise therapy (odds ratio 1.92, 95% confidence interval 1.30 to 2.60). This difference remained at 17 and 29 weeks later. However, in both treatment groups, equal numbers of patients went on to receive total joint replacement surgery. [104] More work will be needed to sort out optimal treatments. The goal of manual therapy is to loosen a tight joint capsule and surrounding tissues around an arthritic joint. This is the proposed mechanism for decreasing pain. Perhaps a combination of manual and exercise therapy would yield better results.

More work on specific types of strengthening exercises will help determine cost-effective approaches. For example, in one study of knee osteoarthritis, concentric strengthening was compared with concentric-eccentric isokinetic training. Both were found to reduce pain and increase function. Stair climbing and descending, however, improved more in the concentric-eccentric group. [105]

Resistance training can benefit patients with neurologic diseases. In adults with Parkinson's disease, resistance training was found to increase muscle strength as much as in control persons of similar age. Speed of gait improved despite the Parkinson's disease and not in the control persons. [106] In long-term stroke survivors, high-intensity resistance training was found to improve function. [107]

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

Rehab 19 (Levels B, A): **Observational and cohort studies are greatly needed to identify effect size for key outcomes, which devices are**

promising enough to merit later comparative clinical trials, and what long-term follow-up shows among older people using assistive devices. These should be followed by randomized trials of the most promising devices.

New Research Addressing This Question: Salient characteristics of assistive technology (AT) highlighted in *New Frontiers* included a significant increase in the use of these technologies—an increase far greater than increases in the US population—but little research on actual use by older persons. Cross-sectional data from six national surveys of community-dwelling adults aged 65 and older show estimates of use of any device to be 14% to 18%. [108] In one retrospective longitudinal study 74% of 85-year-olds were using assistive devices, and this increased to 92% by the age of 90. [109] The most commonly used devices were for bathing and mobility. According to a 2001 survey, 6.2% of Medicare beneficiaries obtained mobility assistive technology. Average prices ranged from $52 for canes to $6,208 for power wheelchairs. [110]

AT is often not used once prescribed or is ill fitting. For example, one survey of 42 nursing home residents using wheelchairs identified 93 instances of inadequate equipment. Yet 86% of users were mostly satisfied with their wheelchairs. [111] The process of wheelchair provision may contribute to shortcomings. When wheelchairs are provided through a multifactorial approach involving experienced therapists, a prescription based on medical conditions and function, and additional therapy for training, new wheelchair owners were found to use their wheelchairs more often. [112] More formalized community-based wheelchair skills training that includes caregivers does improve users' skills. [113] For older persons for whom manual wheelchair use becomes difficult, power-assisted wheelchairs may be an excellent option to improve wheelchair mobility. [114] In a study of another common assistive device—a long-handled bath sponge—86% of patients used the device, and a variety of reasons accounted for the lack of use by the remaining 14%. [115]

The concept of usability defined by the International Organization for Standardization includes effectiveness, efficiency, satisfaction, and context of use. This construct can be applied to all assistive products, even clothing. For example, one study of orthopedic shoe use at 3 months in 93 older adults with degenerative arthritis in their feet added measures of efficiency (how easy shoes were to put on) and satisfaction (whether shoes were considered attractive) to usual measures of effectiveness (increase in stance duration, decrease in skin abnormalities). The fit of the logistic regression model predicting show use had an R^2 value of 34.9% when only effectiveness variables were used. Adding the efficiency variable and then the satisfaction variable increased the R^2 to 43.3% and 56.3%, respectively. [116] This type of research approach may improve both the successful development and use of new assistive products.

Rollators, a frame with four large tires, are especially effective, yet they are probably underused in the United States as assistive devices to compensate for balance problems. In Sweden 4% of the total population uses them, and in Denmark, 6.4% of people aged 56 to 84 years use them. [117] In one study, 89 users reported frequent device use and general satisfaction. Some users, however, reported having problems in handling the rollator, concerns with its weight, and difficulty in transporting it on a bus or folding it for car use. [118]

Some studies suggest that besides improving functional independence, AT can reduce the amount of human help a person requires. One randomized controlled trial showed this to be the case for frail elderly persons, many of whom had been discharged the prior year

from an inpatient rehabilitation program. Home environmental modifications were combined with AT devices after a home assessment by an occupational therapist. [119] Another study analyzed data from the National Long Term Care Survey in 1994 and found persons with disability who used AT used fewer hours of personal assistance. Since this was a cross-sectional study, this association of greater AT use and fewer hours of assistance may not be causal. [120] Another research model, using data from the 1994–1995 National Health Interview Survey Disability Supplement, suggested that AT does reduce informal care hours for persons who are unmarried, better educated, or have better cognitive abilities. However, these same persons used more formal care hours. Therefore, the authors caution against concluding that AT might be a means of offsetting care costs for older disabled persons. [121]

For community-dwelling older adults, occupational therapy is an effective way to help patients obtain effective assistive devices. A systematic review demonstrated clear benefit when occupational therapy, as part of a home hazards assessment of functional ability, not only suggested the use of particular assistive devices but also subsequently helped train the person in behavioral changes to use the devices effectively. [122]

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda, as findings of such research are still needed. Overall, research in assistive device outcomes will require more development of outcome measures. Concepts to be covered include usability, quality of life, social role performance, [123] effectiveness, social significance, and subjective well-being. [124]

PROGRESS IN REHABILITATION FOR SPECIFIC CONDITIONS

See *New Frontiers,* pp. 353–359. For discussion of one new item for the research agenda, see the subsection on rehabilitation for specific conditions in New Horizons in Geriatric Rehabilitation at the end of the chapter

In this section of the rehabilitation chapter in *New Frontiers*, the discussion covered themes in several common disabling conditions: arthritic and related musculoskeletal problems, stroke, cardiac disease, hip fracture, amputation, deconditioning, sarcopenia and frailty, falls, and pain. Pertinent new research on these topics is described under the next ten agenda items.

***Rehab 20 (Level B)*: Epidemiologic and observational studies of older patients with specific disabling conditions are needed in order to identify risk factors and to select key outcomes for measurement in future clinical trials.**

New Research Addressing This Question: According to the Nagi model, one of the earliest models of disability, the disabling process starts with a particular pathophysiology that leads to an impairment, then to a functional limitation, and finally to a disability. [125] A societal limitation could then be present as well. This simpler, linear model of disability contrasts with a rehabilitation research model that uses a "transdomain" approach that evaluates simultaneously the impairment, functional limitation, and disability. [126] This research approach then clarifies contributing factors to disabilities and possible therapeutic approaches. For example, the relatively "simple" act of sit-to-stand performance depends

on impairments in the person, chair-related factors, and compensatory strategies if impairments or chair factors are contributing to a functional disability. As chair seat height is lowered, the more functionally impaired person is less able to perform the task despite an increasing use of compensatory strategies. [127] This research has helped dissect the components of disability, showing that environmental factors as well as person's physiology contribute to functional limitations and disability. Rehabilitation clinicians have always known, from gross observation, that chair height plays a critical role in a patient's independence in transferring out of a chair. This research dissects this phenomenon more completely in a way that will help in the design of more effective rehabilitation strategies.

As disability becomes more widespread and affects a greater number of different populations, more emphasis in studies of disability is being placed on the prevention of disability. Such studies borrow from the traditional public health model and its focus on populations (Figure 12.2). [128,129] The three categories of disability prevention are primary (preventing the disease or pathophysiology), secondary (reducing disability risk factors, effectively treating early or asymptomatic disease, delaying progression of aging-related conditions such as diabetes mellitus, osteoarthritis), and tertiary (limiting progression of already present disability, or preventing additional impairments). [130] After appropriate diagnostic and prevention treatment strategies have been discovered, the health care delivery system needs to be designed to provide appropriate, cost-effective services.

The research on geriatric rehabilitation-related disability prevention and treatment interventions is growing rapidly, especially given the increasing recognition of the multiple

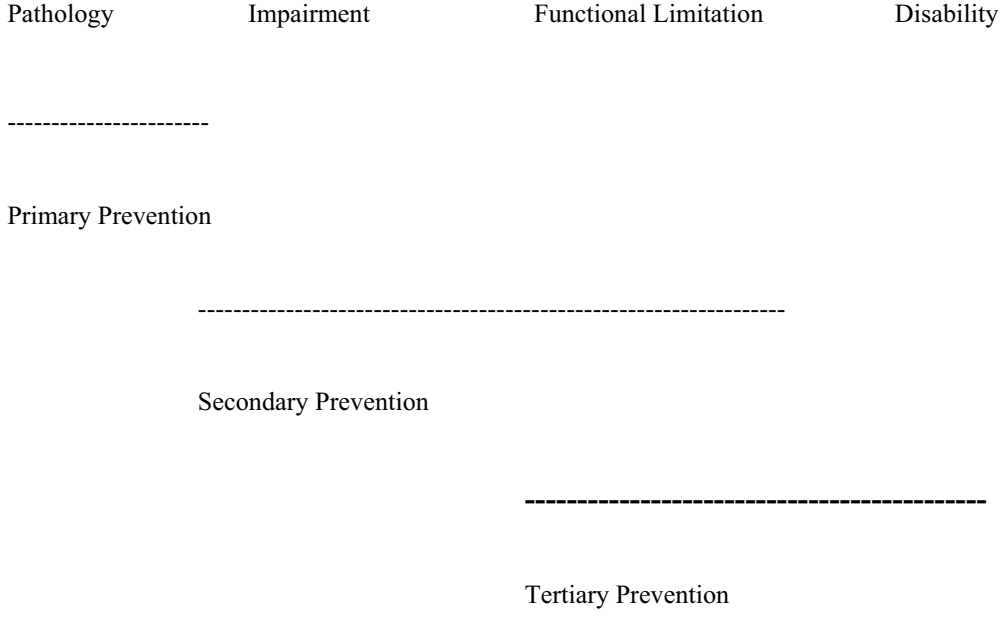

Figure 12.2—The disablement process (Verbrugge and Jette) is depicted in the top line. The public health prevention model below it correlates prevention with points in the disablement process. (Sources: Verbrugge LM, Jette AM. The disablement process. Soc Sci Med 1994;38:1–14. Figure from Magaziner J. Epidemiology of musculoskeletal conditions. Bethesda, MD: Interagency Committee on Disability Research, 2006. Reprinted with permission.)

factors contributing to disablement (eg, in the ICF). For older adults, "enabling" environments include a growing number of assisted-living facilities. [131] These vary in structure and services; they offer options for older adults who, for various reasons, need to change home environments.

A special complexity in understanding disability prevention and rehabilitation needs in older adults is the result of the interactions of frailty and multiple comorbidities. Recent detailed epidemiologic research has shown both the independence of frailty, comorbidities, and disability among seniors and their varying overlapping presence in some individuals. [132] (See Figure 12.3.) As the understanding of the underlying pathophysiology increases, targeting prevention strategies and interventions will be possible.

One new comorbidity index, the Geriatric Index of Comorbidity, combines the number of diseases and their severity. [133] This particular measure was found to have greater concurrent validity with disability and to be a better predictor of mortality than other measures in common use.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

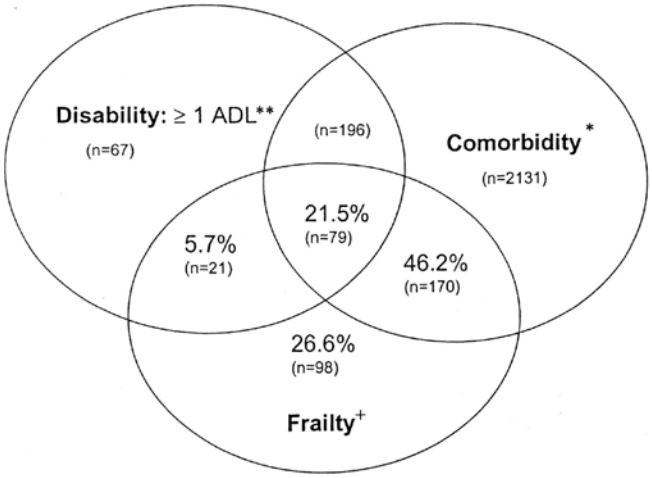

Figure 12.3—Venn diagram displaying the extent of overlap of frailty with activities of daily living disability and comorbidity (≥ 2 diseases). Total represented: 2762 subjects who had comorbidity, disability, or frailty (or two or all three). The number in each group is indicated in parentheses.

+ = Frail: overall N = 368 frail subjects (both cohorts).

* = Cormorbidity: overall N = 2576 with two or more out of the following nine diseases: myocardial infarction, angina, congestive heart failure, claudication, arthritis, cancer, diabetes, hypertension, chronic obstructive pulmonary disease. Of these, 249 were also frail.

** = Disabled: overall N = 363 with a disability in activities of daily living. Of these, 100 were frail.

(Source: Fried LP, Tangen CM, Walston J, et al. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci 2001;56(3):M146–M156. Copyright © The Gerontological Society of America. Reproduced with permission of the publisher.)

***Rehab 21 (Levels B, A)*: Observational and cohort studies are needed to define the efficacy and safety of specific types of exercise, assistive devices, and orthotics for arthritic and musculoskeletal conditions. These studies could lead later to controlled trials comparing the most promising interventions.**

New Research Addressing This Question: Estimates are that the prevalence of osteoarthritis will increase by 50% by 2020.[134] Because osteoarthritis affects multiple joints, research challenges include identifying which specific joints are being studied, as back, knees, hip, feet, and hands can all be affected. And although sometimes emphasis has been on mechanical effects as contributory, there may well be metabolic components. For example, in obese patients with osteoarthritis of the knee, there is also an increased incidence of osteoarthritis in non-weight-bearing joints. Exercise is now accepted as a core component of any rehabilitation regimen because of its benefits, such as delaying the onset of ADL disability.[135] The American Geriatrics Society has published a guideline reviewing the consensus on exercise in osteoarthritis.[136]

Total joint replacements to treat advanced disease will likely be performed more frequently in our aging population. Some studies have looked at specific components of this type of surgery. Minimally invasive total hip replacements are being done in some patients, generally younger. In one series that controlled for three comorbid conditions, recovery was very fast.[137] Timing of these surgeries has been evaluated. Surgeries earlier in the course of the disease may in the long run be more beneficial.[138]

Currently, joint replacements decrease pain and impaired function from arthritic conditions in both the knees and hips. Most patients benefit from these surgeries, but greater gains in function and decreases in pain are associated with social supports (defined as being married or living with someone). One study found that about 20% to 30% of the patients were both unmarried and living alone. Both their pain and function were worse initially at 1 month after surgery but back to levels similar to the general population by 12 months.[139]

Poorer outcomes after total hip replacement occurred in 10% of 922 patients who were re-evaluated through a self-report questionnaire 3 years after surgery. These patients, who had moderate difficulty with all functional activities or worse, experienced pain in the back or lower extremity, severe pain in the operated hip, poor mental health, more than one common geriatric problem, and obesity, and all also had less than college education.[140]

One randomized controlled trial compared a structured exercise program both before and after total hip replacement surgery with usual care in Australia. The exercise group received two supervised clinic sessions a week and were to repeat the activities at home two times a week for a total of 8 weeks before surgery. These structured exercises were continued for 12 weeks after surgery. The control group received only the instruction from hospital therapists. Both groups were comparable in basic demographics, neither group had surgical complications, and the same surgeons operated on the patients in both the intervention and control groups. At 24 weeks after surgery, both stride length and speed of gait were greater in the exercise group.[141]

A Canadian study evaluated clinic-based total knee replacement rehabilitation, comparing it with a home program that was taught to patients during the 5- to 7-day hospitalization. No differences were found between the two groups.[142]

Pain management from total knee replacement during inpatient rehabilitation was found to be improved in a randomized trial using oxycodone twice a day. Patients were able to walk further and had lengths of stay 2.3 days shorter, on average. [143] In total knee replacements, the use of continuous passive motion machines and slider boards has not been associated with better range of motion at discharge, 3, or 6 months. [144]

The effects of dehydration can be marked in older orthopedic rehabilitation patients. Length of stay was significantly longer for patients with azotemia (BUN/creatine $\geq$ 20) and orthostatic hypotension (13.6 $\pm$ 2.7 days versus 7.2 $\pm$ 2.8 days) than for patients without these conditions. Discharge function was similar in the two groups. [145] These huge differences in length of stay indicate a real need to evaluate this problem and possible early interventions in more detail.

Little work has been done focusing on patients' subjective experience before, during, and after joint replacement. One such study used grounded theory in interviewing 9 patients with varied total knee replacement experiences. Patients' experiences were summarized as "enduring," "thinking twice," and "keeping faith." [146] Better understanding of these experiences may lead directly to changes in the prehabilitation, hospitalization, and postoperative phases of the patients' joint replacements.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

> ***Rehab 22 (Levels B, A)***: **Observational and cohort studies are needed in the rehabilitation of musculoskeletal conditions to obtain preliminary data on the effects of the location of the physical therapy, the level of expertise of therapists needed, and how much is accomplished by education of elderly patients. This could lead eventually to controlled trials assessing these variables.**

New Research Addressing This Question: Our literature review found no reports addressing this issue.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

> ***Rehab 23 (Levels B, A)***: **Hypothesis-generating research followed by hypothesis-testing research is needed to identify the key components facilitating better outcomes that are seen in some settings and to identify ways to optimize treatment and outcomes among elderly patients unable to tolerate therapy in a stroke unit or rehabilitation hospital.**

New Research Addressing This Question: A major study has identified many of the components of inpatient IRF care processes for stroke patients and has related these to patient outcomes. [43] (See the discussion under Rehab 11.) Multiple aspects of more effective treatment components were identified.

The usage patterns of anticoagulant, antihypertensive, nonsteroidal anti-inflammatory, and antiplatelet agents in the Post-Stroke Rehabilitation Outcome Project study have been described. Many stroke participants received prophylaxis for deep-vein thrombosis, but 65

cases occurred, almost all in patients with moderate to severe stroke and many within the first day or two of admission. Thirty-three percent of participants received no antiplatelet or anticoagulant medication, suggesting possibilities for increased secondary stroke prevention. Antihypertensive medications were used in 73% of patients, and their blood pressures were on average higher than those of nonhypertensive patients during the entire rehabilitation stay, despite medication use (mean systolic at discharge 146.6 versus 131 mm/Hg). More aggressive blood pressure lowering is indicated during rehabilitation, if tolerated by patients, given the proven benefits of secondary stroke prevention. Neurostimulant medications were used in 20% of participants and were not associated with any differences in length of stay or cognitive or motor recovery. Pain medications were frequently used, and sites of pain, in order of decreasing frequency, were the head, leg, back, shoulder and hip. [147]

Other new research is studying constraint-induced movement therapy that improves motor function in specific types of patients. [148–150] One mechanism is having patients overcome learned disuse. A recent multicenter randomized study included 222 patients who had mostly ischemic strokes in the prior 3 to 9 months and noted that 106 who underwent constraint-induced motor therapy demonstrated clinically relevant improvements in arm motor function that persisted for at least 1 year. [151] Researchers are studying the potential benefits of robotics in stroke rehabilitation with promising approaches. [152,153]

The interactions of family function, caregiver health, and stroke survivor function were evaluated in a trial of 132 patients who had had strokes 3 to 9 months earlier. Thirty-two percent of the families scored positively for ineffective family functioning. Some family conflict was reported by 66% of the caregivers. Predictors of worse caregiver mental health (measured from the Medical Outcomes Study Short Form 36) included ineffective family functioning as well as poorer memory and behavior function in the stroke survivor. High family conflict was associated with poorer caregiver mental health, even if the stroke survivor had lesser memory and behavior problems. [31] In another study evaluating caregivers, a randomized controlled trial of early supported discharge to home for stroke survivors included education and support. Caregivers receiving this intervention consistently experienced a lower caregiver burden than caregivers receiving usual care. [154]

Effective stroke rehabilitation care, in the form of adherence with the stroke rehabilitation guidelines, is associated with better functional outcomes. [155] These are among the first data that validate the recommendations made by the national post-stroke rehabilitation guidelines. [156]

Stroke rehabilitation continues to need to focus on longer term outcomes. In a study that evaluated participation at 6 months after stroke onset, a significant number of people were found to have problems with travel, social activities, recreational activities, moving around the community, and having an important activity to fill the day. [157] Studies for effective interventions to help in these areas are needed.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

***Rehab 24 (Level A)*: Randomized controlled trials of exercise-based cardiac rehabilitation, as a function of age and comorbid conditions, would be very valuable and are urgently needed.**

New Research Addressing This Question: Cardiac rehabilitation programs in older adults will need to adapt to increased activity limitations and chronic comorbidities. In evaluation of two nationally representative cross-sectional surveys (the Health and Retirement Survey and the Assets and Health Dynamics of the Oldest Old study), Oldridge and Stump identified an increased likelihood of mobility and other activity limitation among those with heart disease and especially those with multiple comorbidities. [158] Cardiac rehabilitation programs need to be aware of these issues, both to determine optimal programming and to be sure patients are not unnecessarily excluded from beneficial cardiac rehabilitation. This may be especially important, given preliminary data from a descriptive study of 6-month cardiac rehabilitation program outcomes. The patients studied had a mean age of approximately 76 and had all undergone coronary bypass surgery; they had self-selected to participate in a cardiac rehabilitation program or not. These two groups were generally comparable as a result of the use of strict exclusion criteria. Lower-extremity function and balance were clearly better at 6 months in patients who had participated in the rehabilitation program. [159]

A randomized controlled trial of cardiac rehabilitation for patients with significant cardiac disease is ongoing in Denmark. Forty-nine percent of the 770 subjects are 65 years or older. The researchers noted, however, that the percentage of eligible older patients who consent to participation drops as patients get older. For example, only 17% of eligible patients aged 85 years and older agreed to participate in the study. [160] Nonetheless, this study will contribute to understanding the value of cardiac rehabilitation in older adults.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

> ***Rehab 25 (Level A)***: **Randomized controlled trials are needed to test the efficacy and safety for elderly patients of early, high-intensity physical therapy following hip fracture surgery and of postoperative restrictions on ambulation.**

New Research Addressing This Question: Outcomes from hip fractures are highly variable—from full recovery of walking abilities and activities to survival at wheelchair level to death. If we understood patient prognoses better, it would be clearer for whom the hip fracture represented disability at the end of life where little or no recovery would be possible, for whom recovery would be total without residual problems, or for whom outcomes would fall in between. Clinically appropriate and cost-effective therapies could then be better targeted. One creative analytic approach to this issue used cluster analysis. By collecting known and suspected predictive variables, the researchers used cluster analysis to identify four typological categories, or profiles, of patients with different 1-year outcomes. For example, those patients who died during 1-year follow-up were found to have had significantly diminished prefracture leisure activities, increased disorientation, more comorbidities, greater use of drugs, and unfavorable levels of prefracture ADL scores and relative perceived health. [161] Additional work on this approach may help clinicians more explicitly target appropriate disability management strategies.

Other studies have identified risk factors for mortality and decreased walking ability after hip fracture in individual patients and in comparison with age-matched community-dwelling populations. [162,163] Active medical issues play a role. [164] Neurologic

comorbidity complicates hip fracture rehabilitation and is associated with longer lengths of stay and overall lower functional scores in comparison with controls (hip fracture patients without neurologic impairment). However, no difference was found in the amount of functional gain between the two groups. [165]

Rehabilitation outcomes have been known to depend on social supports in certain situations. In hip fracture patients, a standardized rehabilitation and discharge planning protocol during acute care hospitalization was found to yield better results only in those patients with low social supports (assessed as number of contacts outside the home and the size of patients' social networks). Three-month Barthel Index scores were better, and more patients were living in the community at 6 months. [166]

Rehabilitation services have usually been provided for the few weeks or months after a fracture. However, in a randomized controlled trial, a duration of 6 months of physical therapy (three times a week) that included resistance training was found to result in improved physical function and mobility in more frail community-dwelling patients. Quality-of-life reports were better at 9 to 12 months as well. [167] This finding underscores the potential of structured strength training and exercise in recovery. The next issue is practical implementation, and payment for, such a relatively extensive intervention.

Optimal settings for hip fracture rehabilitation have been evaluated. In Finland, a randomized controlled trial (N = 243) compared outcomes for patients with dementia and hip fractures who were rehabilitated on a geriatric inpatient service with outcomes for patients who received usual local hospital care. Patients with moderate dementia, a Mini-Mental State Examination (MMSE) score of 12 to 17, had shorter inpatient rehabilitation stays (47 versus 147 days, $P = .042$), and a higher percentage were living at home at 3 months (63% versus 17%). Patients with mild dementias (MMSE scores 18 to 23) also had shorter rehabilitation inpatient stays (29 versus 46 days, $P = .002$), and more were living at home at 3 months (91% versus 67%). [168]

One summary review of best practices for older hip fracture patients concluded that evidence has identified some peri-operative practices with consistent benefits. [169] However, types of surgical management, postoperative wound drainage, and even multidisciplinary care do not have consistent evidence for improving outcomes. [170] In combination with some of the work described above, more detailed research is required to determine optimal interventions for specific subcategories of hip fracture patients.

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

> ***Rehab 26 (Levels B, A)***: **Observational and cohort studies should be performed to compare the costs and benefits of using newer prostheses in younger and older persons; factors found to be associated with better outcomes for older persons should then be tested in controlled trials.**

New Research Addressing This Question: A detailed descriptive study of a 5% sample of Medicare patients who had index amputations in 1996 (N = 3565) documented considerable 1-year morbidity and mortality. Reamputation rates for persons with initial amputations at the toe, at the foot or ankle (or both), transtibial, transfemoral, and bilateral sites were 35%, 39%, 23%, 14%, and 29%, respectively. One-year mortality rates for these

levels were, respectively, 23%, 29%, 36%, 50%, and 53%. [171] In a study using Massachusetts Hospital Case Mix and Charge Data from 1997, discharge locations after amputation were as follows: only 33% home, 32% to SNFs, 16% to inpatient rehabilitation, and 15% to other sites. [172]

Better evaluation methods for level of amputation would be very helpful. Out-of-pocket costs and health insurance benefits for care can accumulate significantly for patients and families with each amputation episode. Reasons for high mortality are likely due to diffuse vascular disease and merit further research. Rehabilitation programs, in collaboration with primary care physicians, need to consider this significant mortality in planning appropriate rehabilitation approaches. On a systems level, the rate of dysvascular amputation increased 27% between 1988 and 1996. [173] With the increasing age of the population, the number of patients experiencing amputations will likely increase and require improved systems of care. [174]

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

***Rehab 27 (Levels B, A)*: Basic laboratory research is needed to determine the factors that cause sarcopenia or that interact to cause it in older persons. Findings from this research should then be used in clinical trials of interventions to prevent or treat sarcopenia.**

New Research Addressing This Question: Our literature search found no articles on sarcopenia. However, several articles discussed aspects of bed rest, which we include under this rehabilitation question.

Bed rest, an acute form of inactivity, causes a series of physiologic changes usually referred to as *deconditioning*. In order to truly constitute deconditioning, these changes must be reversible once activity is renewed. Little study has been done measuring specifically the effects of bed rest on older healthy adults. It has been assumed, however, that physiologic decrements are likely to be similar to those experienced by younger persons. Functional decrements have long been assumed to be related to bed rest. The association of bed rest and functional decrements has been confirmed in a study of 680 nondisabled, community-living persons aged 70 years or older. Study participants were asked about "taking to bed" and were surveyed again at 18 months. The loss at 18 months from baseline in instrumental ADLs, mobility, physical activity, and social activity was found to be greater with increasing self-reported days of bed rest in nonfrail individuals than in frail ones. Of note, the nonfrail group always performed better than the frail group. [175]

Special challenges exist for keeping people active once they have lost the ability to be active on their own. One assessment of a bedfast quality indicator report found that SNF residents spend an average of 17 hours in bed, indicating significant disability. [176]

For especially frail elderly patients recovering from acute illness, a very slow inpatient rehabilitation program may be necessary to get them home. A Canadian study of 154 patients described outcomes of "slow stream rehabilitation." Eighty percent of patients came from acute care hospitals and 14% from "fast stream" rehabilitation sites. Fifty-three percent of the patients were discharged to their preferred discharge goal location (the great majority were home) with a long rehabilitation program of up to 9 months. Markers

distinguishing these 53% from those who remained in a nursing home included expert clinician opinion, good vision, better ADL function, and help at home. [60]

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda, as findings of such research are still needed, but with the addition of research that focuses on deconditioning as well as on sarcopenia.

> ***Rehab 28 (Level A)***: **Randomized trials are needed to examine the merits of specific falls-prevention interventions (eg, types or duration or frequency of exercise, mobility aids, home safety interventions) and for specific subgroups of elderly patients (eg, cognitively impaired, hospitalized) and to examine the cost-effectiveness of various falls-prevention strategies.**

New Research Addressing This Question: Fear of falling, an independent risk factor for functional decline and decrease in recreational physical activity, has been evaluated in older hospitalized patients, patient with hip fractures, patients with amputations, older adults transitioning to frailty, and community-dwelling seniors. [177] Fear of falling is associated with history of falls (but not always), a lower Falls Efficacy Scale score (feeling less confident of ability to do activities without falling), use of a walking aid, and more ADL dependency. [178] Fear of falling, even in the absence of any fall history, can be associated with a greatly increased risk of institutionalization. In one study of rehabilitation for hip fractures, Falls Efficacy Scale score was found to improve, but this did not correlate with improvements in the FIM score. [179] This suggests that falls efficacy could be targeted for treatment in more comprehensive hip fracture rehabilitation. Fear of falling is present in patients with amputation, especially if overall perceived health is fair to poor. [180] Even healthy older women without a history of falls can have a fear of falling. This fear of falling is present in active women but is greater in less active women. [177] Falls are independent predictors of the development of the fear of falling. In turn, fear of falling is a predictor of falling. [181] Interventions that help reduce the fear of falling include a physical activity or education program and Tai Chi. [182,183] For rehabilitation patients, a unidimensional fear of falling measure was developed through Rasch analysis. It includes 16 items and rates people's fear of falling on the basis of a hierarchy of activities. [184] This may provide a newer fear-of-falling instrument for research and clinical use.

Risk factors for falls have been extensively studied. Dual tasking of cognitive and physical tasks becomes harder to do in older patients. Maximal motor performance was found to decline significantly with concurrent cognitive tasks, especially in older adults with a history of injurious falls and cognitive impairment. [185] This may be the link between cognitive impairment and higher risk of falls.

A measure of gait stride length variability in ambulatory community-living adults aged 70 years and over is predictive of falls during the following year. [186] In patients admitted to home health care, risk factors include gait and balance difficulties, wandering, depression, and living in unsafe dwellings with environmental hazards. [187] The development and use of normative standards on common objective measures like the Six-Minute Walk Test, Berg Balance Scale, Timed Up and Go Test, and comfortable- and fast-speed walking may help in assessing older adults. [188]

Recurrent falls are an especially challenging rehabilitation problem. For example, one study found that of 100 hip fracture patients, 53% fell at least once in the 6 months

following the initial hip fracture. [189] A cluster of risk factors for these is not surprising—lower performance on balance and mobility measures, prefracture falls history, and use of a gait device.

One small randomized trial used a bilateral separated treadmill to train frail older adults, most of whom had fallen once already. The control group received usual care. Gait parameters improved, but falls over the next 6 months were similar in the exercised and control group. [190]

In the past, multiple types of interventions—either single interventions or several concurrent interventions—have been tested for falls reduction. Some exercise programs and multidimensional interventions have most effectively prevented falls. [191] A randomized factorial trial tested three interventions (exercise, vision, home hazard management) separately and in combination in 1090 participants. The home hazard assessment was included because these are readily available at low cost in Australia. Results showed that the greatest reduction in falls occurred when all three interventions were combined. Exercise alone yielded benefit (14% estimated reduction in annual fall rate, number needed to treat of 7), but neither vision or home hazard management alone reduced falls. [192] Another study, a randomized controlled trial of clinic-based 6-week exercise program for community-dwelling older adults, demonstrated modest reductions in falls at 6 months. [193] One limitation on generalizing such an intervention is that a significant number of participants did not complete the full exercise program. Interventions to reduce falls therefore seem to be more feasible when done at home, but they require sufficient exercise to improve aspects of balance and mobility.

Risk factors for falls were successfully decreased in a study of women with thoracic kyphosis of 50 to 65 degrees (Cobb angle). These women were compared with age-matched controls and showed significantly worse balance and gait by objective measures. The women then received a 4-week spinal proprioceptive extension exercise dynamic program with the use of a spinal weighted kypho-orthosis. Significant improvements occurred in balance, muscle strength in the back, and in the falls efficacy score (from 32.4 ± 13.8 to 13.5 ± 3.5, $P < .001$ with score of 10 normal). Mean physical activity improved as well. [194]

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

> ***Rehab 29 (Levels B, A)***: **Observational and cohort studies are needed to clarify the natural history of pain syndromes, identify risk factors, and describe the effects of treatment approaches. Ultimately, the most promising approaches should be identified and tested in controlled trials.**

New Research Addressing This Question: Pain always has been a huge clinical issue, especially in older patients. One community survey of older adults found that 72% had experienced as least some musculoskeletal pain in the prior 2 weeks. Severe pain was associated with disability. [195] In the rehabilitation process, pain is common, and management challenges are similar to those with pain in other areas of medicine. Pain treatment always requires a comprehensive, whole-person approach. Current recommendations point

to the areas requiring research in rehabilitation in general, especially in postoperative geriatric pain management, cancer, and persistent pain. [196–199]

Modification of This Question in Light of New Research: We recommend keeping this question on the research agenda without modification, as findings of such research are still needed.

NEW HORIZONS IN GERIATRIC REHABILITATION

THEORETICAL UNDERPINNINGS FOR GERIATRIC REHABILITATION

Patient Assessments

Appropriate patient assessments to target rehabilitation therapies and management need further development. For example, on an inpatient rehabilitation unit, OTs and PTs were found to have difficulty detecting both cognitive abnormalities and symptoms of depression in older patients (mean age 73). [200] In a survey of more than 1700 rehabilitation inpatients with musculoskeletal and cardiovascular diseases, 369 patients were identified as appropriate for an in-depth psychologic interview. Chart reviews were done on the interviewed patients. Rehabilitation staff correctly detected mental disorders only 48% of the time in the orthopedic patients and only 32% of the time in cardiovascular patients. [201] The use of clock drawing and clock copying may be an easy way to screen for cognitive problems. Results correlate well with other general cognitive measures, and they do correlate with poorer functional outcomes during inpatient rehabilitation. [202]

New dimensions of assessment that are predictive of functional outcomes will potentially become important for assessment. For example, poor participation in inpatient therapies is associated with both longer lengths of inpatient rehabilitation and poorer functional outcomes. [203] Researchers have created a tool to measure geriatric rehabilitation that assesses mobility, basic ADLs, independent living, leisure, physical functioning, psychologic function, social function, and caregiver status. [204]

Comprehensiveness of assessments may be required in some clinical circumstances. One meta-analysis found that prevention of functional decline in older adults living in the community occurred only if assessments were multidimensional. [4] Where successes have occurred in inpatient and outpatient geriatric evaluation (and management), assessments have been comprehensive. [205] Continued work is needed to best identify the when, where, and how of comprehensive assessment of older adults with disabilities.

> ***Rehab 30 (Levels B, A)***: **Careful observational and longitudinal studies are needed to identify the optimal timing of comprehensive assessments that lead to significant clinical benefit. Comparative studies are needed to identify the most effective and efficient types of assessments. Information from these studies can lead to interventional trials that compare different comprehensive assessment methodologies with clinical outcomes.**

Prehabilitation

The term *prehabilitation* is appearing in the literature now that clinicians and researchers are shifting emphasis toward preventing disability. It began in the sports medicine literature. Athletes prehabilitate, or condition or train, to prevent injuries. Now, in the medical literature the concept is used in several contexts beyond reference to athletes and sports medicine. Initially, in the late 1980s, the focus was on improving care for older adults. [206] Papers describing prehabilitation discuss preoperative exercise to hasten recovery and improve functional outcome, exercise prior to elective intensive rehabilitation care unit admissions to prevent the consequences of deconditioning, and in-home exercise programs for older adults living in the community. [207–209] Gill et al used a randomized controlled trial to demonstrate less decline in function at 7 and 12 months from a 6-month, home-based, PT-prescribed exercise program in moderately, but not severely, frail persons aged 75 years or older. [210] Another randomized controlled exercise study, preoperatively, of total hip replacement patients yielded less stiffness and better physical function, as well as better self-rated improvement in health in the intervention group than in the control group. [211]

> ***Rehab 31 (Levels B, A)***: **Observational studies are needed to identify feasible prehabilitation activities for elective surgical patients. Observational and longitudinal studies are needed of aging adults with a range of musculoskeletal symptoms, including mild, to identify interventions that prevent worsening of symptoms and onset of disability. More interventional studies are needed to assess the effectiveness of promising prehabilitation activities.**

Spirituality

Medical articles and books increasingly address issues of spirituality, religion, and health. [212,213] Religion and spirituality are being studied with various research methods and research instruments. Religious practices are rooted in the beliefs and traditions of specific religions. Spirituality refers to a sense of connectedness with something beyond and can include a sense of power, meaning, or purpose either from within or from a transcendent source. [214]

In one study of geriatric outpatients, self-report of greater spirituality, but not greater religious activity, was found to be associated with better self-reported health status. [215] A detailed study evaluated persons with musculoskeletal disabilities and recent hospitalization (rheumatology or rehabilitation services). The mean age was 56 but included some individuals as old as 82 years. Using a qualitative study design, the researchers found self-reported health to be very dependent on spiritual awareness. A Self Attributes Model was developed to show what internal processes are required for good health. [216]

A cross-cultural study of spirituality, religion, and personal beliefs included 5087 persons who reported belonging to a variety of religions: Christianity, animism, Islam, Judaism, Buddhism, and Hinduism. Differences were found between younger ($<$ 45 years old) and older people. Results showed a correlation between spirituality, religion, and personal beliefs and all quality-of-life domains measured (physical, psychologic, independence, social support, environment). The authors suggested that spirituality and religion could be especially important as a component of quality of life for patients reporting very poor health. [217]

This sampling of recent work suggests that future geriatric rehabilitation research will need to assess aspects of spirituality and health in individuals with mild, moderate, and severe disability, as well as those with disability at the end of life.

***Rehab 32 (Levels B, A)*: More observational studies on spirituality, disability, and rehabilitation are needed to augment our understanding of their relationship. Innovative intervention studies are needed to understand how to enhance healing aspects in the relationships of spirituality, disability, and rehabilitation.**

THE COMPONENTS OF REHABILITATION

Outcomes of Care

Studies of rehabilitation outcomes for older patients comparing care settings have been hampered by the lack of uniform functional measures for use in these varied settings. [218] Setting-specific measures do not have adequate breadth to assess the wide range of functional abilities of persons receiving rehabilitation across multiple health care and community settings. They lack the precision in content, and important functional tasks are excluded. Floor and ceiling effects are common. Computer adaptive testing uses item response theory or Rasch models to determine a hierarchy of items within a questionnaire along a hierarchical unidimensional scale. It uses computer interfaces allowing items to be selected on the basis of the individual ability of each patient. Research with this technology is showing that group scores on three domains—physical and movement, personal care and instrumental, and applied cognition—can be derived for older patients receiving rehabilitation in different settings. [219] This approach works also for complex medical patients who require rehabilitation for cardiac, pulmonary, medical, or surgical complications, and other conditions. [220] Ongoing research on this approach will lead to clinical applications.

There has been a need to better understand longer term functional outcomes in social and community activities in patients who have had either acute onset of disability or more chronic, slowly progressive disability. In the World Health Organization's ICF framework, participation (defined as a person's involvement in a life situation) is conceived as the result of a complex interaction among a person's disease, the person's body structure and function (anatomic parts and physiologic functions), and the person's activity performance (execution of a task or action). Participation is also influenced by personal characteristics and the environmental context, including social and physical elements. Through the use of a newly developed Participation Measure for Post-Acute Care, community participation at 1, 6, and 12 months was assessed for patients receiving rehabilitation in both inpatient and outpatient rehabilitation settings. Personal and social environmental factors were found to play a major role in predicting levels of social and home participation. At 6 months, some participation components in community function were improved. These "community participation" items reflect a person's mobility, functioning in work, and other daily activities. Activities that were being performed less well were social and home participation. These activities reflect communication, social relationships, and home management roles. [221] Ongoing work in this area, using participation measures for patients who have recently received rehabilitation services, will help answer questions in all the rehabilitation agenda items regarding components of care.

Some significant changes have occurred, however, in outcomes of medical rehabilitation programs between 1994 and 2001. Lengths of stay have decreased from 20 to 12 days. Functional status as measured by the FIM score at discharge remained somewhat similar over this 8-year period. However, increases in standard deviations and decreases in absolute values ranging from 3.1 to 6.4 FIM units in all impairment groups, except orthopedic conditions, does raise the question of poorer function at discharge on average. [222] These changes in FIM scores, while small, are likely significant given the large sample sizes (eg, 48,055 stroke survivors, 8871 patients with other neurologic conditions). Possibly, a greater range of patients—from very medically stable to less stable—is now receiving inpatient rehabilitation. The increase in mortality from less than 1% in 1994 to 4.7% in 2001 is not explained by variables in the data set but would be consistent with an increase in the number of sicker patients being admitted to inpatient rehabilitation units.

Rehab 33 (Levels B, A): **Analyses of rehabilitation outcomes in currently collected rehabilitation outcomes databases are needed to better define the relationship of medical conditions and rehabilitation outcomes. Observational studies are needed that use functional and medical outcome measures that cover a broader range of outcomes. Innovative interventional studies are needed that can test these new rehabilitation outcome measures.**

Patient Satisfaction

Patient satisfaction with health care services has now become a routine outcome measure. For people with disabilities and insured through Medicare, dissatisfaction with health care services was greater as the number of ADL limitations increased. The aspects of care most highly associated with dissatisfaction included difficulty in getting to the doctor, availability of medical services at night and on weekends, availability of care by specialists, and follow-up care received. [223] Patient satisfaction has also been shown to be greater for stroke patients in centers that have complied more completely with post-stroke rehabilitation guidelines. [224] Amount of functional recovery has been associated with satisfaction in some, but not other, studies of stroke patients. [225]

Rehab 34 (Levels B, A): **Both observational and interventional studies are required to understand components of dissatisfaction with care and cost-effective interventions that work for patients with activities of daily living limitations.**

REHABILITATION FOR SPECIFIC CONDITIONS

Traumatic Brain Injury

There is a bimodal peak in traumatic brain injury (TBI), with peaks in persons ages 15 to 24 and in those 70 years of age and older. The most frequent cause of TBI in older adults is falling. Evidence suggests that functional impairments in older patients with TBI are more severe and that an age threshold for poor outcomes exists between ages 50 to 60. In a study with an inception cohort of 195 patients with mild, moderate, and severe TBI, older patients (50 to 89 years of age) were found to be more likely than younger patients to become financially dependent and require help of others. However, many of the 49 older patients were still able to live independently and reported being independent in some

kind of work (80% and 49%, respectively, compared with 93% and 61%, pre-injury). [226] A large study of 45,982 cases of ICD-9 TBI in the New York State Trauma Registry (excluding New York City) from 1994 through 1995 documented higher mortality in older patients. Higher mortality occurred in older patients at even mild Glasgow Coma Scores of 13 to 15. [227] Ongoing work will better define the cluster of prognostic factors that may help clinical decision making on both aggressiveness of acute medical care as well as optimal rehabilitation approaches given different levels of injury severity.

Rehab 35 (Levels B, A): **More observational studies are required to understand the range of severity of head injury in older patients who fall, as well as all of the consequences. Different interventional studies need to address the range of traumatic brain injury disability, from mild to moderate to severe and to end-stage.**

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