Guidelines for Adult Stroke Rehabilitation and Recovery

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Endorsed by the American Academy of Physical Medicine and Rehabilitation and the American Society of Neurorehabilitation

The American Academy of Neurology affirms the value of this guideline as an educational tool for neurologists and the American Congress of Rehabilitation Medicine also affirms the educational value of these guidelines for its members

Accepted by the American Speech-Language-Hearing Association

Carolee J. Winstein, PhD, PT, Chair; Joel Stein, MD, Vice Chair; Ross Arena, PhD, PT, FAHA; Barbara Bates, MD, MBA; Leora R. Cherney, PhD; Steven C. Cramer, MD; Frank Deruyter, PhD; Janice J. Eng, PhD, BSc; Beth Fisher, PhD, PT; Richard L. Harvey, MD; Catherine E. Lang, PhD, PT; Marilyn MacKay-Lyons, BSc, MScPT, PhD; Kenneth J. Ottenbacher, PhD, OTR; Sue Pugh, MSN, RN, CNS-BC, CRNN, CNRN, FAHA; Mathew J. Reeves, PhD, DVM, FAHA; Lorie G. Richards, PhD, OTR/L; William Stiers, PhD, ABPP (RP); Richard D. Zorowitz, MD; on behalf of the American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Quality of Care and Outcomes Research

Purpose—The aim of this guideline is to provide a synopsis of best clinical practices in the rehabilitative care of adults recovering from stroke.

Methods—Writing group members were nominated by the committee chair on the basis of their previous work in relevant topic areas and were approved by the American Heart Association (AHA) Stroke Council’s Scientific Statement Oversight Committee and the AHA’s Manuscript Oversight Committee. The panel reviewed relevant articles on adults using computerized searches of the medical literature through 2014. The evidence is organized within the context of the AHA framework and is classified according to the joint AHA/American College of Cardiology and supplementary AHA methods of classifying the level of certainty and the class and level of evidence. The document underwent extensive AHA internal and external peer review, Stroke Council Leadership review, and Scientific Statements Oversight Committee review before consideration and approval by the AHA Science Advisory and Coordinating Committee.

Results—Stroke rehabilitation requires a sustained and coordinated effort from a large team, including the patient and his or her goals, family and friends, other caregivers (eg, personal care attendants), physicians, nurses, physical and occupational therapists, speech-language pathologists, recreation therapists, psychologists, nutritionists, social workers, and others. Communication and coordination among these team members are paramount in maximizing the effectiveness of care.
and efficiency of rehabilitation and underlie this entire guideline. Without communication and coordination, isolated efforts to rehabilitate the stroke survivor are unlikely to achieve their full potential.

**Conclusions**—As systems of care evolve in response to healthcare reform efforts, postacute care and rehabilitation are often considered a costly area of care to be trimmed but without recognition of their clinical impact and ability to reduce the risk of downstream medical morbidity resulting from immobility, depression, loss of autonomy, and reduced functional independence. The provision of comprehensive rehabilitation programs with adequate resources, dose, and duration is an essential aspect of stroke care and should be a priority in these redesign efforts. *(Stroke. 2016;47:e98-e169. DOI: 10.1161/STR.0000000000000098.)*

**Key Words:** AHA Scientific Statements ■ exercise ■ paresis ■ recovery of function ■ rehabilitation ■ stroke

Between 2000 and 2010, the relative rate of stroke deaths dropped by 35.8% in the United States. However, each year stroke affects nearly 800,000 individuals, with many survivors experiencing persistent difficulty with daily tasks as a direct consequence. More than two thirds of stroke survivors receive rehabilitation services after hospitalization. Despite the development of stroke center designation and improved systems to recognize stroke symptoms and deliver care promptly, only a minority of patients with acute stroke receive thrombolytic therapy, and many of them remain with residual functional deficits. Thus, the need for effective stroke rehabilitation is likely to remain an essential part of the continuum of stroke care for the foreseeable future.

Despite the extensive resources devoted to stroke rehabilitation and aftercare, large-scale, rigorous, clinical trials in this field have been few and have been conducted only in the past decade or so. Thus, many gaps continue to be seen in the evidence base for stroke rehabilitation, for which smaller trials of less rigorous design provide the only available data, and in some cases, even these are not yet available. Certain aspects of stroke rehabilitation care are well established in clinical practice and constitute a standard of care that is unlikely to be directly tested in a randomized, clinical trial, for example, the provision of physical therapy (PT) to early stroke survivors with impaired walking ability. Thus, practice guidelines such as this one will likely rely on a mixture of evidence and consensus. It is hoped that the relative proportion of recommendations based on rigorous evidence will grow over time.

This guideline uses the framework established by the American Heart Association (AHA) concerning classes and levels of evidence for use in guidelines, as shown in Tables 1 and 2.

We have organized this guideline into 5 major sections: (1) The Rehabilitation Program, which includes system-level sections (eg, organization, levels of care); (2) Prevention and Medical Management of Comorbidities, in which reference is made to other published guidelines (eg, hypertension); (3) Assessment, focused on the body function/structure level of the *International Classification of Functioning, Disability, and Health (ICF)*; (4) Sensorimotor Impairments and Activities (treatment/interventions), focused on the activity level of the *ICF*; and (5) Transitions in Care and Community Rehabilitation, focused primarily on the participation level of the *ICF*.

Published guidelines are, by their very nature, a reflection of clinical practice at a particular point in time and the evidence base available. As new information becomes available, best practice can change quickly, and it is incumbent on the users of these guidelines to keep the ever-changing nature of clinical knowledge in mind. Equally important, no guideline can substitute for the careful evaluation of the individual patient by an experienced clinician, in which the art and science of medicine intersect. Guidelines that are correct in the aggregate may not represent the best care for any specific individual, and careful individualization is needed at the point of care.

We have benefited from the published Veterans Affairs/Department of Defense stroke rehabilitation guidelines and several of the prior AHA stroke-related guidelines. Although the current guideline is a fundamentally new work, it certainly reflects the insights and judgments of these prior guidelines.

Because stroke is fundamentally a chronic condition, we have attempted to span the entire course of rehabilitation, from the early actions taken in the acute care hospital through reintegration into the community. The end of formal rehabilitation (commonly by 3–4 months after stroke) should not mean the end of the restorative process. In many respects, stroke has been managed medically as a temporary or transient condition instead of a chronic condition that warrants monitoring after the acute event. Currently, unmet needs persist in many domains, including social reintegration, health-related quality of life, maintenance of activity, and self-efficacy (ie, belief in one’s capability to carry out a behavior). Apathy is manifested in >50% of survivors at 1 year after stroke; fatigue is a common and debilitating symptom in chronic stroke; daily physical activity of community-living stroke survivors is low; and depressive symptomology is high. By 4 years after onset, >30% of stroke survivors report persistent participation restrictions (eg, difficulty with autonomy, engagement, or fulfilling societal roles).

**The Rehabilitation Program**

**Organization of Poststroke Rehabilitation Care (Levels of Care)**

Rehabilitation services are the primary mechanism by which functional recovery and the achievement of independence are promoted in patients with acute stroke. The array of rehabilitation services delivered to stroke patients in the United States is broad and highly heterogeneous, varying in the type of care settings used; in the duration, intensity, and type of interventions delivered; and in the degree of involvement of specific medical, nursing, and other rehabilitation specialists. The nature and organization of rehabilitation stroke services in the United States have changed considerably over time in response to various forces, including the increasing integration of hospital and outpatient care delivery systems (at both local and regional levels), the organization of medical and other specialty rehabilitation groups, and most important, repeated changes to the federal reimbursement fee structure (specifically, Centers for Medicare & Medicaid Services), which is...
the central driver of much of the system’s organization and structure. Further systems-level changes are inevitable, given the ongoing federal changes to the healthcare system and the recent focus on “episodes of care,” which promises to result in wholesale changes to the organization of medical care delivery in the United States.10

The highly heterogeneous organizational structure of stroke rehabilitation care in the United States brings with it challenges in terms of determining the quality of care delivered by the system (ie, timeliness, effectiveness, efficiency, safety, fairness, and patient-centeredness). The unique and somewhat idiosyncratic nature of the stroke rehabilitation system in the United States also presents challenges in terms of assessment of which research findings, among the expanding evidence base of stroke rehabilitation care, are applicable to the system. For example, much of the research documenting the benefits of stroke units and other aspects of organized integrated interprofessional models of stroke care was developed in Europe and elsewhere, and the degree to which these findings are directly applicable to the US system of stroke care is often debated.

**Table 1. Applying Classification of Recommendations and Level of Evidence**

<table>
<thead>
<tr>
<th>LEVEL A</th>
<th>Multiple populations evaluated*</th>
<th>Recommendation that procedure or treatment is useful/effective</th>
<th>Sufficient evidence from multiple randomized trials or meta-analyses</th>
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</thead>
<tbody>
<tr>
<td>LEVEL B</td>
<td>Limited populations evaluated*</td>
<td>Recommendation that procedure or treatment is useful/effective</td>
<td>Evidence from single randomized trial or nonrandomized studies</td>
</tr>
<tr>
<td>LEVEL C</td>
<td>Very limited populations evaluated</td>
<td>Recommendation that procedure or treatment is useful/effective</td>
<td>Only expert opinion, case studies, or standard of care</td>
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<tr>
<th>SIZE OF TREATMENT EFFECT</th>
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<tbody>
<tr>
<td>CLASS I</td>
</tr>
<tr>
<td>Procedure/Treatment SHOULD be performed/administered</td>
</tr>
<tr>
<td>CLASS IIa</td>
</tr>
<tr>
<td>Additional studies with focused objectives needed</td>
</tr>
<tr>
<td>IT IS REASONABLE to perform procedure/administer treatment</td>
</tr>
<tr>
<td>CLASS IIb</td>
</tr>
<tr>
<td>Additional studies with broad objectives needed; additional registry data would be helpful</td>
</tr>
<tr>
<td>Procedure/Treatment MAY BE CONSIDERED</td>
</tr>
<tr>
<td>CLASS III</td>
</tr>
<tr>
<td>Procedure/Test</td>
</tr>
<tr>
<td>Treatment</td>
</tr>
<tr>
<td>COR II: No benefit</td>
</tr>
<tr>
<td>Not Helpful</td>
</tr>
<tr>
<td>No Proven Benefit</td>
</tr>
<tr>
<td>COR III: Harm</td>
</tr>
<tr>
<td>Excess Cost with Benefit or Harmful</td>
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A recommendation with Level of Evidence B or C does not imply that the recommendation is weak. Many important clinical questions addressed in the guidelines do not lend themselves to clinical trials. Although randomized trials are unavailable, there may be a very clear clinical consensus that a particular test or therapy is useful or effective.

*Data available from clinical trials or registries about the usefulness/efficacy in different subpopulations, such as sex, age, history of diabetes, history of prior myocardial infarction, history of heart failure, and prior aspirin use.

†For comparative effectiveness recommendations (Class I and IIa; Level of Evidence A and B only), studies that support the use of comparator verbs should involve direct comparisons of the treatments or strategies being evaluated.
the 2010 AHA scientific statement “Comprehensive Overview of Nursing and Interdisciplinary Rehabilitation Care of the Stroke Patient.”11 We briefly review the different stroke neurology, rehabilitation care settings that are essential components of this system (Appendix 1).

Ideally, rehabilitation services are delivered by a multidisciplinary team of healthcare providers with training in neurology, rehabilitation nursing, occupational therapy (OT), PT, and speech and language therapy (SLT). Such teams are directed under the leadership of physicians trained in physical medicine and rehabilitation (physiatrist) or by neurologists who have specialized training or board certification in rehabilitation medicine. Other health professionals who play an essential role in the process include social workers, psychologists, psychiatrists, and counselors.11

Health care provided during the acute hospital stay is focused primarily on the acute stabilization of the patient, the delivery of acute stroke treatments, and the initiation of prophylactic and preventive measures. Although the delivery of rehabilitation therapies (OT/PT/SLT) is generally not the first priority, data strongly suggest that there are benefits to starting rehabilitation as soon as the patient is ready and can tolerate it.11

The cardinal feature of acute inpatient care for stroke patients in the United States is its brevity; the median length of stay for patients with ischemic stroke is only 4 days. Regardless of whether rehabilitation is started during the inpatient stay, all patients should undergo a formal assessment (often conducted by the OT/PT/SLT services) of the patient’s rehabilitation needs before discharge.12 The discharge process may also involve rehabilitation nursing case managers and social workers who can assess psychosocial issues that may influence the transition.

Healthcare services provided after hospital discharge are referred to as postacute care services and are designed to support patients in their transition from the hospital to home and in their pursuit of achieving the highest level of functioning possible. In addition to the rehabilitation care provided by OT/PT/SLT, care may include physiatrists or other physicians, rehabilitation nurses, and nursing aides. The intensity of rehabilitation care varies widely, depending on the setting, with the most intensive rehabilitation care provided in inpatient rehabilitation facilities (IRFs), followed by skilled nursing facilities (SNFs), which provide “subacute” rehabilitation.

IRFs provide hospital-level care to stroke survivors who need intensive, 24-hour-a-day, interdisciplinary rehabilitation care that is provided under the direct supervision of a physician. Medicare (Centers for Medicare & Medicaid Services) regulations specify that admission to IRFs should be limited to patients for whom significant improvement is expected within a reasonable length of time and who are likely to return to a community setting (rather than being transferred to another setting such as a SNF or long-term care facility). Medicare regulations also generally dictate that IRFs provide at least 3 hours of rehabilitation therapy (defined as PT, OT, and SLT) per day for at least 5 d/wk.11 Physicians are expected to have training or experience in rehabilitation, and daily physician visits are typical. Registered nurses are present on a continuous basis and commonly have specialty certification in rehabilitation nursing. An IRF can be located as a geographically distinct unit within an acute care hospital or as a free-standing facility.

SNFs (also known as subacute rehabilitation) provide rehabilitation care to stroke survivors who need daily skilled nursing or rehabilitation services. Admission to SNFs may be requested for patients who the rehabilitation team determines may not reach full or partial recovery or if skilled nursing services are required to maintain or prevent deterioration of the patient. SNFs are required to have rehabilitation nursing on site for a minimum of 8 h/d, and care must still follow a physician’s plan, although there is no requirement for direct daily supervision by a physician.11 SNFs can be stand-alone facilities, but when located within an existing nursing home or hospital, they must be physically distinguishable from the larger institution (eg, a separate designated wing, ward, or building).

Nursing homes provide long-term residential care for individuals who are unable to live in the community. Many individuals who reside in nursing homes initially enter the facility under their Medicare short-term SNF benefit and then transition to long-term care once the needs for skilled nursing are no longer present. Medicare will provide insurance coverage for up to 100 days in an SNF but does not cover long-term nursing home care, which is generally paid out of pocket, by long-term care insurance, or through the Medicaid program.

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**Table 2. Definition of Classes and Levels of Evidence Used in AHA/ASA Recommendations**

<table>
<thead>
<tr>
<th>Class</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Class I</td>
<td>Conditions for which there is evidence for and/or general agreement that the procedure or treatment is useful and effective</td>
</tr>
<tr>
<td>Class II</td>
<td>Conditions for which there is conflicting evidence and/or a divergence of opinion about the usefulness/efficacy of a procedure or treatment</td>
</tr>
<tr>
<td>Class IIa</td>
<td>The weight of evidence or opinion is in favor of the procedure or treatment</td>
</tr>
<tr>
<td>Class IIb</td>
<td>Usefulness/efficacy is less well established by evidence or opinion</td>
</tr>
<tr>
<td>Class III</td>
<td>Conditions for which there is evidence and/or general agreement that the procedure or treatment is not useful/effective and in some cases may be harmful</td>
</tr>
</tbody>
</table>

**Therapeutic recommendations**

<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Evidence A</td>
<td>Data derived from multiple randomized, clinical trials or meta-analyses</td>
</tr>
<tr>
<td>Level of Evidence B</td>
<td>Data derived from a single randomized trial or nonrandomized studies</td>
</tr>
<tr>
<td>Level of Evidence C</td>
<td>Consensus opinion of experts, case studies, or standard of care</td>
</tr>
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</table>

**Diagnostic recommendations**

<table>
<thead>
<tr>
<th>Level of Evidence</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Evidence A</td>
<td>Data derived from multiple prospective cohort studies using a reference standard applied by a masked evaluator</td>
</tr>
<tr>
<td>Level of Evidence B</td>
<td>Data derived from a single grade A study, ≥1 case-control studies, or studies using a reference standard applied by an unmasked evaluator</td>
</tr>
<tr>
<td>Level of Evidence C</td>
<td>Consensus opinion of experts</td>
</tr>
</tbody>
</table>

AHA/ASA indicates American Heart Association/American Stroke Association.
Long-term acute care hospitals are another inpatient setting that delivers postacute rehabilitation care. Long-term acute care hospitals provide extended medical and rehabilitative care to stroke patients with complex medical needs resulting from a combination of acute and chronic conditions (eg, ventilator-dependent care, pain management). As a consequence of this high-needs patient population, facilities must demonstrate an average length of stay of at least 25 days.14,15 Because of these requirements, long-term acute care hospitals provide care to a relatively small but growing minority of stroke patients.14

For stroke patients who go home after an acute hospitalization, rehabilitation care can be provided in the community either by a home healthcare agency (HHCA) or through outpatient offices and clinics. The intensity of rehabilitation care can vary tremendously across these 2 settings. For patients in the Medicare program to be eligible for HHCA services, they must be certified as being homebound by a physician (defined by the Centers for Medicare & Medicaid Services as unable to leave the home except to receive medical care or to have occasional nonmedical trips). HHHCAs focus on delivering skilled nursing care and rehabilitation therapy (eg, OT, PT, SLT), as well as some limited assistance with daily tasks provided by home health aides supervised by nurses. Care encompasses medical and social needs and services that are designed to assist the patient in living in his or her own home.13 Currently, home healthcare services are reimbursed under a prospective payment system that covers up to 60 days of services. These services may be extended if they can be clinically justified. Home healthcare services may also be performed in assisted living facilities or other group homes but are not reimbursed if the services are duplicative of the services of another facility or agency.

Appropriateness of Early Supported Discharge Rehabilitation Services

For selected stroke patients, early discharge to a community setting for ongoing rehabilitation may provide outcomes similar to those achieved in an inpatient rehabilitation unit. This early supported discharge (ESD) model of care links inpatient care with community services and allows certain patients to be discharged home sooner with support of the rehabilitation team.

The efficacy of ESD for patients with acute stroke was evaluated in the ESD Trialists’ systematic review.16 This 2012 review concluded that “appropriately resourced ESD services provided for a selected group of stroke patients can reduce long-term dependency and admission to institutional care as well as reducing the length of hospital stay.” No adverse impacts were identified on either mood or the subjective health status of patients or caregivers with ESD. ESD has been studied primarily in Europe and Australia/New Zealand, where systems of care are different than in the United States and where the average acute care hospitalization length of stay for stroke is longer than in the United States. Extrapolation of these results to the United States should take these distinctions into account.

A meta-analysis conducted by Langhorne et al17 and updated by Langhorne and Holmqvist18 found that ESD services reduce inpatient length of stay and adverse events (eg, readmission rates) while increasing the likelihood of independence and living at home. Several recent systematic reviews have also reported that ESD after stroke was associated with shorter hospital lengths of stay, lower overall costs of care, lower risk of institutionalization, and no adverse effects on functional recovery.19–21

To be effective, ESD should be considered for patients with mild to moderate stroke when adequate community services for both rehabilitation and caregiver support are available and can provide the level of intensity of rehabilitation service needed.22 Patients should remain in an inpatient setting for their rehabilitation care if they are in need of skilled nursing services, regular contact by a physician, and multiple therapeutic interventions.

Examples for need of skilled nursing services include (but are not limited to) the following:

- Bowel and bladder impairment
- Skin breakdown or high risk for skin breakdown
- Impaired bed mobility
- Dependence for activities of daily living (ADLs)
- Inability to manage medications
- High risk for nutritional deficits

Examples for need of regular contact by a physician include (but are not limited to) the following:

- Medical comorbidities not optimally managed (eg, diabetes mellitus and hypertension)
- Complex rehabilitation issues (eg, orthotics, spasticity, and bowel/bladder)
- Acute illness (but not severe enough to prevent rehabilitation care)
- Pain management issues

Examples for need of multiple therapeutic interventions include (but are not limited to) the following:

- Moderate to severe motor/sensory deficits, and/or
- Cognitive deficits, and/or
- Communication deficits

Outpatient therapies require patients to travel from their home to obtain care at hospital-based or free-standing facilities. All outpatient OT, PT, and SLT services must be certified by a physician who is responsible for establishing a planned set of therapy services. These therapies must be complex enough that they can be performed only by a qualified healthcare professional. Treatment plans need to be reviewed and recertified every 30 days.

Multiple transitions in care are typical for individuals recovering from stroke and pose particular challenges for healthcare providers, stroke survivors, and their caregivers in terms of maintaining continuity of care and avoiding undesirable lapses in the rehabilitation program of care. Moreover, stroke survivors need to navigate the transition from a medical model of treatment to a more community-based model that includes return to work (for some), leisure activities, and exercise for fitness. The Transitions in Care and Community Rehabilitation section addresses transitions to the community after discharge.

Trends in the Use of Acute and Postacute Stroke Rehabilitation in the United States

The organization of rehabilitation stroke services in the United States has changed considerably over time in response to the frequent changes to the federal reimbursement fee structure for both acute (inpatient) and postacute
care. Currently, ≈70% of Medicare beneficiaries discharged for acute stroke use Medicare-covered postacute care, with most receiving rehabilitation care from multiple providers in several different settings. Considering the first setting after the acute hospitalization, the largest proportion of stroke patients are referred for rehabilitation to an SNF (32%), followed by an IRF (22%) and then HHCA (15%). Major changes in the Medicare postacute care reimbursement policies starting in the 1990s dramatically affected use patterns, particularly for HHCA, after the introduction of an interim payment system in 1997 with extensive changes to its rules and regulations in 2000. The introduction of prospective payment systems for SNFs (1998), IRFs (2002), and long-term acute care hospitals (2002) also affected their use. Between 1996 and 2003, the proportion of Medicare stroke patients who received care from HHCAs declined by >25% during this period (from 20% to 15%), whereas the proportion who received SNF or IRF care remained relatively unchanged. However, the proportion of stroke patients not referred to any postacute care increased from 26% to 31% during this period, and an analysis of 2006 Medicare data found that this proportion had increased to 42%. Although legislated payment changes have had major influences on where rehabilitation services are provided, several other nonclinical factors affect the use of postacute care rehabilitation services. There is considerable geographic variability in the use of these services in the United States, which is driven in part by local differences in the availability of postacute care settings and regulatory practices. Factors such as the daily census, case mix, teaching status, ownership, and urbanicity of the hospital and the percentage of patients served by Medicare have been shown to influence use patterns of postacute care services. At the patient level, sociodemographic factors such as age, income, race, and living circumstances have also been shown to affect the use and type of rehabilitation services provided.

Of central interest to researchers and policy makers is the need for a better understanding of the impact of rehabilitation care at these different rehabilitation settings on patient outcomes, especially relative to resource use and costs. The studies that have compared outcomes in hospitalized stroke patients first discharged to an IRF, an SNF, or a nursing home have generally shown that IRF patients have higher rates of return to community living and greater functional recovery, whereas patients discharged to an SNF or a nursing home have higher rehospitalization rates and substantially poorer survival. However, all of these studies have limitations resulting from their observational designs, which rely on administrative data or data from a limited number of facilities. Importantly, most of these studies demonstrate substantial baseline differences in patient case mix between settings, with IRF patients having a more favorable prognostic outlook because of their younger age, lower prestroke disability, fewer comorbidities, and greater caregiver/family support and because they have been selected for their potential to return to the community. These differences serve to illustrate that the decision to refer a stroke patient to a particular setting after discharge is dictated by a complex set of demographic, clinical, and nonclinical factors that are also inevitably related to patient outcomes. This inherent confounding or channeling bias has been addressed by these studies through the application of complex statistical methods. However, uncertainty remains about how much of the final difference in outcome is attributable to residual confounding resulting from unmeasured factors (particularly stroke severity and pre-stroke disability). Despite these concerns, the consistency of the findings in favor of IRF referral suggests that stroke survivors who qualify for IRF services should receive this care in preference to SNF-based care.

### Recommendations: Organization of Poststroke Rehabilitation Care (Levels of Care)

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is recommended that stroke patients who are candidates for postacute rehabilitation receive organized, coordinated, interprofessional care.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>It is recommended that stroke survivors who qualify for and have access to IRF care receive treatment in an IRF in preference to a SNF.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Organized community-based and coordinated interprofessional rehabilitation care is recommended in the outpatient or home-based settings.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>ESD services may be reasonable for people with mild to moderate disability.</td>
<td>IIb</td>
<td>B</td>
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</table>

### Rehabilitation Interventions in the Inpatient Hospital Setting

There is strong evidence that organized, interprofessional stroke care not only reduces mortality rates and the likelihood of institutional care and long-term disability but also enhances recovery and increases independence in ADLs. Although many small, randomized, clinical trials have studied interventions in the acute rehabilitation phase, the only large, randomized, clinical trials in stroke recovery and rehabilitation have focused on the chronic recovery phase. This section updates the scientific statement on the comprehensive overview of nursing and interprofessional rehabilitation care of the stroke patient and previously summarized recommendations for care of the stroke survivor in the inpatient rehabilitation phase.

Although acute stroke units have higher levels of nurse staffing, earlier assessments of stroke type and treatment, and more intensive physiological monitoring, rehabilitation units (including comprehensive stroke units in Europe) emphasize recovery and rehabilitation, involving rehabilitation physicians and allied health professionals, increased interprofessional staff education and training, greater patient and caregiver participation in rehabilitation, and early mobilization protocols. Age, cognition, functional level after stroke, and to a lesser extent continence have shown consistent associations with poststroke outcomes, and stroke severity is associated with acute discharge disposition, final discharge disposition, and functional level. In recent years, lengths of stay in IRFs have decreased significantly, but in survivors with mild to moderate stroke, patient satisfaction does not appear to be diminished, and recovery actually may be faster. In the United States, data after the initiation of prospective payment for rehabilitation in 2002 suggest that discharges from IRFs to institutional settings have increased.
Timing and intensity of acute rehabilitation also are important issues in poststroke functional outcomes but remain controversial. Overall, a 2009 meta-analysis demonstrated insufficient evidence to support or refute the efficacy of routine very early mobilization after stroke compared with conventional care.\textsuperscript{57} In the recently completed randomized, controlled trial (RCT) of the efficacy and safety of very early mobilization within 24 hours of stroke onset (A Very Early Rehabilitation Trial [AVERT]), the high-dose, very early mobilization protocol was associated with a reduction in the odds of a favorable outcome at 3 months.\textsuperscript{30} Early mobilization after stroke is recommended in many clinical practice guidelines worldwide. The AVERT findings should affect clinical practice by refining present guidelines, but clinical recommendations should be informed by future analyses of dose-response associations.

The only evidence assessing the intensity of stroke rehabilitation comes from literature comparing IRFs with subacute rehabilitation. In a study of 222 subjects, Chan et al\textsuperscript{59} reported that subjects whose care included an IRF stay experienced functional scores at least 8 points higher (twice the minimally detectable change) on the Activity Measure for Post-Acute Care than those who went to SNFs or received home health/outpatient care. A retrospective cohort study of 360 subjects demonstrated that subjects who received \textgreater;3 hours of therapy daily made significantly more functional gains than those receiving \textless;3 hours daily, although hemorrhagic stroke, left-sided brain injury, earlier IRF admission, and longer IRF stay also were associated with total functional improvement.\textsuperscript{60}

Finally, the efficacy of complementary medicine techniques has been studied in the IRF environment. In a randomized, clinical trial of 274 subjects receiving acupuncture, PT, or both, no synergistic effect was found when acupuncture was added to PT, although all subjects exhibited functional gains.\textsuperscript{61} An RCT of 53 subjects receiving whole-body somatosensory stimulation or exercise therapy in addition to conventional rehabilitation demonstrated no significant increases in the recovery of balance and ADLs.\textsuperscript{62}

For evidence pertaining to dysphagia; interventions for upper limb rehabilitation, including upper extremity activities (ie, ADLs, instrumental ADLs [IADLs]), touch, and proprioception; lower extremity rehabilitation, including mobility (eg, locomotion) and balance/vestibular rehabilitation; and therapies for cognitive impairments and hemi-spatial neglect, the reader is directed to those subsections in The Rehabilitation Program section.

### Prevention and Medical Management of Comorbidities

#### Prevention of Skin Breakdown and Contractures

Hemiparesis, sensory changes, and altered levels of consciousness place the patient with stroke at risk for joint and muscle contractures and skin breakdown. Pressure ulcers are also associated with impaired circulation, older age, and incontinence. Regular assessment of skin and the use of objective scales of risk such as the Braden scale are valuable in the prevention of skin injury and should be followed by regular skin inspection with documentation.\textsuperscript{63} Agency for Healthcare Research and Quality (AHRQ) guidelines recommend minimizing or eliminating friction, minimizing pressure, providing appropriate support surfaces, avoiding excessive moisture, and maintaining adequate nutrition and hydration.\textsuperscript{64} Specific measures include regular turning (at least every 2 hours), good hygiene, and the use of special mattresses and proper wheelchair seating to prevent skin injury.\textsuperscript{11}

After stroke with hemiparesis, 60% of patients will develop joint contracture on the affected side within the first year, with wrist contractures occurring most commonly in patients who do not recover functional hand use.\textsuperscript{65,66} The occurrence of elbow contractures within the first year after stroke is associated with the presence of spasticity within the first 4 months.\textsuperscript{67} These contractures can cause pain and make self-care, including dressing and hygiene, difficult. Many clinicians recommend daily stretching of the hemiplegic limbs to avoid contractures, and patients and families should be taught proper stretching techniques to avoid injury and to maximize effectiveness. Resting hand splints are often applied to prevent contractures in hemiplegic wrist and fingers, but their effectiveness is not well established.\textsuperscript{68,69} There is controversy over the benefit of resting hand splints such that the Royal College of Physicians National Institute for Clinical Excellence guidelines recommend against the use of resting hand splints but the Veterans Affairs/Department of Defense clinical practice guidelines recommend their use.\textsuperscript{4,70,71} Application of resting hand splints combined with other treatments, including early botulinum toxin injection to wrist and finger flexors, may be beneficial.\textsuperscript{72} Early after stroke, positioning of the hemiplegic shoulder in maximum external rotation for 30 minutes each day either in bed or in a chair can be useful for preventing shoulder contracture.\textsuperscript{73,74} Applying serial casting or static adjustable splints may be beneficial in preventing elbow or wrist contractures, although data are conflicting.\textsuperscript{4,72,75,76} Surgical release of the brachialis, brachioradialis, and biceps muscles is a reasonable option to treat pain and range-of-motion limitations in patients with substantial established elbow flexor contractures.\textsuperscript{77}

Ankle plantarflexion contractures after stroke can affect gait quality and safety. The use of an ankle-foot orthosis (AFO) can improve gait in patients with active plantarflexion during the swing phase of gait but also may be beneficial in preventing ankle contracture.\textsuperscript{78} For nonambulatory patients, the use of a resting ankle splint at night, set in the plantigrade position (ankle at 90° and subtalar neutral), or

### Recommendations: Rehabilitation Interventions in the Inpatient Hospital Setting

<table>
<thead>
<tr>
<th>Recommendations: Rehabilitation Interventions in the Inpatient Hospital Setting</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
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<tbody>
<tr>
<td>It is recommended that early rehabilitation for hospitalized stroke patients be provided in environments with organized, interprofessional stroke care.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>It is recommended that stroke survivors receive rehabilitation at an intensity commensurate with anticipated benefit and tolerance.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>High-dose, very early mobilization within 24 hours of stroke onset can reduce the odds of a favorable outcome at 3 months and is not recommended.</td>
<td>III</td>
<td>A</td>
</tr>
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standing on a tilt table for 30 min/d is probably useful in preventing contracture.78

<table>
<thead>
<tr>
<th>Recommendations: Prevention of Skin Breakdown and Contractures</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>During hospitalization and inpatient rehabilitation, regular skin assessments are recommended with objective scales of risk such as the Braden scale.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>It is recommended to minimize or eliminate skin friction, to minimize skin pressure, to provide appropriate support surfaces, to avoid excessive moisture, and to maintain adequate nutrition and hydration to prevent skin breakdown. Regular turning, good skin hygiene, and use of specialized mattresses, wheelchair cushions, and seating are recommended until mobility returns.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Patients, staff, and caregivers should be educated about the prevention of skin breakdown.</td>
<td>I1a</td>
<td>B</td>
</tr>
<tr>
<td>Positioning of hemiplegic shoulder in maximum external rotation while the patient is either sitting or in bed for 30 minutes daily is probably indicated.</td>
<td>I1b</td>
<td>C</td>
</tr>
<tr>
<td>Resting hand/wrist splints, along with regular stretching and spasticity management in patients lacking active hand movement, may be considered.</td>
<td>I1b</td>
<td>C</td>
</tr>
<tr>
<td>Surgical release of brachialis, brachioradialis, and bicep muscles may be considered for substantial elbow contractures and associated pain.</td>
<td>I1b</td>
<td>B</td>
</tr>
<tr>
<td>Resting ankle splints used at night and during assisted standing may be considered for prevention of ankle contracture in the hemiplegic limb.</td>
<td>I1b</td>
<td>B</td>
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**Prevention of Deep Venous Thrombosis**

Survivors of acute stroke are at high risk of deep venous thrombosis (DVT) and pulmonary embolism (PE) as a result of a combination of limb immobility and reduced activity level.79 Prevention of DVT and PE can be divided into pharmacological and mechanical methods in both ischemic and hemorrhage strokes. Prophylactic treatment is initiated depending on the type of stroke and use of thrombolytic therapy. Therapy usually is continued throughout the rehabilitation stay or until the stroke survivor regains mobility, with few studies examining the optimal duration of prophylaxis. For patients with mild motor impairments who are discharged directly home from the hospital, DVT prophylaxis may not be needed. For patients discharged to an SNF with a stay that extends beyond from the hospital, DVT prophylaxis may not be needed. For patients with type of stroke and use of thrombolytic therapy. Therapy usually is continued throughout the rehabilitation stay or until the stroke survivor regains mobility, with few studies examining the optimal duration of prophylaxis. For patients with mild motor impairments who are discharged directly home from the hospital, DVT prophylaxis may not be needed. For patients discharged to an SNF with a stay that extends beyond from the hospital, DVT prophylaxis may not be needed. For patients with type of stroke and use of thrombolytic therapy. Therapy usually is continued throughout the rehabilitation stay or until the stroke survivor regains mobility, with few studies examining the optimal duration of prophylaxis. For patients with mild motor impairments who are discharged directly home from the hospital, DVT prophylaxis may not be needed. For patients discharged to an SNF with a stay that extends beyond from the hospital, DVT prophylaxis may not be needed.

Recommendations for the prevention of DVT and PE in ischemic stroke are delineated in great detail in the American College of Chest Physicians’ “Antithrombotic Therapy and Prevention of Thrombosis, 9th edition.”80 One meta-analysis of 16 trials involving 23043 patients with acute ischemic stroke compared stroke survivors receiving varying amounts of unfractionated heparin (UFH) with control subjects.81 The use of high-dose UFH (>15000 U/d) was associated with a reduction in PE (odds ratio [OR], 0.49; 95% confidence interval [CI], 0.29–0.83) but also with an increased risk of intracerebral hemorrhage (ICH; OR, 3.86; 95% CI, 2.41–6.19) and extracerebral hemorrhage (ECH; OR, 4.74; 95% CI, 2.88–7.78). Low-dose UFH (<15000 U/D) decreased the thrombosis risk (OR, 0.17; 95% CI, 0.11–0.26) but had no influence on the risk of PE (OR, 0.83; 95% CI, 0.53–1.31). The risk of ICH or ECH was not significantly increased (OR, 1.67; 95% CI, 0.97–2.87 for ICH; OR, 1.58; 95% CI, 0.89–2.81 for ECH) with prophylactic-dose UFH.

Adjusted-dose low-molecular-weight heparin (LMWH) decreased the risk of both DVT (OR, 0.07; 95% CI, 0.02–0.29) and PE (0.44; 95% CI, 0.18–1.11), but this benefit was offset by an increased risk of ICH (OR, 2.01; 95% CI, 1.02–3.96) and ECH (OR, 1.78; 95% CI, 0.99–3.17). Prophylactic-dose LMWH (defined as 3000–6000 IU/d) reduced the incidence of both DVT (OR, 0.34; 95% CI, 0.19–0.59) and PE (OR, 0.36; 95% CI, 0.15–0.87) without an increased risk of ICH (OR, 1.39; 95% CI, 0.53–3.67) or ECH (OR, 1.44; 95% CI, 0.13–16). For prophylactic-dose LMWH, the number needed to treat to avoid 1 event was 7 for DVT and 38 for PE.

Overall, the guidelines of the American College of Chest Physicians (9th edition) found an estimated reduction in overall mortality of 12 deaths per 1000 individuals receiving either UFH or LMWH compared with no anticoagulation82; no form of prophylaxis is 100% effective in preventing venous thromboembolism in this population, however.

A meta-analysis82 and a Cochrane systematic review of 9 trials involving 3137 subjects confirmed the superiority of LMWH over UFH.83 Only 1 high-quality cost-effectiveness analysis comparing LMWH with UFH in acutely ill medical subjects (not stroke) demonstrated fewer complications with LMWH at a lower overall cost.84 Intermittent pneumatic compression or sequential compression devices are designed to spur blood flow by intermittently applying pressure on the calf muscles and vasculature. One Cochrane systematic review of 2 small studies including 177 subjects demonstrated a nonsignificant trend toward a lower risk of DVT (OR, 0.45; 95% CI, 0.19–1.10) with no significant effect on mortality (OR, 1.04; 95% CI, 0.37–2.89).85

Elastic compression stockings, also referred to as graduated compression stockings, are designed to promote venous blood flow by applying a pressure gradient from the ankle more proximally. One large, randomized, clinical trial involving 2518 subjects failed to demonstrate a positive or negative effect on the occurrence of symptomatic proximal DVT or PE.86 However, subjects using elastic compression stockings had an increase in skin complications (relative risk [RR], 4.18; 95% CI, 2.4–7.3). One Cochrane systematic review of 2 trials including 2615 subjects demonstrated no significant reduction in DVT (OR, 0.88; 95% CI, 0.72–1.08) or death (OR, 1.13; 95% CI, 0.87–1.47).85

The addition of elastic compression stockings to intermittent pneumatic compression has been studied in a few small studies but has failed to demonstrate a positive or negative effect.87 Studies in other patient populations have demonstrated...
that the combination of elastic compression stockings and pharmacological prophylaxis significantly reduced the incidence of symptomatic or asymptomatic DVT (OR, 0.40; 95% CI, 0.25–0.65). However, the benefit of treatment should be weighed against the increase in skin complications observed with the use of elastic compression stockings.88

With respect to hemorrhagic stroke, prophylactic-dose heparin does not increase the risk of recurrent intracranial bleeding significantly, although the overall quality of the evidence is low.89 In 1 small study comparing the initiation of prophylactic heparin on the second and fourth hospital days, there were no harmful or beneficial effects on any outcomes.89 This study provides very low-quality evidence that early use of prophylactic-dose heparin is safe in stroke survivors with primary ICH.

Comparisons of the effects between UFH and LMWH and the effects of intermittent pneumatic compression and elastic compression stockings have not been done in stroke survivors with primary ICH. Therefore, recommendations are consistent with those of ischemic stroke.89

### Treatment of Bowel and Bladder Incontinence

Urinary incontinence and fecal incontinence are common problems after stroke. Approximately 40% to 60% of stroke patients have urinary incontinence during their acute admission for stroke, falling to 25% by hospital discharge. At 1 year, 15% will remain incontinent of urine.90 Age, cognition, and motor impairments are risk factors for bladder incontinence. Fecal incontinence prevalence is approximately 40% acutely but diminishes to 20% by discharge from rehabilitation. Age and functional impairment are risk factors for fecal incontinence on admission for stroke.91 Impaired awareness of urinary incontinence is correlated with mortality92 and the need for nursing home care 3 months after stroke.93 On a positive note, many patients recover continence after stroke. Because of the risk of skin breakdown, the social stigma, and the burden of care associated with incontinence, management of bowel and bladder continence is an essential part of the rehabilitation process.

Although considerable data on the rate of urinary incontinence exist, there is a paucity of published studies on therapeutic interventions to improve rates of continence. The recommendation to remove indwelling urinary catheters within 24 hours is based on the Centers for Disease Control and Prevention recommendations for all hospitalized patients to prevent catheter-associated urinary tract infections and is not specific to stroke.94

The studies reported by Pettersen et al92 and Myint et al95 combined multiple recommendations representing “best practice” for bladder management and applied them to a modest-sized population of stroke patients. Their studies showed success but limited generalizability because of study design. It is impossible to ascertain which of the multiple interventions were responsible for the improvements seen.

Cognitive awareness plays a role in continence and ultimately in overall stroke outcome. There are many types and causes of incontinence, ranging from impaired awareness of the need to void to difficulty with mobility in reaching the bathroom to communication difficulties resulting from aphasia.

We were unable to identify any high-quality studies of treatment for fecal incontinence after stroke, and recommendations are based on the general population of adults.96
Assessment, Prevention, and Treatment of Hemiplegic Shoulder Pain

Shoulder pain is common after stroke, with an incidence during the first year of 1% to 22%.\textsuperscript{97,98} The reported prevalence of shoulder pain varies between 5% and 84%, depending on the acuity and definition of shoulder pain used.\textsuperscript{99} The development of shoulder pain after stroke is associated with shoulder subluxation and motor weakness. Importantly, these 2 factors have strong covariance, suggesting that motor impairment may be the more important predictive factor.\textsuperscript{100} However, motor weakness is not predictive of pain severity in the hemiplegic shoulder. Spasticity is believed to contribute to the genesis of shoulder pain in some patients, although a causal relationship has not been confirmed. Other predictors of shoulder pain include older age, left hemiplegia, the presence of tactile extinction and reduced proprioception in the painful limb, early complaints of pain, reduced passive shoulder abduction and external rotation of glenohumeral joint, a positive Neer impingement sign (shoulder pain with passive abduction of the internally rotated arm), and tenderness to palpation over the biceps tendon and supraspinatus.\textsuperscript{101–105}

Hemiplegic shoulder pain is multifactorial. Pain is associated with shoulder tissue injury, abnormal joint mechanics, and central nociceptive hypersensitivity. About one third of patients with acute stroke have abnormal ultrasound findings in the hemiplegic shoulder when studied at the time of admission to acute inpatient rehabilitation, including effusion in biceps tendon or subacromial bursa; tendinopathy of biceps, supraspinatus, or subscapularis; and rotator cuff tear.\textsuperscript{106,107} Such findings are more prevalent in the hemiplegic shoulder than in the nonhemiplegic shoulder and in those with more severe hemiplegia, subluxation, spasticity, limited joint range, and shoulder pain.\textsuperscript{106} The frequency of abnormal ultrasound findings in the hemiplegic shoulder increases over the course of rehabilitation in patients with more severe motor impairment.\textsuperscript{106,107} Although there is an association between abnormal findings on shoulder ultrasound and hemiplegic shoulder pain in patients with acute stroke, a causal association has not been established. Among patients with acute and chronic stroke with hemiplegic shoulder pain, the presence of shoulder tissue injury on imaging is not associated with the severity of pain.\textsuperscript{108,109}

Patients with stroke-related hemiplegia demonstrate altered movement patterns at certain stages of recovery. In the acute phase of stroke, shoulder subluxation is associated with pain. In those with chronic stroke and hemiplegic shoulder pain, there is capsular stiffness and altered resting position of the scapula in lateral rotation.\textsuperscript{103,110} Compared with those without voluntary movement, patients with some movement in the painful hemiparetic shoulder have a higher rate of shoulder joint tissue injury on magnetic resonance imaging, suggesting that more physical activity promotes injury.\textsuperscript{106} However, the relationship between altered kinematics and pain in the hemiparetic shoulder has not been established. For example, shoulder joint kinematics are altered with spasticity, yet there are no clear correlations between reductions in Ashworth and pain scores or reductions in subluxation and pain.\textsuperscript{111} Thus, the exclusive role of peripheral nociceptive pain in the mechanically altered hemiplegic shoulder has been questioned.\textsuperscript{112}

There is recent evidence supporting both a peripheral and a central neuropathic role for shoulder pain.\textsuperscript{112–114} Patients with hemiplegic shoulder pain have a higher prevalence of altered somatosensory function with reduced sensory thresholds and decreased kinesthesia than patients without pain and normal control subjects.\textsuperscript{105,115–117} In addition, patients with shoulder pain have higher rates of allodynia and hyperpathia on both the affected and less affected sides than stroke patients without pain.\textsuperscript{116,117} Patients with painful shoulders also have higher heat pain thresholds and lower pain pressure thresholds.\textsuperscript{117,118} Soo Hoo and colleagues\textsuperscript{118} found lower pain pressure thresholds on the affected and less affected sides in patients with shoulder pain. Somatosensory evoked responses from the affected upper limb differ between stroke patients with and those without shoulder pain.\textsuperscript{119} Although diagnostically distinct from hemiplegic shoulder pain, complex regional pain syndrome (also called shoulder-hand syndrome) is characterized by allodynia and hyperpathia and includes shoulder pain as a key component. Thus, there is growing recognition that hemiplegic shoulder pain is a syndrome with biomechanical and central nervous system components and overlaps with complex regional pain syndrome.

Interventions to prevent the onset of and to treat shoulder pain in patients with stroke-related hemiplegia include proper positioning, maintenance of shoulder range of motion, and motor retraining. For people in wheelchairs, lap trays and arm troughs might be useful positioning devices to reduce shoulder pain and subluxation. Some suggest that consistent performance of aggressive passive range-of-motion exercises may reduce or prevent later shoulder problems, but the evidence in support of or against this suggestion is missing. Aggressive range of motion of the complex shoulder joint, if done improperly, could do more harm than good. The use of slings, especially during ambulation training to protect the shoulder from traction injury, may be considered, and the use of overhead pulley exercises should be avoided.\textsuperscript{120} Research has focused on several adjuvant treatments, including strapping, acupuncture, and neuromuscular electrical stimulation (NMES). There are a few RCTs with mixed results on shoulder strapping for the prevention of shoulder pain after acute stroke.\textsuperscript{121–123} Each study used different strapping (or taping) techniques and measured different pain outcomes. In the largest of these, Pandian and others\textsuperscript{123} randomized 162 patients with acute stroke to either shoulder taping or sham taping. There was a trend toward a difference in visual analog pain scale and pain-related disability scores over 30 days, but these differences were not statistically or clinically significant. Currently, there is insufficient evidence to support or refute the efficacy of shoulder strapping (taping) for the prevention of hemiplegic shoulder pain.

Acupuncture in combination with standard therapeutic exercise may be a safe and effective adjuvant for the treatment of hemiplegic shoulder pain. This was suggested by Lee and colleagues\textsuperscript{124} in a recent systematic review of this topic. They found 7 RCTs, all showing positive effects. However, they could not recommend concrete conclusions because of the limited number of available trials.

Various types of skin surface electrical stimulation have been evaluated for the treatment of hemiplegic shoulder pain, including transcutaneous electrical nerve stimulation (TENS) and NMES. These modalities have not been evaluated sufficiently, and their efficacy for pain prevention and treatment...
remains inconclusive. The largest RCT to date testing surface NMES to a hemiplegic shoulder showed no effect on pain prevention in patients with acute stroke; however, pain was not a primary outcome measure in this study. Compliance with the use of surface NMES has been variable in these studies, and surface NMES has been shown to be less well tolerated than intramuscular NMES. Intramuscular NMES for 6 h/d over 6 weeks with 4 implanted electrodes showed efficacy in 2 open-label trials. Pain differences between treatment and control groups remained significant 12 months after treatment, and NMES was more effective in patients with less chronic stroke (defined as <7 months after stroke in this study). Although fully implanted intramuscular stimulators for hemiplegic shoulder have been developed, there are insufficient data to support efficacy to date.

Corticosteroid injection into glenohumeral joint or subacromial space is commonly used to treat shoulder pain. There are limited studies on the use of steroid injection in the painful hemiplegic shoulder. Observational studies have shown a significant reduction in hemiplegic shoulder pain after either glenohumeral or subacromial injection, but the long-term pain reduction has not been verified. These injections result in superior short-term pain reduction compared with standard care. There are only 2 randomized trials of shoulder joint injections for pain. Snels and colleagues showed no significant effect on pain reduction after glenohumeral injection. In contrast, Rah and others showed a significant reduction in pain after corticosteroid injection compared with placebo. In the latter study, Rah et al selected only patients with shoulder joint pathology that was verified by ultrasonography.

Botulinum toxin injections into the shoulder musculature have shown mixed results in the management of shoulder pain. de Boer and colleagues showed no impact of botulinum toxin injection into the subscapularis of painful hemiplegic shoulders, whereas Yelnick and colleagues showed significant reductions in pain scores in patients treated for shoulder spasticity. Some investigators have noted reduced pain with shoulder movement after botulinum toxin injections to the pectoralis major and biceps brachii, but others found no change in reported pain scores after pectoralis major injection. Lim et al found botulinum toxin injections to the pectoralis major, infraspinatus, and subscapularis muscles superior to glenohumeral steroid injection. Botulinum toxin injections may decrease shoulder spasticity and pain associated with spasticity-related joint mobility restrictions but are not sufficient to reduce shoulder pain in general.

Supraspinal nerve blocks may be effective in reducing shoulder pain through a reduction of both nociceptive and neuropathic pain mechanisms. A recent randomized, clinical trial showed that supraspinal nerve blocks were superior to placebo injections in reducing hemiplegic shoulder pain for up to 12 weeks after treatment. In another small, comparison study of patients with nonneuropathic hemiplegic shoulder pain, supraspinal nerve blocks were as effective as glenohumeral triamcinolone injections.

Surgical tenotomy of pectoralis major, lattissimus dorsi, teres major, or subscapularis may be considered for patients with severe hemiplegia and restrictions in shoulder range of motion. In patients with clinical evidence of a central pain component associated with sensory changes, allodynia, and hyperpathia, medication management with neuromodulating medications may be considered.

Central Pain After Stroke

Central poststroke pain is pain that results from a lesion in the somatosensory system rather than from a peripheral nociceptive or psychogenic cause. Diagnostic criteria include requirements that the pain occur after stroke, be located in an area of the body that corresponds to the lesion in the central nervous system, and not be accounted for by nociceptive or peripheral neuropathic pain. Central pain is classically associated with thalamic stroke (Dejerine-Roussy syndrome) but can result from a lesion anywhere along the spinothalamic and thalamocortical tracts within the central nervous system. Central pain symptoms are usually described as burning or aching and often include
alldynia associated with touch, cold, or movement. Use of diagnostic criteria for central poststroke pain such as those proposed by Klit et al can be helpful. The incidence of central poststroke pain is estimated at 7% to 8%, and it typically begins within a few days after stroke, with the majority of patients becoming symptomatic within the first month.

There is limited evidence on the efficacy of proposed treatments for central poststroke pain. Pharmacotherapy combined with therapeutic exercise and psychosocial support is a reasonable approach. Response to treatment is best assessed with standardized serial measurements such as pain diaries, visual analog scales, or pain questionnaires. Pharmacotherapy has relied primarily on antidepressant medications and anticonvulsants. Amitriptyline 75 mg at bedtime has been shown to lower daily pain ratings and to improve global functioning. Lamotrigine can reduce daily pain ratings and cold-induced pain, but only 44% of patients given this medication have a good clinical response. Results for pregabalin have been mixed, with 2 clinical trials finding that daily pain reporting with pregabalin was not significantly better than with placebo. Sleep and anxiety were improved with pregabalin, however. Gabapentin has not been well studied for poststroke central pain but has been effective in other forms of neuropathic pain. Other options for central pain management include carbamazepine and phenytoin, but their usefulness is not well established.

There are few nonpharmacological options for the management of central poststroke pain. TENS has been shown to be ineffective in a small trial. Motor cortex stimulation can be given with a surgically implanted dural electrode overlying the motor cortex that is connected to a subcutaneous pulse generator. In several case series, pain reductions of >50% on the visual analog scale were achieved in 50% to 83% of patients, with effectiveness for up to 2 years after implantation. However, cortical stimulator implantation is associated with several complications, including infection, hardware failure, postoperative seizures, and long-term epilepsy. Motor cortex stimulation may be an option for intractable central poststroke pain. Deep brain stimulation has conflicting evidence for the management of central pain and currently cannot be recommended.

### Recommendations: Central Pain After Stroke (Continued)

<table>
<thead>
<tr>
<th>Class</th>
<th>Level of Evidence</th>
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<tr>
<td>TENS has not been established as an effective treatment.</td>
<td>III</td>
</tr>
<tr>
<td>Motor cortex stimulation might be reasonable for the treatment of intractable central poststroke pain that is not responsive to other treatments in carefully selected patients.</td>
<td>IIb</td>
</tr>
<tr>
<td>Deep brain stimulation has not been established as an effective treatment.</td>
<td>III</td>
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#### Prevention of Falls

A great deal of research literature exists on the epidemiology, risk factors, and development of prevention programs for falls in the general population of older adults. Less information is available for individuals with stroke. Falls and their prevention in individuals with stroke require special considerations. Risk factors, interventions, and prevention programs developed for the community-living older population will not necessarily translate to the population of individuals with stroke. The Balance and Ataxia section provides more discussion.

Up to 70% of individuals with a stroke fall during the first 6 months after discharge from the hospital or rehabilitation facility. Individuals with stroke are also at risk to be repeat fallers and to experience an injury associated with a fall. A larger portion of fractures occurring in individuals with stroke (27%) involve the hip or pelvis compared with <10% of the general population of older adults who fall. The loss of bone mineral density (BMD) associated with stroke may contribute to the higher hip fracture rate for individuals with stroke.

In addition to the physical consequences associated with fractures and related injuries, falls have psychological and social consequences. The impairments in balance, gait, motor control, perception, and vision contribute to a heightened fear of falling in individuals with stroke. Studies indicate that 30% to 80% of individuals with stroke report various levels of fear associated with falling and mobility. Fear of falling can lead to reduced levels of physical activity and deconditioning, creating a cascade that may result in greater declines in physical activity, a decrease in ADLs, a loss of independence, fewer community interactions, social isolation, and depression. Ironically, the reduction in physical activity resulting from fear of falling can itself contribute to an increased risk of falls.

#### Risk Factors and Assessment

Evaluation of risk factors is widely recognized as the first step in preventing falls. A systematic review of factors contributing independently to falls in the general older population identified previous falls, low muscle strength, impaired gait, poor balance, and use of specific and multiple medications as the strongest risk factors for falls. Research suggests that risk factors in the stroke population are similar overall but with some differences. For example, a history of falls before a stroke does not appear to be as strong a risk factor as it is in the general older population.

The probability of falling also increases with the number of risk factors. Tinetti and others reported that the 1-year risk of falling among the general elderly population increased from a range of 8% to 19% for individuals with no risk factors to >70% for individuals with ≥4 risk factors.
The assessment of risk factors varies across settings and circumstances. For example, a majority of falls for individuals with stroke that occur during hospitalization are associated with transfers and attempting activities without supervision, whereas the majority of falls for individuals with stroke living in the community are associated with walking.192

Numerous fall risk assessment tools are available. A recent systematic review183 identified 8 commonly used fall risk assessment tools with existing reliability and validity. The most commonly used assessment instrument in the 43 prevention studies reviewed was the Morse Fall Scale.184 The Berg Balance Scale has demonstrated good sensitivity and specificity in predicting falls in individuals with stroke.185 Several federal and professional associations have developed fall prevention toolkits that include risk assessment instruments and protocols (eg, the National Center of Patient Safety Falls Toolkit, the Centers for Disease Control and Prevention Stopping Elderly Accidents, Deaths and Injuries Toolkit, the AHRQ Preventing Falls in Hospitals—A Toolkit for Improving Quality Care, and the AHRQ Step-Up to Stop Falls Toolkit).

Prevention Programs
The most comprehensive assessment of preventing falls in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172 The evidence specific for fall prevention in the community is the recent Cochrane database review.172 The evidence specific for fall prevention in the general population of older adults is the recent Cochrane database review.172

A new seizure diagnosis after stroke can be classified as early (beginning within the first few days of stroke) or late.
Secondary Stroke Prevention

Stroke shares many risk factors with other forms of cardiovascular disease such as hypertension, smoking, hyperlipidemia, and inactivity. With hospitalization for acute stroke brief, it is particularly important to address the secondary prevention of stroke and other cardiovascular diseases during the postacute rehabilitation phase of care. Readers are directed to the most recent AHA/American Stroke Association (ASA) secondary stroke prevention guideline for further information.

Poststroke Depression, Including Emotional and Behavioral State

In the United States and globally, depression and anxiety are common after stroke and are associated with increased mortality and poor functional outcomes. There is evidence that the likelihood of depression increases with stroke severity, but the mechanisms of poststroke depression are incompletely understood. Depression has been reported in up to 33% of stroke survivors compared with 13% of age- and sex-matched control subjects, but reliable estimates of the incidence and prevalence of depression in a stroke cohort are limited. Predictors of poststroke depression include a history of depression, severe disability, cognitive impairment, previous stroke, a positive family history of psychiatric disorder, and female sex. As poststroke psychosocial issues are studied, greater understanding of the complexity of the problem is obtained. For example, Vickery et al analyzed how the stability of self-esteem plays a role in the rate of depressive symptoms. The depression and emotionalism section of the 2005 stroke rehabilitation clinical practice guidelines does an excellent job of describing the incidence of poststroke depression and pseudo-bulbar affect. What is clear from the literature is that these issues are real and warrant assessment and treatment as early as possible and on an ongoing basis. The section on poststroke depression in the AHA/ASA “Palliative and End-of-Life Care in Stroke” scientific statement gives highlights of prevention, assessment, and treatment. Here, we highlight how poststroke depression affects stroke rehabilitation and recovery and, vice versa, how rehabilitation and exercise affect depression.

Although data are inconclusive as to whether improvement of poststroke depression is independently associated with functional improvement, depression can negatively affect a patient’s ability to actively participate in rehabilitation therapies. It is important to address symptoms early in the rehabilitation process, especially given the recent trend for less time in rehabilitation. Depression frequently coexists with other psychiatric symptoms. Anxiety in particular is found to coexist with depression in the poststroke patient population but frequently goes undiagnosed. Anxiety can create uncomfortable or disabling feelings of worry/fear accompanied by physical symptoms that make participation in therapy more difficult. Shimoda and Robinson reported that generalized anxiety disorder accompanied by poststroke depression delayed recovery from depression, delayed ADL recovery, and reduced overall social functioning. Unfortunately, few studies have been conducted to address the treatment of and recovery from poststroke generalized anxiety disorder. Anxiety symptoms in poststroke patients should be assessed and treated, particularly in those patients with a diagnosed depressive disorder. Any patient diagnosed with 1 form of mood disorder should be assessed for others.

A review of intervention trials for treatment of poststroke depression yielded no evidence of benefits of psychotherapy in treating depression after stroke. de Man van Ginkel et al identified additional nursing practices that had a positive impact on reducing depression symptoms, including life review therapy, motivational interviewing, nursing support programs, and physical exercise.

Rehabilitation, Exercise, and Recovery

A study with 49 depressed patients (24 treated for depression and 25 not treated as determined by physician preference) was conducted to evaluate the effects of poststroke depression and antidepressant therapy on the improvement of motor scores and disability. Poststroke depression was found to have negative effects on functional recovery, and the pharmacological treatment of depression was found to counterbalance this effect. Similarly, a study with 55 patients with poststroke major or minor depression found that remission of poststroke depression over the first few months after stroke is associated with greater recovery of ADL function than continued depression. Early effective treatment of depression may have a positive effect on the rehabilitation outcome. No larger-scale studies following up on this line of research were found.

Physical exercise may provide a complementary treatment for depression. Exercise may affect depressive symptoms through a number of mechanisms. For example, the hypothalamic-pituitary-adrenal axis may be dysregulated in depression, resulting in elevated cortisol levels. Exercise can improve regulation of hypothalamic-pituitary-adrenal responses. Depression also has direct and indirect consequences on immune function, and regular exercise may serve as a nonpharmaceutical stimulus for enhancing immune function. Furthermore, social contact through group exercise may be beneficial for individuals with depression.

Meta-analyses in adults with depression (but without stroke) have shown positive effects of exercise on depressive symptoms. A Cochrane review reported a large clinical effect with a standardized mean difference of −0.82 of physical exercise on depressive symptoms. A systematic review suggested that physical exercise was effective in treating depression, especially in individuals with high baseline levels of depression.

In a meta-analysis of 13 studies (n=1022 patients), Eng and Reime found that depressive symptoms after stroke were lower immediately after ≥4 weeks of exercise (standardized mean difference=−0.13 [95% CI, −0.26 to −0.01]). Exercise appeared to have a small beneficial effect on depressive symptoms across both the subacute and chronic stages of stroke recovery, but these effects were not retained after the exercise was terminated. Saunders et al reviewed...
8 exercise studies that included a depression outcome in a stroke population and meta-analyzed 3 of these studies. They concluded that the results were inconsistent among the trials. A major criticism is that the majority of the stroke studies used depressive symptoms as a secondary outcome, and as a result, the levels of depressive symptoms varied widely in these studies. Given the strong evidence in nonstroke populations with depression, coupled with the preliminary evidence in stroke populations, exercise may be useful as a potential treatment to reduce depressive symptoms in individuals with stroke.

Depression and other psychological disorders, specifically anxiety, can occur at any time after stroke. Healthcare providers should evaluate these issues during poststroke follow-up visits. One study compared different diagnostic tools to determine whether one was superior over another. Bergersen et al reported that patients and their caregivers fail to discuss psychosocial issues or symptomology with their providers. There are cultural differences in reporting psychosocial issues, resulting in part from perceived cultural morays discouraging personal feelings.209 Varying post-stroke assessments on the basis of cultural background is an important consideration specifically in poststroke depression. Nonpharmacological treatment options can provide some successful outcomes. Unfortunately, there are no well-designed RCTs in which various treatment interventions are compared to determine superiority. Because of the complexity of the psychosocial diseases and limited understanding, a number of treatment options should be tried to determine patient-specific effectiveness. This supports the need for ongoing monitoring after treatment.

Medication
Poststroke depression is treatable with a variety of antidepressant medications, with selective serotonin reuptake inhibitors (SSRIs) and tricyclic antidepressants being the most widely studied.232,239 Treatment with heterocyclic antidepressant medications and SSRIs appears to be a viable option for poststroke depression, but their absolute or relative efficacy has yet to be fully established.240 In 1 study of 870 veterans with poststroke depression, poststroke SSRI treatment was associated with longer survival. The authors concluded that after a stroke, SSRI initiation or resumption of treatment should be considered as part of a medication therapy management service, especially if the patient has a history of depression or was taking an SSRI before the stroke. A 2008 Cochrane review analyzing data for 13 pharmaceutical agents, including tricyclic antidepressants, SSRIs, and monoamine oxidase inhibitors, found some benefit of pharmacotherapy in terms of a complete remission of depression and improvement in scores on depression rating scales, but there was also an associated increase in adverse events.272 The analyses were complicated by a lack of standardized diagnostic and outcome criteria and differing analytic methods. To the best of our knowledge, there have been no studies on the effectiveness of a combined drug intervention (eg, SSRIs) and rehabilitation intervention on recovery outcomes after stroke.

### Poststroke Osteoporosis
BMD and lean tissue mass commonly decline after stroke.242–244 Although declines in BMD and lean tissue mass can occur in both limbs, changes on the paretic side are more profound. BMD can decrease by >10% in <1 year in the paretic lower limb.242 Moreover, the decline in BMD, coupled with balance deficits resulting from stroke, increases fracture risk.245 Changes in BMD after stroke are correlated with functional deficits in the paretic limb(s). Jørgensen et al assessed 40 patients at 6 days, 7 months, and 1 year after stroke. Seventeen patients were
Initially nonambulatory, and 23 were ambulatory. Ambulatory status was predictive of changes in BMD 1 year after stroke. The nonambulatory patients had a 10% reduction in BMD in the paretic lower limb compared with a 3% reduction in BMD in ambulatory patients. Moreover, among the 17 patients who were initially nonambulatory, 12 regained walking ability with assistance 2 months after stroke. Those patients who regained ambulation ability had an 8% reduction in BMD in the paretic lower limb compared with a 13% reduction in those who remained nonambulatory. Pang et al found that femur BMD and lean mass were significantly lower and fat mass was significantly higher on the paretic side compared with the nonparetic side in ambulatory men and women who suffered a stroke >1 year earlier. However, the degree to which BMD was preserved in the paretic lower extremity was significantly correlated with 6-minute walk test distance, peak oxygen consumption (\(V_O_2\)), and handheld dynamometry. Multiple regression analysis revealed that peak \(V_O_2\) was a significant predictor of paretic limb BMD and lean tissue mass. Paretic upper limbs also demonstrate significant declines in BMD and lean mass after stroke. The decline in BMD and lean mass is associated with paretic upper limb strength assessed by handheld dynamometry.

The US Preventive Services Task Force recommends osteoporosis screening in all women ≥65 years of age; women <65 years of age whose fracture risk is greater than or equal to that of older white women with no additional risk factors should also undergo osteoporosis screening. The US Preventive Services Task Force concludes that there is inconclusive evidence to make any osteoporosis screening recommendations for men. Individuals with stroke have an increased risk for osteoporosis, particularly on the paretic side. The risk of fracture is also increased in patients with stroke. In men with stroke, although osteoporosis and fracture risks are higher, no clear guidance on screening can be provided at this time. The current US Preventive Services Task Force recommendations are appropriate in the stroke population.

Limited research indicates that increased levels of physical activity such as ambulation and resistance training attenuate the decline in, maintain, or increase BMD and lean tissue mass after stroke.

### Assessment

#### Level of Disability

Stroke can affect numerous aspects of neural function and structure. Clinically, this most often manifests as weakness, with other common impairments being aphasia, neglect, visual field deficit, cognitive changes such as executive dysfunction or memory loss, major depression, sensory deficits, dysarthria, and problems with coordination.

Measures of body function tend to be more objective, easier to define, and easier to measure compared with other levels of the World Health Organization’s ICF but may have less relevance to a patient’s function and independence. Limited correlation exists across ICF dimensions. The reason is that numerous factors have a greater influence on outcome as one moves from body function/structure to activity limitations, participation restrictions, and quality of life. During acute stroke management, the focus tends to be more on measures of body function, whereas toward the more chronic phases, the emphasis shifts to activities and participation. Regardless of ICF dimension, formal standardized and validated measures should be used to the extent possible.

Many methods are available to measure loss of body function/structure. Chief among these is the physical examination. Many scales have been devised. Some are global scales that aim to capture all major deficits and to combine the assessment into a single score, whereas others are modality specific. In the United States, the most widely used global assessment of impairment is the National Institutes of Health Stroke Scale, which ranges from 0 to 42, with higher scores indicating more severe loss of body function/structure. Training and formal certification on National Institutes of Health Stroke Scale scoring are widely available, increasing the precision of this measure and permitting the use of this tool by a variety of disciplines. The National Institutes of Health Stroke Scale is a good predictor of short-term and long-term morbidity and mortality and has been found to be sensitive to change in numerous studies. Limitations of the National Institutes of Health Stroke Scale include low granularity for defining differences in level of impairment and insensitivity to many common poststroke deficits such as depression, hand-motor deficits, swallowing, or memory loss.

Many modality-specific measures have been constructed for measuring loss of body function/structure across the many brain neural systems. Common examples include the upper limb motor section of the Fugl-Meyer scale or the Box and Block Test for measuring arm motor deficits; the leg motor section of the Fugl-Meyer scale or gait velocity for measuring leg motor deficits; the Western Aphasia Battery or the Boston Naming Test for language deficits; the Behavioral Inattention Test or The Line Cancellation test for measuring neglect; the Nottingham Sensory Assessment or the sensory section of the Fugl-Meyer scale for measuring somatosensory deficits; the Hamilton Depression Scale or the Beck Depression Inventory II for measuring severity of depression symptoms; and the Mini-Mental Status Exam or Trail Making Tests (A and B) for cognitive deficits. More complete lists of such tests have been compiled. In addition, the National Institute of Neurological Disorders and Stroke has compiled a set of common data elements for each dimension of the ICF, including the 3 major dimensions of body structures/body functions (impairments), activities (activity limitations), and participation (participation restrictions).

Some scales focus on measures that require specific equipment such as a dynamometer for measuring hand grip strength, various perimetry devices (eg, Humphrey or octopus) for measuring visual field loss, an electric goniometer for measuring

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<tr>
<th>Recommendations: Poststroke Osteoporosis</th>
<th>Class</th>
<th>Level of Evidence</th>
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<tbody>
<tr>
<td>It is recommended that individuals with stroke residing in long-term care facilities be evaluated for calcium and vitamin D supplementation.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>It is recommended that US Preventive Services Task Force osteoporosis screening recommendations be followed in women with stroke.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Increased levels of physical activity are probably indicated to reduce the risk and severity of poststroke osteoporosis.</td>
<td>IIa</td>
<td>B</td>
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</table>
range of motion, or von Frey filaments for measuring tactile sensory deficits. Robotic devices are receiving increasing attention for their ability to quantify loss of body function/structure, in some cases generating data that cannot be obtained by a human examiner. Telemedicine may be used by examiners in remote locations to measure level of disability.

The assessment of body function/structure in a patient recovering from stroke may be performed to predict outcome, to monitor recovery, to monitor response to a new therapy, to guide new treatment decisions, to document clinical status as part of reimbursement, to inform patient stratification such as in selecting postdischarge setting, in the context of a clinical trial, as part of stroke center or rehabilitation ward certification requirements, or in compliance with a stroke care plan protocol. Valid reliable measures have been defined for each of these purposes. Similar considerations apply to choosing the frequency with which impairments are measured.

Assessing Overall Rehabilitation Needs
After acute hospital admission for stroke, patients should have comprehensive assessments of body structures and function, activity limitations, and participation restrictions according to the ICF. These assessments can be performed concurrently with diagnostic testing as soon as 24 hours after admission, as the patient’s medical stability allows. Evaluation of a stroke survivor’s rehabilitation needs is best performed by an interprofessional team that can include a physician with expertise in rehabilitation, nurses, physical therapists, occupational therapists, speech/language therapists, psychologists, and orthotists. Prvu Bettger and colleagues noted that among acute hospitals participating in the AHA’s Get With The Guidelines program, 90% of patients have an assessment for postacute rehabilitation services documented, but little information is available about the nature or reliability of these assessments. If clinically indicated, appropriate postacute rehabilitation settings include outpatient rehabilitation or day rehabilitation programs, skilled nursing–level rehabilitation, long-term acute care hospitals, and acute rehabilitation hospitals.

Selection of the most appropriate level of care requires consideration of many factors, including the severity of residual neurological deficits, resulting activity limitations, cognitive and communicative ability, psychological status, swallowing ability, premorbid functional ability, medical comorbidities, level of family/caregiver support, likelihood of returning to community living, and ability to participate in a rehabilitation program. Certain factors such as older age, impaired cognition, lower functional level after stroke, and urinary incontinence are predictors of the need for inpatient rehabilitation care. The presence of neglect syndrome can predict a longer rehabilitation stay and lower functional status at discharge. Among patients with less neurological impairment, assessment of balance function with standardized measures such as the Berg Balance Scale or the Postural Assessment Scale for Stroke can help determine the risk of fall and need for inpatient rehabilitation rather than discharge home with outpatient services. (The Prevention of Falls section provides more information). For patients who can walk, assessment of gait speed with the 10-m walk test can help determine functional ambulatory ability. Risk of fall with ambulation is important for counseling patient and family on safety.

A comprehensive determination of functional abilities appears to be useful before acute hospital discharge with standardized assessments such as the Barthel Index or the Functional Independence Measure (FIM). Both the Barthel Index and the FIM are strong predictors of discharge functional status, discharge destination after inpatient rehabilitation, and length of rehabilitation stay. The FIM is the most commonly used functional measure in the United States because it is tied to the prospective payment system of the Centers for Medicare & Medicaid Services.

There currently is no single functional assessment with measurement properties that is used throughout the entire clinical course of stroke care (acute hospital, inpatient rehabilitation, and outpatient care) for tracking stroke rehabilitation outcome. A computerized questionnaire called the Activity Measure for Post-Acute Care is not specific to stroke but has demonstrated feasibility as such a tool in stroke populations. Although it requires cognitive and language ability to complete, proxy responses to the Activity Measure for Post-Acute Care are well correlated with patient responses. Thus, the Activity Measure for Post-Acute Care may prove to be a suitable longitudinal outcome measure for stroke patients, including those with cognitive deficits and aphasia.

ADLs, IADLs, and Disability Measurement
The term ADLs typically refers to routine self-care tasks that people perform as part of their everyday life. ADLs are generally subdivided into those associated with personal self-care and fundamental mobility, often referred to as basic ADLs, and tasks involving more complex domestic, community, and leisure activities, referred to as IADLs.

An evidence-based consensus conference on improving measurement of disability sponsored by the AHRQ concluded that a single consensus definition of disability is not feasible or desirable. The AHRQ report contends that the meaning of disability is dependent on context and the purpose for which the definition will be used. The ICF uses disability as a generic term that includes aspects of body functions and structure, activity, and participation within the context of the environment and personal/social factors. The recommendations below for ADLs, IADLs, and disability are based on the conceptual approach to disability endorsed by the World Health Organization.

In the 2005 stroke rehabilitation clinical practice guidelines, there were 2 recommendations on the assessment of function. The first was that a standardized assessment tool be used to evaluate functional status in individuals with stroke. The second recommendation was to consider using the FIM as the standardized assessment for function in individuals with stroke.

Over the past decade, there has been substantial progress in 2 general areas pertaining to measurement of function and disability, including ADLs and IADLs. The first is more sophisticated methodological approaches to assessment, specifically the development of methods based on item response theory and computer-adapted testing. The second is the recent attention to patient-centered and patient-reported outcome measures. The emphasis on patient-centered and patient-reported measures is related to healthcare reform and the implementation of the Patient Protection and Affordable Care Act.
New tools for assessment include the Patient-Reported Outcomes Measurement Information System\(^2\) and the NIH Toolbox.\(^2\) Both the Patient-Reported Outcomes Measurement Information System and the NIH Toolbox are designed to help clinicians and healthcare consumers by providing a common platform based on procedures and metrics that will generate outcomes comparable across large populations, including individuals with stroke.

The largest and most comprehensive source of evidence-based reviews and reports focused on stroke rehabilitation is available from the Evidence-Based Review of Stroke Rehabilitation (EBRSR) program supported by the Canadian Stroke Network.\(^2\) Information and the evidence-based reports from EBRSR are available online.\(^2\)

Specific to the assessment of ADLs and IADLs (disability), the EBRSR has produced an evidence-based report titled “Outcome Measures in Stroke Rehabilitation.”\(^2\) All reviewed assessments are classified according to the World Health Organization’s ICF conceptual framework. The frequently used modified Rankin Scale is included within the Activity/Disability Outcome Measures section. With the use of the ICF, each assessment is categorized as providing information at the level of body functions and structure, activities, or participation. All assessment instruments in the EBRSR report are evaluated with 8 criteria. The criteria were derived from a comprehensive review of 413 articles on measurement methodology by the Health Technology Assessment Program.\(^2\) The criteria include operationally defined ratings for appropriateness, reliability, validity, responsiveness, precision, interpretability, acceptability, and feasibility. Appendix 2 includes measures reviewed in the EBRSR report as of November 2012.

**Assessment Challenges**

The instruments included in Appendix 2 and the evidence-based reviews in the EBRSR are based on traditional measurement models. As noted above, new assessments are being developed with the use of item response theory and computer-adapted testing. These assessments are difficult to evaluate with the traditional criteria such as validity and reliability normally used in evidence-based reviews. For example, Hsueh and colleagues\(^3\) reported the development of a computer-adapted test for evaluating ADLs in individuals with stroke referred to as the ADL-CAT (computer-adapted test). The authors report the ADL-CAT produced scores that were highly correlated with traditional ADL measures such as the Barthel Index but could be completed in one-fifth the time required to administer the Barthel Index.\(^3\) New or refined criteria consistent with advances in measurement approaches need to be developed and incorporated into existing levels of evidence hierarchies to accommodate the evaluation and evidence-based reviews of assessments.

Another challenge in establishing functional assessment guidelines is how to incorporate the growing emphasis on patient reported and patient-centered measures within the assessment of ADLs, IADLs, and other disability measures. The solution to this challenge extends beyond simply asking patients or consumers to respond to traditional ADL questions such as “Can you put on an article of clothing?” Rather, it requires patients and other stakeholders to be active partners in the assessment process and to help identify the items and outcomes that should be measured. Until computer-adapted tests (eg, ADL-CAT) for ADLs and IADLs become routine in practice, a combination of assessments such as a basic ADL measure (eg, the 10-item Barthel Index)\(^4\) or the FIM and an IADL measure (eg, the 15-item Frenchay Activity Index)\(^4\) is recommended to capture the broad spectrum of ADL function. Recently, a Rasch analysis was used to validate a combined measure of basic and extended daily life functioning after stroke.\(^4\) Even those recovering from mild stroke or transient ischemic attack (eg, those scoring 100 on the Barthel Index) continue to demonstrate deficits in health status. Although basic ADL measures may not be sufficiently sensitive to change among the least impaired stroke survivors, the IADL assessment tool will likely be more sensitive to these more subtle deficits at discharge and provide useful information for discharge planning.

### Assessment of Motor Impairment, Activity, and Mobility

Motor impairments are common after stroke and occur when the stroke lesion includes the corticospinal system, that is, the motor cortical areas and the corticospinal tract.\(^5\) Indeed, the

<table>
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<tr>
<th>Recommendations: Assessment of Disability and Rehabilitation Needs</th>
<th>Class</th>
<th>Level of Evidence</th>
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<tbody>
<tr>
<td>It is recommended that all individuals with stroke be provided a formal assessment of their ADLs and IADLs, communication abilities, and functional mobility before discharge from acute care hospitalization and the findings be incorporated into the care transition and the discharge planning process.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>It is recommended that all individuals with stroke discharged to independent community living from postacute rehabilitation or SNFs receive ADL and IADL assessment directly related to their discharge living setting.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>A functional assessment by a clinician with expertise in rehabilitation is recommended for patients with an acute stroke with residual functional deficits.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Determination of postacute rehabilitation needs should be based on assessments of residual neurological deficits; activity limitations; cognitive, communicative, and psychological status; swallowing ability; determination of previous functional ability and medical comorbidities; level of family/caregiver support; capacity of family/caregiver to meet the care needs of the stroke survivor; likelihood of returning to community living; and ability to participate in rehabilitation.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>It is reasonable that individuals with stroke discharged from acute and postacute hospitals/centers receive formal follow-up on their ADL and IADL status, communication abilities, and functional mobility within 30 days of discharge.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>The routine administration of standardized measures can be useful to document the severity of stroke and resulting disability, starting in the acute phase and progressing over the course of recovery and rehabilitation.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>A standardized measure of balance and gait speed (for those who can walk) may be considered for planning postacute rehabilitation care and for safety counseling with the patient and family.</td>
<td>IIb</td>
<td>B</td>
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extremity function, balance, and mobility is used to quantify the functional consequences of the motor impairments. Accurate assessment provides prognostic information and guides the selection of motor interventions and the tailoring of these interventions to each individual.

Assessment of motor impairments and activity is critical for delivering efficient, high-quality rehabilitation services to individuals with stroke. Assessment results are used to determine who needs further services, what types of services are required, what is the most appropriate setting for those services, which interventions to select, how to tailor the interventions to individual patients, and whether the rehabilitation services are achieving the desired outcomes. When standardized assessments are implemented within and across facilities, measures that are familiar and clinician friendly and meet the clinical needs of the service are generally implemented most easily.

Technology to objectively measure real-world activity has been emerging over the past decades. Alternatively, clinicians have relied on self-report measures to gain insight into what a person is doing in daily life. The assumption that clinic performance is equivalent to outside-of-clinic performance may not be true. Whereas patient-reported outcomes allow a more patient-centered approach, some self-report measures are prone to reporting biases. Commercially available devices to measure movement when people are outside the rehabilitation clinic are now readily available and becoming more user friendly. These devices include wrist-worn accelerometers, ankle-worn accelerometers, step-activity monitors, and the more economical alternative, pedometers. Recording movements allow the clinician to measure the quantity and sometimes the types of movements occurring in everyday life.

### Assessment of Communication Impairment

Communication is a vital aspect of daily functioning, and stroke frequently results in communication impairment. One million people in the United States are estimated to haveaphasia, commonly as a result of stroke. Communication impairment can negatively affect participation in life activities immediately after the stroke and can result in long-term deficits. It is important to identify problems early with a thorough and holistic assessment. It is equally important to identify strengths and compensatory strategies that can enable the patient to maximize independence and to reenter life activities with as much competency and confidence as possible.

In recent years, more attention has been given to incorporating the ICF framework and principles into the assessment of communication. Communication is required for most daily activities, so everyday life can be significantly affected by impairment. In previous years, assessment focused on disability; now attention is focused on maximizing quality of life and participating in daily activities. Additionally, caregivers are increasingly included in the evaluation process because their skill and attitude have a significant impact on creating successful communication exchanges.

Telerehabilitation is becoming an accepted alternative to face-to-face communication assessment for people with communication impairment; however, telerehabilitation requires adequate technology. Multiple studies have demonstrated that telepractice for communication assessment is feasible and effective.

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<tr>
<th>Recommendations: Assessment of Motor Impairment, Activity, and Mobility</th>
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<tr>
<td><strong>Motor impairment assessments (paresthesia/muscle strength, tone, individuated finger movements, coordination) with standardized tools may be useful.</strong></td>
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<tr>
<td><strong>Upper extremity activity/function assessment with a standardized tool may be useful.</strong></td>
</tr>
<tr>
<td><strong>Balance assessment with a standardized tool may be useful.</strong></td>
</tr>
<tr>
<td><strong>Mobility assessment with a standardized tool may be useful.</strong></td>
</tr>
<tr>
<td><strong>The use of standardized questionnaires to assess stroke survivor perception of motor impairments, activity limitations, and participation may be considered.</strong></td>
</tr>
<tr>
<td><strong>The use of technology (accelerometers, step-activity monitors, pedometers) as an objective means of assessing real-world activity and participation may be considered.</strong></td>
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<tr>
<td><strong>Periodic assessments with the same standardized tools to document progress in rehabilitation may be useful.</strong></td>
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<th><strong>Assessment of Communication Impairment</strong></th>
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<tr>
<td><strong>Communication assessment should consist of interview, conversation, observation, standardized tests, or nonstandardized items; assess speech, language, cognitive-communication, pragmatics, reading, and writing; identify communicative strengths and weaknesses; and identify helpful compensatory strategies.</strong></td>
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Telerehabilitation is reasonable when face-to-face assessment is impossible or impractical.

Communication assessment may consider the individual’s unique priorities using the ICF framework, including quality of life.

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<th><strong>Assessment of Cognition and Memory</strong></th>
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| Cognitive impairment is found in a substantial portion of stroke survivors, affecting more than one third of stroke survivors at 3 and 12 months after stroke. These impairments persist in many individuals for years and are associated with poor long-term survival, higher disability, and greater institutionalization rates. Tatemichi et al found that the RR for dependent living associated with cognitive impairment was 2.4 at 3 months after stroke after adjustment for age and physical impairment. Another study found the RR of death associated with dementia 5 years after stroke was 3.11 (95% CI, 1.79–5.41) after adjustment for the effects of demographic factors, cardiac disease, severity of stroke, stroke type, and recurrent stroke. The cognitive domains most likely to be defective in patients with stroke compared with

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*References omitted for brevity.*
control subjects were memory, orientation, language, and attention. Because physical and cognitive impairments after stroke have independent prognostic implications, evaluation of both domains should be routine in the clinical care of stroke patients. Prospective studies have shown that cognitive status is an important determinant of poststroke success. The Neurobehavioral Cognitive Status Examination is a brief screening tool that assesses cognition in the ability areas of language, constructions, memory, calculation, and reasoning. A small prospective study found that the Neurobehavioral Cognitive Status Examination both provides a rapid and sensitive measure of cognitive function and appears to predict functional status change as a result of inpatient stroke rehabilitation. A formal neuropsychological examination (including assessment of language, neglect, praxis, memory, emotional responses, and specific cognitive syndromes) may be helpful after the detection of cognitive impairment with a screening instrument. Neuropsychological protocols must be sensitive to a wide range of abilities, especially the assessment of executive and attentional functions. Brief mental status scales inadequately assess executive skills and other higher-level cognitive functions. Specific areas that should be included in this type of assessment include the following:

- Processing speed
- Simple attention and complex attention ("working memory")
- Receptive, expressive, and repetition language abilities
- Praxis (performing skilled actions such as using a tool)
- Perceptual and constructional visual-spatial abilities, including issues related to visual fields and neglect
- Memory, including language-based memory and visual-spatial memory, and differentiating learning, recall, recognition, and forced-choice memory
- Executive functioning, including awareness of strengths and weaknesses, organization and prioritization of tasks, task maintenance and switching, reasoning and problem solving, error awareness and safety judgment, and emotional regulation

**Recommendations: Assessment of Cognition and Memory**

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<th>Recommendations: Assessment of Cognition and Memory</th>
<th>Class</th>
<th>Level of Evidence</th>
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<tr>
<td>Screening for cognitive deficits is recommended for all stroke patients before discharge home.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>When screening reveals cognitive deficits, a more detailed neuropsychological evaluation to identify areas of cognitive strength and weakness may be beneficial.</td>
<td>IIA</td>
<td>C</td>
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**Sensory Impairments, Including Touch, Vision and Hearing**

Stroke may result in a variety of different types of sensory impairment such as loss of vision, touch, proprioception, hearing, and others. Sensory impairments are often assessed through physical examination, although methods exist for more precise measurement of certain sensory deficits such as automated perimetry for visual field loss or audiometry for hearing loss. Although these are not routinely used, such testing may be useful when a detailed understanding of sensory impairment is needed.

Various forms of sensory deficit are commonly seen after stroke. For example, somatosensory deficits are present in 45% to 80% of patients, and visual field loss occurs in roughly 30% (estimates range from 15% to 52%) of patients. The high degree of connectivity in the human brain not only results in loss of function directly in the affected sensory modality but also affects complex behaviors that require distributed multimodal processing such as fine motor control. As a result, sensory impairments are directly linked to activity limitations and participation restrictions after stroke and can improve with therapeutic intervention, particularly those based on multimodal interventions such as virtual reality and augmented reality.

**Somatosensory Impairments**

Somatosensory impairments include tactile, pain, temperature, pressure, vibration, proprioception, stereognosis, and graphesthesia. Tactile deficits may be the most common form of sensory deficit after stroke. In the months after a stroke, patients show substantial but variable somatosensory recovery, especially for proprioception. Studies of experimental stroke in primates and rats describe the neurobiological basis of sensory recovery after stroke, with overall similar findings in human subjects scanned with functional magnetic resonance imaging. Assessment of sensory deficits remains largely a matter of bedside examination; however, sensory scales are under study, and new devices can quantify deficits.

**Visual Impairments**

The most common visual impairment after stroke is visual field loss, affecting 30% of stroke survivors. Vision plays a central role in many human functions, so a reduction in vision can affect many roles, quality of life, motivation, and social behaviors. Although assessment of visual field loss is most often obtained with confrontation methods at the bedside, automated perimetry methods are more sensitive and precise and thus may be preferred in settings where such clarity is deemed important such as evaluation for driving. Some degree of spontaneous restoration of visual fields generally occurs after stroke. However, the percentage of patients who achieve significant recovery is uncertain, with estimates ranging from 7% to 85%, and the degree of recovery is variable. As with many features of spontaneous behavioral recovery after stroke, gains are highest early after the injury, with the maximum period of spontaneous recovery of visual fields being reported to be in the first 2 to 10 days, the first month, or the first 3 months. Numerous other forms of visual impairment may be seen after stroke such as abnormal eye movements, reduced visual acuity, diplopia, impaired color vision, difficulty with reading, and deficits in higher-order visual processing.

**Hearing Impairments**

Stroke can also result in acute hearing loss. This may be present in as many as 21% of patients with posterior circulation ischemia, often resulting from ischemia in the distribution of the anterior inferior cerebellar artery, and in most cases is attributable to infarction in the inner ear. As a result, stroke-related hearing loss is usually accompanied by vertigo and often with additional deficits related to brainstem/cerebellar infarction. Audiometry
is more sensitive than bedside assessment of hearing loss. Neurootologic testing may provide insights by characterizing and measuring associated forms of vestibular dysfunction. Most patients show partial or complete recovery by 1 year after stroke.388

<table>
<thead>
<tr>
<th>Recommendation: Sensory Impairments, Including Touch, Vision, and Hearing</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluation of stroke patients for sensory impairments, including touch, vision, and hearing, is probably indicated.</td>
<td>IIa</td>
<td>B</td>
</tr>
</tbody>
</table>

Sensorimotor Impairments and Activities

Dysphagia Screening, Management, and Nutritional Support

Dysphagia is common after stroke, affecting 42% to 67% of patients within 3 days after stroke. Of these patients, about half aspirate, and one third of those patients develop pneumonia.389 Dysphagia or aspiration can lead to pneumonia, malnutrition, dehydration, weight loss, and overall decreased quality of life. Aspiration may be “silent” or “occult” and not clinically obvious. Early identification through screening can reduce the risk of developing these adverse health consequences.389 Additionally, observational studies suggest that dysphagia screening reduces the risk of pneumonia.390

A systematic review of 8 studies demonstrated that the odds of being malnourished were increased if dysphagia was present after stroke.391 Despite the potential consequences of dysphagia, a review of nursing nutritional care concluded that a functional, supportive, and educational nursing nutritional role was essential, but little evidence was of sufficient quality to support policy and practice development or to inform education.392

In 2012, a group of dysphagia experts came to the consensus that early dysphagia screening should be conducted and that although no one screening tool can be recommended, a valid tool should be used.393 Additional systematic reviews and studies also support early screening for dysphagia. However, because dysphagia screening has not been well standardized and its utility has not been established rigorously in RCTs, it has been removed from The Joint Commission performance standards and from Get With The Guidelines–Stroke performance measures. Nonetheless, it remains an important component of clinical care. Therefore, we include the same recommendation that appears in the most recent “Guidelines for the Early Management of Patients With Acute Ischemic Stroke.”394

Once dysphagia or aspiration risk has been identified, a clinical bedside evaluation can provide valuable diagnostic information about the swallow mechanism and how to proceed with managing the patient. However, a bedside evaluation alone cannot predict the presence or absence of aspiration because patients can aspirate without overt clinical signs or symptoms.395

Instrumental evaluation (videofluoroscopy, fiberoptic endoscopic evaluation of swallowing, or fiberoptic endoscopic evaluation of swallowing with sensory testing) allows the clinician to visualize swallow physiology, thus determining the presence or absence of aspiration, the quantity of aspiration, and the physiological or structural causes for dysphagia. This information is necessary for forming an appropriate and effective treatment plan, which can include swallowing therapy and diet recommendations.396–398 There is no consensus in the literature on a preferred instrumental study. Both videofluoroscopy and fiberoptic endoscopic evaluation of swallowing can be used to evaluate the swallow mechanism.

Additionally, a large cohort study was completed, showing that fiberoptic endoscopic evaluation of swallowing with sensory testing is a relatively safe procedure for evaluating the sensory and motor aspects of dysphagia. Clinical judgment should be used to weigh the advantages and disadvantages of each study for each individual patient.399

Multiple systematic reviews showed that behavioral interventions, including “swallowing exercises, environmental modifications such as upright positioning for feeding, safe swallowing advice, and appropriate dietary modifications,”400 should be considered for the management and treatment of dysphagia.400,401 A group of dysphagia and swallowing rehabilitation experts reviewed 10 principles of neural plasticity and discussed how they should be incorporated into dysphagia rehabilitation strategies and interventions to promote evidence-based practice.402 Other therapies considered in systematic reviews, including drug therapy, NMES, pharyngeal electric stimulation, physical stimulation, transcranial direct current stimulation (tDCS), and transcranial magnetic stimulation, have no conclusive evidence supporting their use in dysphagia treatment.400 Additionally, acupuncture may be a beneficial alternative treatment of dysphagia.403 Cohort studies have shown that oral hygiene protocols may help reduce aspiration pneumonia after stroke.404,405

Recently, there have been a series of clinical trials called the Feed or Ordinary Diet (FOOD) trials, which are large, well-designed RCTs that address when and how to feed patients after stroke.406–408 As a result of underrecruitment, definitive conclusions cannot be made; however, these studies and a Cochrane review offer much information.

Nutritional supplements are recommended only for patients with malnutrition or those at risk of malnutrition. Routine oral nutritional supplements are not associated with improved functional outcome at 6 months after stroke. This clinical trial has found that few participants (8%) were malnourished at baseline and that supplements may contribute to hyperglycemia if the patient is not malnourished.409

Early tube feeding (started within 7 days) may increase the survival of dysphagic patients who cannot safely eat by mouth; however, this may keep patients alive “in a severely disabled state when they otherwise would have died.”407 Therefore, to reduce case fatality, providers should initiate early tube feeds; however, they can wait up to 7 days after a stroke to initiate tube feeds, especially when conversations about the goals of care are needed. Tube feeds via nasogastric route are reasonable for the first 2 to 3 weeks after stroke unless there is a strong reason to opt for percutaneous endoscopic gastrostomy placement (eg, cannot pass a nasogastric tube).407
Early percutaneous endoscopic gastrostomy placement is not supported for stroke patients. After this time period, percutaneous endoscopic gastrostomy placement is recommended because it is associated with fewer treatment failures, higher feed delivery, and improved albumin concentration.

### Nondrug Therapies for Cognitive Impairment, Including Memory

Impairments in multiple domains of cognition, including attention, processing speed, executive function, verbal and visual memory, language, and perception, occur frequently after stroke. Stroke doubles an individual’s risk for dementia (including Alzheimer disease). Cognitive rehabilitation has been the traditional nonpharmacological method to treat cognitive impairment and has been defined as a “systematic, functionally-oriented service of therapeutic cognitive activities, based on an assessment and understanding of the person’s brain-behavior deficits.” These treatments are directed at the restoration or reestablishment of cognitive activity, the acquisition of strategies to compensate for impaired cognitive function, and the use of adaptive technique or equipment for increasing independence. Few studies have assessed interventions for cognitive deficits in the IRF environment. An RCT (n=83 at >4 months after stroke) compared a multicomponent cognitive therapy and graded activity training with cognitive therapy alone over 12 weeks and demonstrated that the multicomponent therapy exceeded the cognitive therapy in fatigue reduction and improved physical endurance. A systematic review published in 2011 of cognitive rehabilitation in stroke that searched guidelines in stroke management, other systematic reviews, and clinical RCTs concluded that compensatory strategies can be used to improve memory outcomes. However, use of an external memory aid is in itself a memory task, so those with the greatest need also have the greatest problems using them. One solution to this problem has been the development of a paging system whereby a paging service with a customized set of reminders and appropriate date and time sends out reminders to the individual pager that is carried by the person who needs to be reminded. Recently, this idea has been modernized by the use of text message reminders to one’s mobile device. The use of a paging system can significantly reduce everyday failures of memory and planning in stroke survivors. However, there was not enough evidence from RCTs to determine whether cognitive rehabilitation for memory problems after stroke is helpful.

Recently, attention has focused on the application of physical activity and exercise to improve cognitive function after stroke. Meta-analysis suggests that physical activity has a protective effect against cognitive decline and may improve cognitive function in older adults without cognitive impairment. A number of mechanisms have been suggested to explain the effects of exercise on cognition after stroke, including the increase in cerebral blood volume, increased expression of growth factors such as brain-derived neurotrophic factor, and a positive effect on depressive symptoms, which may mediate an improvement in cognitive performance.

In animal models, a stimulating and enriched environment has been shown to improve neurobehavioral function and learning after stroke. Although it is not yet known exactly what type of environment might provide optimal stimulation for a person who has had a stroke, it has been suggested that the setting should be conducive to participating in physical activity and cognitive and social activities.

### Recommendations: Dysphagia Screening, Management, and Nutritional Support

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early dysphagia screening is recommended for acute stroke patients to identify dysphagia or aspiration, which can lead to pneumonia, malnutrition, dehydration, and other complications.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Dysphagia screening is reasonable by a speech-language pathologist or other trained healthcare provider.</td>
<td>Ia</td>
<td>C</td>
</tr>
<tr>
<td>Assessment of swallowing before the patient begins eating, drinking, or receiving oral medications is recommended.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>An instrumental evaluation is probably indicated for those patients suspected of aspiration to verify the presence/absence of aspiration and to determine the physiological reasons for the dysphagia to guide the treatment plan.</td>
<td>Ia</td>
<td>B</td>
</tr>
<tr>
<td>Selection of instrumental study (fiberoptic endoscopic evaluation of swallowing, videofluoroscopy, fiberoptic endoscopic evaluation of swallowing with sensory testing) may be based on availability or other considerations.</td>
<td>Iib</td>
<td>C</td>
</tr>
<tr>
<td>Oral hygiene protocols should be implemented to reduce the risk of aspiration pneumonia after stroke.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Enteral feedings (tube feedings) should be initiated within 7 days after stroke for patients who cannot safely swallow.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Nasogastric tube feeding should be used for short term (2–3 weeks) nutritional support for patients who cannot swallow safely.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Percutaneous gastrostomy tubes should be placed in patients with chronic inability to swallow safely.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Nutritional supplements are reasonable to consider for patients who are malnourished or at risk of malnourishment.</td>
<td>Ila</td>
<td>B</td>
</tr>
<tr>
<td>Incorporating principles of neuroplasticity into dysphagia rehabilitation strategies/interventions is reasonable.</td>
<td>Ila</td>
<td>C</td>
</tr>
<tr>
<td>Behavioral interventions may be considered as a component of dysphagia treatment.</td>
<td>Iib</td>
<td>A</td>
</tr>
<tr>
<td>Acupuncture may be considered as an adjunctive treatment for dysphagia.</td>
<td>Iib</td>
<td>B</td>
</tr>
<tr>
<td>Drug therapy, NMES, pharyngeal electrical stimulation, physical stimulation, tDCS, and transcranial magnetic stimulation are of uncertain benefit and not currently recommended.</td>
<td>III</td>
<td>A</td>
</tr>
</tbody>
</table>
Cognitive Rehabilitation

Systematic reviews that include people with both traumatic brain injury and stroke are generally more positive on the benefits of cognitive rehabilitation than those involving people with stroke alone. This may be due in part to the smaller number of stroke-only studies and the confounding factors of age and vascular involvement with stroke. A Cochrane review of RCTs found a benefit of cognitive rehabilitation after stroke on some aspects of attention deficits at the end of the treatment period. All aspects of attention were similarly affected; attention training had a positive effect on divided attention immediately after the intervention (4 studies) but no effect on selective attention (6 studies), alertness (4 studies), or sustained attention (4 studies). Two cognitive rehabilitation RCTs found improvements in subjective measures of attention and mental slowness after stroke immediately after treatment and at follow-up.

The European Federation of Neurological Societies guidelines on cognitive rehabilitation summarized a number of publications related to memory rehabilitation interventions without external memory aids, rehabilitation interventions with nonelectronic external memory aids, and rehabilitation interventions with assistive electronic technologies (the specific number of studies identified and reviewed was not given). They concluded the following:

- That memory strategies without electronic aids are possibly effective (Level C recommendation)
- That specific learning strategies such as errorless learning are probably effective (Level B recommendation)
- That nonelectronic external memory aids such as diary or notebook keeping are possibly effective (Level C recommendation)
- That electronic external memory devices such as computers, paging systems, and portable voice organizers are probably effective (Level B recommendation)
- That the use of virtual environments has shown positive effects on verbal, visual, and spatial learning and that memory training in virtual environments is rated as possibly effective (Level C recommendation)
- That a direct comparison of memory training in virtual environments versus nonvirtual environments is still lacking and no recommendation can be made as to the specificity of the technique

An updated review of the literature (2003–2008) concluded that (1) for individuals with mild memory impairments, memory strategy training, including the use of internalized strategies (eg, visual imagery) and external memory compensations (eg, notebooks), is recommended as a practice standard; (2) for individuals with severe memory deficits, the use of external compensations, including assistive technology, with direct application to functional activities is recommended as a practice guideline; and (3) for individuals with severe memory impairments, errorless learning techniques may be effective for learning specific skills or knowledge, although with limited transfer to novel tasks or reduction in overall functional memory problems.

However, a recent Cochrane meta-analysis with 13 cognitive rehabilitation RCTs reported no benefit to executive functioning after stroke, whereas other systematic reviews using a broader range of evidence have suggested some limited evidence. Current studies are small and have highly varied content, making comparisons difficult. Notably, an RCT delivered strategies focused on problem solving by 3 methods (face to face, online, and computer training) and found that although all improved problem-solving and IADL abilities, the face-to-face training group resulted in the most improvement in problem-solving self-efficacy. Another RCT found that using a pager was effective in increasing goal attainment (ie, medication and appointments) but that stroke participants’ performance returned to baseline levels when the pager was discontinued. In contrast, specific aspects of memory (eg, visual-spatial recall, subjective memory experience, verbal and prospective memory, working memory, and attention) have been shown to improve after stroke in 6 different controlled trials that used very diverse cognitive training strategies.

A systematic review of the literature (1995–2011) focused specifically on information and communication technology tools for individuals with acquired brain injury, including stroke. reviewed 5 studies that addressed memory problems. The quality of the studies was so low that it was not possible to determine whether the tools were beneficial.

Only 2 studies have examined the effects of tDCS on attention in stroke patients. The first study found that anodal tDCS over the left dorsolateral prefrontal cortex was associated with enhanced complex attention (working memory) performance. The second study found that noninvasive anodal tDCS applied to the left dorsolateral prefrontal cortex improved attention compared with sham stimulation. Although improved attention may result in improved memory because people are better able to initially register information, neither addressed whether the performance benefits resulted in improved memory learning and retention.

In summary, most cognitive rehabilitation programs use a variety of activities, including practice requiring attention, planning or working memory with pencil and paper or computerized activities, and teaching of compensatory strategies. Although a growing number of RCTs have addressed immediate effects on standardized psychobehavioral tests, few studies have assessed the durability of treatment effects or relevance to everyday functioning.

Exercise

Cumming et al performed a systematic review through 2011 and found 12 RCTs and controlled, clinical trials that studied the effects of a physical activity or exercise-based intervention on cognitive function in stroke. They concluded that there are reasonably consistent and relatively small positive effects of exercise on cognition, with some studies finding specific positive effects on memory. However, the pool of studies identified was small, and methodological shortcomings were widespread.

Because most studies measured cognition or memory as a secondary outcome, there was a wide range of baseline cognitive abilities, including those without cognitive impairment. The dose and content of the exercise protocols have
been highly diverse, preventing recommendations on the optimal intensity or timing. Although no longitudinal exercise or physical activity studies have been undertaken to prevent cognitive impairment or dementia after stroke, it would seem reasonable to extend the results of studies in older adults that suggest a protective effect of exercise on cognitive decline.

### Enriched Environment

An RCT that modified the stroke rehabilitation environment with the provision of a computer with Internet, books, games, virtual reality gaming technology, and encouragement from staff to use the activities increased the engagement of patients with cognitive activities and reduced time spent inactive and alone. Särkämö et al performed a single-blind RCT to determine whether listening to music everyday can facilitate the recovery of cognitive functions after stroke. Two months of daily listening (95 minutes daily) to self-selected music after acute stroke improved verbal memory, focused attention, and depressive symptoms compared with listening to an audio book or not listening to music.

Four weeks of playing virtual reality games for 30-minute sessions 3 times weekly improved visual attention and short-term visuospatial memory in a very small RCT of patients early after stroke. These games required primarily paretic arm movements (eg, raise a hand to stop soccer balls from entering the goal).

#### Use of Drugs to Improve Cognitive Impairments, Including Attention

Several medications are used to treat general cognitive disorders, but little literature addresses their use for poststroke cognitive deficits. Dextromethamphetamine has been studied for poststroke motor recovery, but no studies have substantiated its use for cognitive disorders. Although the effect of methylphenidate in 1 small trial might rely partly on an improvement in attention and effort through cingulum modulation, no studies have assessed its use in cognitive rehabilitation after stroke. Modafinil has been studied for the treatment of poststroke depression and fatigue but not cognitive recovery. Atomoxetine also has been studied for the treatment of poststroke depression but not cognitive deficits.

Donepezil has been studied in a small, randomized, clinical trial. Ten right-hemispheric stroke survivors were randomized to receive either 5 mg donepezil or placebo. The donepezil group demonstrated significant improvements on the Mini-Mental Status Examination 1 month after completion of treatment, and functional magnetic resonance imaging showed increased activation in both prefrontal areas, both inferior frontal lobes, and the left inferior parietal lobe.

A pilot study randomized 50 subjects to receive either rivastigmine or placebo. Subjects receiving rivastigmine demonstrated statistically significant improvement (1.70 versus 0.13; \( P=0.02 \)) on the animal subtask of the verbal fluency measure compared with those on placebo, but a non-significant trend toward improvement was observed in the Color Trails II test, described as a culture-fair test of visual attention, graphomotor sequencing, and effortful executive processing abilities.

A study of 47 subjects at least 6 months after stroke were randomized to receive fluoxetine, nortriptyline, or placebo. Although no significant group effect was found at the end of treatment, the placebo group exhibited deterioration in executive functioning 21 months after treatment, whereas the groups who received fluoxetine or nortriptyline significantly improved, independently of depressive symptoms (\( F=12.1 \) \( df=1, 45; P=0.001 \)). The improvement was attributed to possible reorganization of neuronal networks associated with prefrontal functions based on modulation of monoaminergic neurotransmission and the activity of neurotrophins.
Limb Apraxia

Limb apraxia is “a decrease or difficulty in performing purposeful, skilled movements” that cannot be attributed to hemiplegia or lack of effort.\(^{451}\) It is more common after left hemispheric than right hemispheric stroke.\(^{452}\) Although not traditionally believed to affect daily life function,\(^{453,454}\) there is now evidence that apraxia is associated with reduced independence in daily life activities.\(^{455-457}\) Despite its incidence and its impact on independent functioning, there is a paucity of research on therapeutic interventions for limb apraxia. Several systematic reviews have been conducted since 2005,\(^{458-461}\) reviewing 5 small RCTs across the 4 reviews. Since these reviews, no additional RCTs and only 1 case study have been published.\(^{462}\) Two reviews concluded that there was not enough information to determine whether interventions for apraxia were efficacious.\(^{458,459}\) Some studies have found immediate postintervention improvements on apraxia tests or in daily life activities, but few have found lasting advantages for the trained groups.\(^{459}\)

<table>
<thead>
<tr>
<th>Recommendations: Use of Drugs to Improve Cognitive Impairments, Including Attention</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>The usefulness of donepezil in the treatment of poststroke cognitive deficits is not well established.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>The usefulness of rivastigmine in the treatment of poststroke cognitive deficits is not well established.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>The usefulness of antidepressants in the treatment of poststroke cognitive deficits is not well established.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>The usefulness of dextroamphetamine, methylphenidate, modafinil, and atomoxetine in the treatment of poststroke cognitive deficits is unclear.</td>
<td>IIb</td>
<td>C</td>
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</table>

**Recommendations: Limb Apraxia**

| Strategy training or gesture training for apraxia may be considered. | IIb | B |
| Task practice for apraxia with and without mental rehearsal may be considered. | IIb | C |

Hemispatial Neglect or Hemi-Inattention

Hemispatial neglect, also called hemiagnosia, hemineglect, unilateral neglect, spatial neglect, contralateral neglect, unilateral visual inattention, hemi-inattention, neglect syndrome, or contralateral hemispatialagnosia, is a neuropsychological condition in which, after damage to a part of 1 hemisphere of the brain is sustained, a deficit in attention to and awareness of 1 side of space is observed. These symptoms are not attributable to a primary sensory (eg, visual) or motor deficit; they are typically contralateral to the lesion. Hemispatial neglect is common after stroke\(^{463}\) and significantly impairs the ability to participate effectively in rehabilitation.\(^{464}\) Although neglect improves over time, neglect symptoms continue to interfere with daily functioning long after stroke.\(^{465-467}\) The interventions developed for neglect fall into 2 general categories: bottom-up approaches, designed to remediate attention processes for the left hemispace and internal representations of space, and top-down approaches, aimed at teaching the person strategies for compensating for neglect.\(^{468}\) Most studies of neglect have been plagued by low-quality methods and small sample sizes.

Three systematic reviews have been completed since 2005,\(^{468-470}\) reviewing 24 unique randomized, clinical trials and 14 additional studies with weaker designs. The interventions studied and outcome measures varied widely in these reviews. Fifteen additional RCTs investigating neglect were found that were not included in those reviews (prism adaptation, 2; virtual reality, 2; limb activation, 2; neck vibration with prism adaptation, 1; visual scanning with limb activation, 1; mental practice, 1; repetitive transcranial magnetic stimulation, 4; and optokinetic stimulation, 2).\(^{471-483}\) There is evidence for the efficacy of several top-down and bottom-up approaches in improving both immediate performance and long-term performance on standard neglect tests such as cancellation tests and line bisection tests.\(^*\) These include half-field eye patching, visual scanning training, prism adaptation, limb activation, optokinetic stimulation, mental imagery (but see the work by Welfringer and colleagues\(^{482}\)), and brain stimulation with repetitive transcranial magnetic stimulation, theta burst transcranial magnetic stimulation, or tDCS. Two randomized, clinical trials of eye patching for unilateral neglect in 35 subjects\(^{487}\) and 60 subjects\(^{488}\) did not demonstrate any significant functional improvement. None of these treatments resulted in improvement on all neglect tests.

Few studies have examined the efficacy of these interventions on daily life functioning. Several have used the behavioral tests from the Behavioral Inattention Test\(^{490}\) or the Baking Tray Test,\(^{499}\) which are simulated real-life activities. Some studies have examined functional outcomes with the Catherine Bergego Scale,\(^{491}\) which measures neglect symptoms during everyday activities or paragraph reading tasks. Others have used the less sensitive, general tests of functioning in ADLs such as the Barthel Index\(^{330}\) and the FIM.\(^{492}\) There is limited evidence to date that these interventions increase daily life functioning, even when performance on neglect tests has improved,\(^{468,470}\) although some individual RCTs have found positive results on daily function.\(^{469,471,472,481,484}\)

Cognitive rehabilitation may have immediate benefits on tests of neglect, as supported by a meta-analysis of 23 RCTs, but it is uncertain whether disability associated with neglect was altered.\(^{410}\) Finally, a meta-analysis\(^{495}\) found that compensatory scanning training improved reading and visual scanning in people with visual field defects (and possibly coexisting visual neglect).

It is important to note that in many of the studies, the target intervention was provided in addition to regular therapy or scanning training. Therefore, there is not sufficient evidence to ascertain whether neglect interventions are effective when provided in isolation. In addition, several issues in understanding how to treat neglect exist. These include understanding the heterogeneous response to treatment across clients, the heterogeneous response to treatment across measured tasks, the parameters of treatment (dosing, type of practice activity during or after treatment), and the relative efficacy of the various interventions, either alone or in combination.

\(^*\)References 469–471, 473, 475, 476, 478, 480, 481, 484–486
Communication Disorders

Disorders of communication and related cognitive impairments are common after stroke and include aphasia, cognitive-communication disorders, dysarthria, and apraxia of speech. Communication disorders may affect speaking, listening, reading, writing, gestures, and pragmatics. The presence of a communication disorder may negatively affect social participation, psychosocial well-being, and quality of life.

A certified speech and language pathologist normally performs the evaluation and treatment of communication disorders. The overall goals of speech and language treatment are to facilitate the recovery of communication, to assist patients in developing strategies to compensate for communication disorders, and to counsel and educate people in the patient’s environment on assistive communication supports to facilitate communication, to decrease isolation, and to meet the patient’s wants and needs. Compensatory and assistive communication supports may range from low-tech strategies such as paper/pencil and communication boards/books to high-tech devices that include smart phones and speech-generating devices.

Cognitive-Communication Disorders

There is great diversity in the presentation of cognitive-communication problems after stroke. A systematic review of cognitive-communication disorders after right hemispheric stroke suggested that many individuals at both the chronic and acute phases of recovery benefit from sentence- or discourse-level communication treatments.

Several reviews summarize research evidence for treatments of attention, visual neglect, memory training, and other cognitive treatments for individuals with acquired brain injuries, including right hemispheric stroke. Although RCTs are lacking, a systematic review concludes that there is now sufficient information to support evidence-based protocols to implement empirically supported treatments for cognitive and communication disability after stroke. The Nondrug Therapies for Cognitive Impairment, Including Memory section above provides more information on nonpharmacological treatments for cognitive disorders after stroke.

Aphasia

An RCT indicated that daily aphasia therapy in very early stroke recovery (starting at 3 days) improved communication outcomes in people with moderate to severe aphasia. One systematic review of treatment in patients at >6 months after stroke concluded that aphasia therapy continued to be efficacious in the chronic stages, whereas another concluded that there was no significant relationship between time after onset and response to treatment. Insufficient evidence exists to know when treatment should start or how long it should continue.

Several systematic reviews have indicated that intensive treatment is favored, but there is no consensus on the optimum amount, intensity, distribution, or duration of treatment. For subacute aphasia, 1 RCT has shown that a short duration (3 weeks) of intensive therapy is efficacious, whereas another RCT indicated that intensive treatment over a longer duration (12 weeks) may not always be feasible. Therefore, intensive therapy should be provided as tolerated and feasible.

A variety of different treatment approaches for aphasia have been developed. Small-group and single-subject studies support their efficacy. A systematic review of RCTs of aphasia treatment stated that no conclusions can be made about the effectiveness of one treatment over another.

Three RCTs evaluated computer-based therapy, with 1 RCT comparing it with no treatment, 1 comparing it with the same treatment provided by a speech and language therapist, and the third comparing it with the same amount of nonlinguistic computer training. These 3 trials concluded that computer-based therapy is feasible and efficacious. Therefore, computerized treatment is beneficial and can be used to supplement treatment provided by a speech-language pathologist.

A systematic review concluded that communication partner training is effective in improving communication activities or the participation of the communication partner. It is also probably effective in improving communication activities or the participation of individuals with chronic aphasia when they are interacting with trained communication partners. Communication partners may include family members and caregivers, healthcare professionals, and others in the community or organization. Further studies are needed to examine the impact of communication partner training with individuals with acute aphasia.

Two systematic reviews have addressed group therapy. Group treatments for people with aphasia occur across the continuum of care. Overall, results indicate that group participation can improve specific linguistic processes with no significant difference in outcomes between individual one-on-one therapy and group therapy. There is also some evidence that outpatient and community-based group participation can benefit social networks and community access.

Several small RCTs have shown that drug therapy appears to be beneficial in conjunction with SLT, whereas other studies have failed to show a benefit. Drugs showing promise include donepezil, memantine, and galantamine. Bromocriptine and piracetam do not appear beneficial. More extensive studies of pharmacotherapy for aphasia are needed before the routine use of any medication can be
recommended. Further research on the dose and timing of administration is needed.

Brain stimulation techniques, including epidural cortical stimulation, repetitive transcranial magnetic stimulation, and rTDCS, have been used to modulate cortical excitability during poststroke language recovery. Small studies have shown therapeutic benefits when brain stimulation techniques are used, typically in combination with behavioral language therapy. Most studies are small-group or single-subject studies and have been conducted in patients with chronic aphasia. Two RCTs investigating repetitive transcranial magnetic stimulation in acute and subacute aphasia found mixed results. Brain stimulation combined with speech language therapy may benefit selected patients, but more information on the site of stimulation and stimulation parameters is needed before it can be used in routine clinical practice.

### Motor Speech Disorders: Dysarthria and Apraxia of Speech

Dysarthria is a collective term for a group of speech disorders that result from paralysis, weakness, or incoordination of the speech musculature after neurological damage. Dysarthria can affect, singly or in combination, any of the subsystems underlying speech production: the respiratory, laryngeal, velopharyngeal, and oral-articulatory subsystems. It is estimated that 20% of stroke patients present with dysarthria, although the type of dysarthria and its specific characteristics vary, depending on factors such as lesion site and severity.

Apraxia of speech is a disorder of motor planning or programming resulting in difficulty in volitionally producing the correct sounds of speech. In addition to articulatory disturbances, prosodic deficits such as slow rate of speech and restricted variations in pitch and loudness may be present. Apraxia of speech typically co-occurs with nonfluent aphasia, and the existence of a pure apraxia of speech without aphasia is debatable.

Motor speech disorders affect the intelligibility, naturalness, and efficiency of communication. The presence of a motor speech disorder may negatively affect social participation, psychosocial well-being, and quality of life.

Speech and language therapists use a range of behavioral treatments to address motor speech disorders in individuals after stroke. Behavioral treatments for motor speech disorders are diverse in their focus and theoretical underpinnings and should be tailored to the individual’s unique strengths, deficits, goals, priorities, and circumstances. Behavioral treatments may focus on improving the physiological support for speech and target impairments in respiration, phonation, articulation, and resonance. Behavioral treatments may also include strategies to increase the precision of articulation, to modify the rate and loudness of speech, and to improve prosody. To date, no randomized, clinical trials have addressed the efficacy of these approaches, but small, nonrandomized group studies and carefully designed, single-subject, experimental studies have demonstrated positive results. Individuals with motor speech disorders may improve as a result of treatment, even when the condition is chronic. There is no consensus on the optimum amount, distribution, or variability of practice or the best type, frequency, and timing of treatment.

Patients with motor speech disorders may benefit from using augmentative and alternative communication devices to supplement their communication. Augmentative and alternative communication devices range from simple picture boards or spelling boards to portable amplification systems and high-tech electronic devices with eye-tracking capability. Supplemental strategies such as gesture or writing can be used to enhance communication attempts. Two systematic reviews have concluded that augmentative and alternative communication and speech supplementation techniques may be useful for individuals with motor speech disorders, when speech is insufficient to meet the individual’s communication needs.

The effects of motor speech disorders after stroke extend beyond the physiological characteristics of the impairment. Studies have shown that the resulting communication difficulties affect social participation and quality of life and that the psychosocial impact of a motor speech disorder is disproportionate to the severity of the physiological impairment.
Behavioral management of motor speech disorders includes support and counseling. Interventions addressing the broad life implications of motor speech disorders are being developed, and pilot studies are underway.534

Addressing environmental factors during rehabilitation is consistent with the ICF and warrants consideration.535–537 For individuals with motor speech disorders, this may include providing education that addresses the knowledge and attitudes of communication partners or modifying the characteristics of the physical environment such as reducing noise levels.535–537

Telerehabilitation may be used to overcome barriers of access to services.538 The quality of telerehabilitation services must be consistent with the quality of services delivered face to face.538 Studies demonstrating the feasibility of telerehabilitation in the management of dysarthria are emerging.535

<table>
<thead>
<tr>
<th>Recommendations: Motor Speech Disorders: Dysarthria and Apraxia of Speech</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interventions for motor speech disorders should be individually tailored and can include behavioral techniques and strategies that target:</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Physiological support for speech, including respiration, phonation, articulation, and resonance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global aspects of speech production such as loudness, rate, and prosody</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Augmentative and alternative communication devices and modalities should be used to supplement speech.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Telerehabilitation may be useful when face-to-face treatment is impossible or impractical.</td>
<td>Ila</td>
<td>C</td>
</tr>
<tr>
<td>Environmental modifications, including listener education, may be considered to improve communication effectiveness.</td>
<td>Iib</td>
<td>C</td>
</tr>
<tr>
<td>Activities to facilitate social participation and promote psychosocial well-being may be considered.</td>
<td>Iib</td>
<td>C</td>
</tr>
</tbody>
</table>

**Spasticity**

Spasticity, classically defined as a velocity-dependent resistance to stretch of a muscle, is a component of the upper motor neuron syndrome. Poststroke spasticity may have dystonic features, including involuntary muscle activity and limb positioning. Spasticity is correlated with activity limitations associated with hygiene, dressing, and pain. These activity limitations increase caregiver burden and reduce quality of life as measured by the EuroQol-5.539

When spasticity is present, the cost of care is 4 times higher than when spasticity is absent; however, because spasticity is strongly associated with stroke severity, the independent impact of spasticity on costs is not known.540 Thus, the cost of treating spasticity may not reduce the overall cost of stroke-related care. For example, in 1 study, the use of botulinum toxin injections for upper limb spasticity combined with therapy was not found to be cost-effective compared with therapy alone.541

The prevalence of poststroke spasticity in any limb is in the range of 25% to 43% over the first year after stroke.542–545

For patients who require acute rehabilitation after stroke, the prevalence of spasticity in any limb is 42%.546 The incidence of upper limb spasticity over the first 3 months in patients admitted to rehabilitation is 33%.9 The strongest predictor of moderate to severe spasticity (Ashworth scale score ≥2) is severe proximal and distal limb weakness on acute hospital or rehabilitation admission.540,547

The use of resting hand splints is not effective for reducing wrist and finger spasticity, and the use of such splints is controversial for the prevention of contracture in the setting of spasticity.75 For ankle plantarflexor spasticity, a short course of ankle casting may facilitate spasticity reduction after injection of botulinum toxin. Taping, however, has no effect on spasticity after lower limb botulinum toxin injection and is not recommended.548,549

NMES combined with therapy may improve spasticity, but there is insufficient evidence that the addition of NMES improves functional gait or hand use.550 Vibration applied to spastic muscle groups might be considered to reduce spasticity transiently, but it is not effective for long-term reduction of spastic hypertonia.551–553

Injection of botulinum toxin is used commonly to treat upper limb spasticity in patients with stroke and is recommended in several recent review articles and previously published guidelines as an important tool in the comprehensive management of poststroke spastic hypertonia.149,554–557 Injections of botulinum toxin A can reduce spasticity significantly as measured by the Ashworth scale. In a meta-analysis, botulinum toxin was shown to have a small but statistically significant effect on activity as measured by the Disability Assessment Scale after injection into the upper limb.558 However, improvements were attributable to the lowered resistance to muscle stretch during passive repositioning of the upper limb rather than to the actual skilled functional use of the arm and hand. Thus, there is no evidence to suggest that botulinum toxin injections will improve functional upper limb use, but it may improve limb active or passive limb positioning for activities such as dressing and hygiene.559,560

Although botulinum toxins are clinically recommended for spasticity reduction, it is not clear that they are a cost-effective means to manage spastic hypertonia compared with physical or occupational therapies alone.541 However, if a reduction in caregiver burden is taken into account, the use of botulinum toxins with therapy may be cost-effective.561 The early injection of botulinum toxins as soon as hypertonia appears may be effective in preventing later spasticity, but this needs further study.562,563

Botulinum toxins injected into the ankle plantarflexor and inverter muscles significantly reduce lower limb spasticity as measured by the Ashworth scale.564–566 Injections may also improve gait speed, although only slightly.567 Botulinum toxin injections into the rectus femoris muscle may improve tonic knee extension during the swing phase of gait in stroke, but further study is needed.568 Although botulinum toxins have been used to improve orthotic fit, no studies of this application have been reported.

Oral antispasticity agents, including baclofen, dantrolene sodium, and tizanidine, have a marginal effect on reducing generalized spasticity, but dose-limiting side effects such as tiredness and lethargy are common.569–577 Intrathecal baclofen therapy is effective in reducing generalized spastic
Balance and Ataxia

Balance depends on sensory inputs from the visual, vestibular, and somatosensory systems. These sensory inputs are integrated and used to control anticipatory and reactive motor output to postural disturbances. Balance impairment (inclusive of postural control impairment) is common after stroke because stroke can affect 1 or more of the sensory and motor networks. Impaired balance makes it difficult to safely complete ADLs, to move about the home and community, and to live independently. A large percentage of people report falling at least once in the first 6 months after stroke. People with stroke who fall are twice as likely to sustain a hip fracture compared with those who fall but do not have a stroke. Balance impairments can result in low balance confidence, which in turn may further reduce activity. If left undetected or untreated, balance impairments can result in a cascade of serious, undesirable, and expensive events.

Evaluation of balance abilities is considered part of routine clinical practice in individuals with stroke. Standardized tests of balance challenge different aspects of postural control such as anticipatory postural reactions during a variety of functional behaviors. Specific balance limitations identified during the evaluation will help determine the risk of falling and guide the selection and tailoring of balance-specific interventions.

Although balance training programs have been shown to be beneficial after stroke, no specific approach or program has been demonstrated to be superior, nor is the optimal timing clear. Balance training has been successfully implemented as group and one-on-one sessions, circuit training, and hospital- versus home- versus community-based programs. Content of the training typically includes balance-specific activities, (eg, practice responding to challenges in standing) and more general activities (eg, strengthening exercises, gait activities). Shorter, more time-intensive programs appear comparable to longer, less time-intensive programs. Progression to more challenging training activities over the course of training is important. The one type of training that has not been shown to be beneficial for balance is water-based programs.

Studies of balance training have generally been small, typically 10 to 60 subjects. Subjects typically have been able to ambulate independently (with or without an assistive device) and be relatively cognitively intact. Four systematic reviews and meta-analyses have reviewed the effects of various interventions on balance after stroke, with the latest one published in 2013. Findings across these reviews show inconsistent effects on balance outcomes. Subsequent published RCTs have tested a variety of types of balance training devices (sliding board, trunk exercises on a physioball, shoe wedge) or programs (yoga, Tai Chi, gait training, motor imagery). The later studies have similar methodological challenges (8–40 subjects per group) and lead to similar, inconsistent conclusions about the superiority of any 1 specific treatment. Likewise, a systematic review of fall prevention after stroke has shown that inconsistencies in outcome measures, intervention type, and implementation in previous research make it difficult to determine the effectiveness of fall prevention programs after stroke. The Prevention of Falls section provides more discussion.

Use of devices and orthotics (eg, cane, AFO) also improves balance. Finally, it should be noted that improving balance alone may not be sufficient for preventing falls because falls may have multiple contributing causes.

Ataxia is a disorder of coordinated muscle activity during voluntary movement associated with injury to the cerebellum, cerebellar peduncles, and brainstem cerebellar tracts. Patients with ataxia have delayed movement initiation, timing errors, abnormal limb trajectories, and dysmetria. Ataxia is present in 68% to 86% of patients with brainstem stroke. Ataxia typically improves during acute rehabilitation. Ataxia without concurrent hemiparesis has a better prognosis for functional recovery in acute rehabilitation. However, the presence of ataxia with or without weakness does not affect general functional recovery negatively. Ataxia can affect the quality of use of the functional hand negatively because patients with cerebellar lesions can have impaired motor learning (eg, reduced skill improvement on a pursuit rotor task or ability to learn a finger sequence). Despite this, case studies indicate that intensive task-oriented therapy may improve motor performance and actual use of ataxic limbs in patients with stroke-related ataxia.
After participating in a task-oriented training program, patients improved reaching speed and had reduced trunk motion during reaching. \(^6^{13}\) Stoykov and others \(^6^{06}\) noted that postural training and provision of trunk support could have a positive impact on upper limb control and dexterity in a patient with upper limb ataxia. There is a paucity of research on rehabilitation approaches to limb ataxia, but at present, postural training and task-oriented upper limb training are recommended.

<table>
<thead>
<tr>
<th>Recommendations: Balance and Ataxia</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals with stroke who have poor balance, low balance confidence, and fear of falls or are at risk for falls should be provided with a balance training program.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Individuals with stroke should be prescribed and fit with an assistive device or orthosis if appropriate to improve balance.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>Individuals with stroke should be evaluated for balance, balance confidence, and fall risk.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Postural training and task-oriented therapy may be considered for rehabilitation of ataxia.</td>
<td>IIb</td>
<td>C</td>
</tr>
</tbody>
</table>

**Mobility**

The loss or difficulty with ambulation is one of the most devastating sequelae of stroke, and restoration of gait is often one of the primary goals of rehabilitation. Gait-related activities include such tasks as mobility during rising to stand, sitting down, stair climbing, turning, transferring (eg, wheelchair to bed or bed to chair), using a wheelchair after stroke, walking quickly, and walking for specified distances. \(^6^{14}\) Limitations in gait and gait-related activities are associated with an increase in fall risk. A number of systematic reviews have demonstrated enhanced outcomes of gait, gait-related activities, and ADLs \(^6^{15}\) after intensive, repetitive task training. \(^6^{16}\)–\(^6^{18}\) The role of treadmill training and electromechanics-assisted gait training remains under study. \(^5^{19}\)

Key training parameters for improving mobility after stroke are activity-specific and functional task practice; practice that is progressively more difficult and challenging; practice that is of sufficient intensity, frequency, and duration; and practice that is at an appropriate time relative to stroke onset. \(^6^{16}\)–\(^6^{20}\) These parameters pertain to treadmill training with or without body weight support, circuit training, mobility training, and electromechanics-assisted training. \(^6^{16}\)

Dickstein \(^6^{21}\) reviewed a variety of mobility training techniques and found that gains were comparable across treatments but generally insufficient for patients to advance to a higher functional walking category on the basis of the categories defined by Perry et al. \(^2^{77}\) No benefit was seen for more complex methods such as treadmill and robotic-based interventions compared with more traditional approaches.

Circuit class therapy is a form of group treatment with exercises focused on repetitive practice of functional tasks. \(^6^{22}\)–\(^6^{24}\) A 2009 meta-analysis and recent systematic review concluded that circuit class therapy was a safe and effective method for improving mobility after stroke. \(^6^{23}\)–\(^6^{25}\)

Treadmill training in the context of task-specific training may be used with or without body weight support or therapists to assist the paretic lower extremity in stepping. A recent systematic review concluded that compared with no intervention or with an intervention with no walking component, treadmill training without body weight support improved walking speed and distance among ambulatory people after stroke. Although these benefits were maintained beyond the intervention period, it is not yet known whether treadmill training is superior to overground walking training. \(^6^{21}\)–\(^6^{26}\) Recently, it was demonstrated that treadmill training with body weight support and traditional gait training were equally effective in improving walking and transfers in patients dependent on walking assistance after stroke. \(^5^{1}\)–\(^6^{27}\) A recent systematic review, including those <3 months after stroke and unable to walk, reported that those individuals who are earlier after stroke and more severe are more likely to have a better gait recovery outcome with mechanically assisted training compared with overground training and by using a harness in conjunction with the mechanical device. Mechanically assisted walking (eg, treadmill, electromechanical gait trainer, robotic device, servo-motor) with body weight support was found to be more effective than overground walking at increasing independent walking in nonambulatory patients early after stroke. \(^6^{28}\)

**Lower Extremity Strengthening**

A 2007 review concluded that graded strength training improves the ability to generate force but does not transfer to improvements in walking. \(^6^{28}\) However, a more recent meta-analysis demonstrated that providing lower limb resistance training to community-dwelling individuals who are 6 months after stroke has the capacity to improve comfortable gait speed and total distance walked. \(^6^{29}\) Similarly, a 2008 review concluded that despite limited long-term follow-up data, there is evidence that resistance training produces increased strength, gait speed, and functional outcomes, as well as improved quality of life. \(^5^{30}\)

NMES has been used to stimulate the ankle dorsiflexors during the swing phase of the gait cycle. A recent systematic review revealed a small but significant treatment effect of NMES on gait capacity in individuals in the chronic phase after stroke. \(^6^{31}\) Similarly, a meta-analysis revealed the effectiveness of NMES at improving gait speed in subjects after stroke. \(^6^{32}\) Several RCTs have observed improved recovery of gait function after stroke in the chronic \(^5^{50}\)–\(^6^{33}\) and acute phases \(^6^{36}\)–\(^6^{37}\) when NMES was applied in conjunction with a conventional rehabilitation program. Studies comparing the use of an AFO to NMES in controlling foot drop during walking have found similar results. \(^6^{38}\)–\(^6^{39}\) Although subjects preferred the foot drop stimulator used in 2 multisite RCTs, both the stimulator and a conventional AFO produced equivalent functional gains. \(^5^{38}\)–\(^6^{40}\)–\(^6^{41}\) Similar results were obtained in a comparison of surface peroneal nerve stimulation and use of an AFO. \(^6^{42}\)–\(^6^{44}\) Significant improvements in functional mobility were found with both peroneal nerve stimulation and AFO during the treatment period and were maintained at the 6-month follow-up.

**Medications for Motor Recovery**

Several medications have been studied as potential contributors to stroke recovery in general and to motor recovery in
particular, including dextroamphetamine, methylphenidate, levodopa, and SSRIs. Fluoxetine was found to be helpful for motor recovery in a double-blind, placebo-controlled trial, and several smaller studies of SSRIs were also suggestive of benefit. A systematic review and meta-analysis found evidence of benefit for SSRIs in overall disability after stroke. The overall quality of these studies was not sufficient, however, to make a definitive recommendation, and larger, well-controlled trials are in progress. A randomized, double-blind, placebo-controlled trial of dextroamphetamine in 71 subjects was negative, and a subsequent systematic review of the use of amphetamines for improving motor recovery after stroke found inconsistent findings, and these carry a risk of adverse cardiovascular effects. A randomized, double-blind, placebo-controlled trial of levodopa found short-term benefit of this therapy compared with placebo for motor function but was limited by relatively small size (47 subjects analyzed), baseline differences in stroke severity and patient age between the 2 treatment groups, and the short-term follow-up of only 3 weeks after the completion of therapy.

**Acupuncture**

The Ottawa Panel recommends that there is good scientific evidence to consider including acupuncture as an adjunct to standard stroke rehabilitation to improve walking mobility. Shiftett reviewed a number of RCTs of acupuncture for stroke recovery and performed a reanalysis suggesting that acupuncture may be effective as an adjunctive treatment for improving walking speed.

**Transcutaneous Electrical Nerve Stimulation**

TENS provides electrically induced sensory input to the lower limb. A meta-analysis revealed that there was insufficient research to make conclusions about the effectiveness of TENS in improving gait and gait-related activities. Three subsequent RCTs provided evidence of a potential benefit of TENS on physical function after stroke, particularly when combined with task-related activity.

**Rhythmic Auditory Cueing**

Rhythmic auditory cueing is a therapy approach in which overground walking is synchronized to a rhythmic auditory cue to improve temporal and spatial gait measures. An evidence synthesis found moderate evidence of improved velocity and stride length in people with stroke after gait training with rhythmic music. Synchronizing walking to rhythmic auditory cues can result in short-term improvement in gait measures of people with stroke. Further high-quality studies are needed before recommendations for clinical practice can be made.

**Use of AFOs**

Use of AFOs is an effective method of compensating for motor impairments in the lower limb after stroke. The reader is referred to the section below on adaptive equipment for details.

**Robotic and Electromechanics-Assisted Training Devices**

Robots and electromechanics-assisted training devices have been used in an effort to promote gait recovery after stroke. Most of these devices incorporate body weight support along with treadmills or foot platform pedals analogous to an elliptical trainer. Their main advantage over conventional gait training is that they reduce the need for intensive therapist support. These devices include the Lokomat, the Gait Trainer GT 1, and the AutoAmbulator. A Cochrane systematic review updated in 2013 concluded that patients with stroke who received electromechanics-assisted gait training in combination with PT were more likely to achieve independent walking than patients receiving gait training without these devices, but it did not find an increase in gait velocity. The review concluded that the individuals most likely to benefit from this therapy appear to be those who are within the first 3 months after stroke and those who are unable to walk. In contrast, a study by Hornby et al demonstrated greater improvement in gait velocity and single limb support time on the paretic limb after therapist-assisted locomotor training compared with robotic-assisted locomotor training. A systematic review found improved balance for stroke survivors receiving robotic gait training, but there was insufficient evidence comparing robotic gait training with conventional gait training to determine whether these therapies are similar in this regard.

Exoskeletal wearable lower limb robotic devices are also available for gait training after stroke and allow overground walking with the device. Most of these devices (eg, Ekso Bionics, Richmond, CA; Indego, Parker-Hannifin; and ReWalk, Marlborough, MA) are bilateral in design, although unilateral exoskeletal wearable devices have also been developed (eg, Bionic Leg, AlterG, Fremont, CA). Although a pilot study of a unilateral device did not demonstrate benefit compared with conventional exercise therapy, most of the devices in this class have not yet been examined in controlled trials for stroke survivors. Overall, although robotic therapy remains a promising therapy as an adjunct to conventional gait training, further studies are needed to clarify the optimal device type, training protocols, and patient selection to maximize benefits.

**Electromyographic Biofeedback**

Electromyographic biofeedback is a technique that uses visual or audio signals to provide the patient with feedback on his/her muscle activity. The literature on the use of electromyographic biofeedback plus conventional rehabilitation includes some studies suggesting improved motor power, functional recovery, and gait quality compared with conventional rehabilitation alone. However, a 2007 Cochrane database systematic review did not find a treatment benefit. The results of the systematic review are limited because the trials were small, were generally poorly designed, and used varying outcome measures, making it difficult to compare across studies.

**Virtual Reality**

Virtual reality is the use of computerized technology to allow patients to engage in specific task practice within a computer-generated visual environment in a naturalistic fashion. An environment that may be more interesting to a subject may enhance motivation to practice. In 2011, the Cochrane Stroke Group concluded that there was insufficient evidence to reach conclusions about the effect of virtual reality and interactive video gaming on gait speed. However, a recent systematic...
review suggests that virtual reality promotes changes in gait parameters despite diversity of protocols, participant characteristics, and number of subjects included.

**Traditional Physiotherapeutic Approaches (Neurodevelopmental Therapy/Bobath, Brunnstrum, Proprioceptive Neuromuscular Facilitation)**

A recent systematic review conducted by Langhammer and Stanghellie assessed the efficacy of the traditional physiotherapeutic approaches. Although improvements in motor function were demonstrated, no trial showed that these approaches were superior to the respective comparison therapies. Similarly, it was concluded that neurodevelopmental approaches were equivalent or inferior to other approaches in improving walking ability in a 2007 systematic review.

**Water-Based Exercises**

The conclusions drawn in a 2012 Cochrane systematic review revealed that the evidence from RCTs to date does not confirm or refute that water-based exercises after stroke might help to improve gait and gait-related activities.

### Recommendations: Mobility (Continued)

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensive, repetitive, mobility-task training is recommended for all individuals with gait limitations after stroke.</td>
<td>I A</td>
<td></td>
</tr>
<tr>
<td>An AFO after stroke is recommended in individuals with remediable gait impairments (eg, foot drop) to compensate for foot drop and to improve mobility and paretic ankle and knee kinematics, kinetics, and energy cost of walking.</td>
<td>I A</td>
<td></td>
</tr>
<tr>
<td>Group therapy with circuit training is a reasonable approach to improve walking.</td>
<td>Ila A</td>
<td></td>
</tr>
<tr>
<td>Incorporating cardiovascular exercise and strengthening interventions is reasonable to consider for recovery of gait capacity and gait-related mobility tasks.</td>
<td>Ila A</td>
<td></td>
</tr>
<tr>
<td>NMES is reasonable to consider as an alternative to an AFO for foot drop.</td>
<td>Ila A</td>
<td></td>
</tr>
<tr>
<td>Practice walking with either a treadmill (with or without body-weight support) or overground walking exercise training combined with conventional rehabilitation may be reasonable for recovery of walking function.</td>
<td>Iib A</td>
<td></td>
</tr>
<tr>
<td>Robot-assisted movement training to improve motor function and mobility after stroke in combination with conventional therapy may be considered.</td>
<td>Iib A</td>
<td></td>
</tr>
<tr>
<td>Mechanically assisted walking (treadmill, electromechanical gait trainer, robotic device, servo-motor) with body weight support may be considered for patients who are nonambulatory or have low ambulatory ability early after stroke.</td>
<td>Iib A</td>
<td></td>
</tr>
<tr>
<td>There is insufficient evidence to recommend acupuncture for facilitating motor recovery and walking mobility.</td>
<td>Iib B</td>
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</table>

### Upper Extremity Activity (Includes ADLs, IADLs, Touch, Proprioception)

The majority of individuals with stroke experience problems with the upper extremity, most commonly paresis, which is the key impairment in most cases. Only a small portion of people fully recover from upper limb paresis after a stroke, with the remainder left with lingering upper extremity impairments, activity limitations, and participation restrictions. An inability to use the upper extremity in daily life can lead to loss of independence with ADLs and of important occupations (eg, work, driving) and can even contribute to institutionalization.

Task-specific training, or functional task practice, is based on the premise that practice of an action results in improved performance of that action and is focused on learning or relearning a motor skill. Task-specific practice is an element of or used in combination with many upper extremity interventions such as constraint-induced movement therapy (CIMT) and NMES. Across a large number of studies, the key elements of task-specific training are repeated, challenging practice of functional, goal-oriented activities. Trunk restraint during task-specific training is beneficial in reducing compensatory trunk movements and promoting proximal movement control. Strengthening upper extremity muscles may be beneficial as an adjunct to task-specific training when therapy time permits, or when the strengthening activities can be performed outside formal therapy sessions.

CIMT has been demonstrated to improve upper extremity activity, participation, and quality of life in individuals with baseline ability to control wrist and finger extension compared with usual care. It is less clear whether CIMT has...
any advantage over dose-matched conventional upper limb therapy.686,687 CIMT can be delivered in its original form 3 to 6 h/d for 5 d/wk for 2 weeks or in a modified version 1 h/d for 3 d/wk for 10 weeks. The modified CIMT intervention appears to result in improvements that are comparable to the original version, although it has not been as extensively tested.688-694

Bilateral upper limb training has not been as well studied as CIMT. Two meta-analyses and more recent trials suggest that there is a small but measurable benefit compared with no intervention, but no consistent evidence of superiority over other task-specific training interventions has been shown.695-698 Recent trials comparing bilateral training with CIMT or modified CIMT indicate that they may have similar efficacy for individuals with preserved isolated wrist and finger movement.700-702

For individuals with more severe paresis, the potential for recovery of upper extremity function is greatly reduced, particularly later after stroke.624 Robotic therapy can deliver larger amounts of upper extremity movement practice for these individuals. There are a variety of types of upper extremity robots, consisting primarily of workstation devices used in a rehabilitation facility but also including some wearable exoskeletal devices that can be used in a home environment. A Cochrane review updated in 2012 found that upper limb robotic therapy provided benefit with regard to ADLs and arm function but not arm muscle strength.703 The variation within the trials with regard to duration and amount of training, the specific devices used, and patient populations studied limits the interpretation of these results. Moreover, many of the studies performed with robot-aided therapy have compared it with usual care rather than dose-matched conventional upper limb exercise therapy. Those studies incorporating dose-matched exercise as a comparison treatment show minimal or no differences in the efficacy between these 2 treatments.704,705 Overall, robotic therapy appears to provide some benefit for upper extremity motor abilities and participation but is of uncertain utility compared with dose-matched conventional upper limb exercise therapies.706-713

NMES can be used for those with minimal ability for volitional muscle activation. It may be beneficial for improving upper extremity activity if used in combination with task-specific training, particularly when applied to the wrist and hand muscles.714-716 Alternatively, it is beneficial in preventing or correcting shoulder subluxation.125,132,717

Mental practice, or mental imagery, may be useful as an adjunct to upper extremity exercise therapies.718-722 Initial training in mental practice occurs within a therapy session, but additional practice can happen outside formal therapy time. It is feasible to integrate mental practice with physical practice.723 Longer durations of mental practice appear to produce more benefit.724

Virtual reality and video gaming have the potential to increase participant engagement and the amount of upper extremity movement practice. Computer-based video games are widely available for recreational purposes for the general public, including those with handheld controllers (eg, Wii) and motion capture systems (Xbox Kinect, Microsoft, Inc). In addition, these systems can be used as remotely monitored telerehabilitation systems.725 To date, most studies of efficacy have been small and have used a variety of technologies and training programs, making generalization difficult. A Cochrane review666 found benefit in terms of upper limb function and ADLs but no improvements in upper limb strength. The studies were of low quality in many cases, reducing confidence in this finding. Efficacy of Virtual Reality Exercises in Stroke rehabilitation (EVREST),727 a multicenter, randomized, clinical trial, is under way that may provide more definitive evidence. At present, virtual reality and video gaming are reasonable alternative methods to engage individuals with stroke in the rehabilitation process and to increase the amount of movement practice.666,728,729,731-733

A variety of interventions have been the focus of ≥1 studies but have not yet been shown to be consistently beneficial for upper limb motor rehabilitation. These include somatosensory stimulation734-738 and noninvasive brain stimulation (transcranial magnetic stimulation or tDCS) in combination with upper extremity exercise therapy.739-746 interventions targeting motor apraxia,48 and manual therapy approaches such as stretching, passive exercise, and mobilization,248 although these approaches are a routine part of practice for individuals with more severely affected upper extremities to prevent contracts and to manage spasticity.

Finally, upper extremity rehabilitation programs can be delivered in a variety of settings such as inpatient hospitals and outpatient clinics and within the home. A recent systematic review and subsequent RCT indicate that both outpatient and home service delivery models produce similar results on upper extremity activity, including the ability to perform ADLs.740,746

<table>
<thead>
<tr>
<th>Recommendations: Upper Extremity Activity, Including ADLs, IADLs, Touch, and Proprioception</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional tasks should be practiced; that is, task-specific training, in which the tasks are graded to challenge individual capabilities, practiced repeatedly, and progressed in difficulty on a frequent basis.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>All individuals with stroke should receive ADL training tailored to individual needs and eventual discharge setting.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>All individuals with stroke should receive IADL training tailored to individual needs and eventual discharge setting.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>CIMT or its modified version is reasonable to consider for eligible stroke survivors.</td>
<td>IIa</td>
<td>A</td>
</tr>
<tr>
<td>Robotic therapy is reasonable to consider to deliver more intensive practice for individuals with moderate to severe upper limb paresis.</td>
<td>IIa</td>
<td>A</td>
</tr>
<tr>
<td>NMES is reasonable to consider for individuals with minimal volitional movement within the first few months after stroke or for individuals with shoulder subluxation.</td>
<td>IIa</td>
<td>A</td>
</tr>
<tr>
<td>Mental practice is reasonable to consider as an adjunct to upper extremity rehabilitation services.</td>
<td>IIa</td>
<td>A</td>
</tr>
<tr>
<td>Strengthening exercises are reasonable to consider as an adjunct to functional task practice.</td>
<td>Ila</td>
<td>B</td>
</tr>
<tr>
<td>Virtual reality is reasonable to consider as a method for delivering upper extremity movement practice.</td>
<td>IIa</td>
<td>B</td>
</tr>
</tbody>
</table>
Adaptive Equipment, Durable Medical Devices, Orthotics, and Wheelchairs

Many patients require assistive devices, adaptive equipment, mobility aids, wheelchairs, and orthoses to maximize independent functioning after stroke. Many types of adaptive devices and equipment are available. Type and level of functional deficit, degree of achieved adaptation, and the structural characteristics of the living environment determine the need for a particular item.

A vast array of adaptive devices are available, including devices to make eating, bathing, grooming, and dressing easier for patients with functional limitations. The Convention on the Rights of Persons With Disabilities supports facilitating access by individuals with disabilities to quality mobility aids, devices, and assistive technologies by making them available at affordable cost.750 Many patients may need to use adaptive devices early during rehabilitation but will not require long-term use. This should be taken into account when the provision of a device is considered. Examples of adaptive devices include (but are not limited to) eating utensils with built-up handles, rocker knives, plate guards, nonskid placemats, long-handled sponges for bathing, handheld showers, tub and shower chairs, grab bars for bathrooms, and elevated toilet seats. A meta-analysis found that OT increased independence in ADLs.752 The protocols in these studies focused on improving personal ADLs, including the provision and training in the use of adaptive equipment.

Stroke can cause a number of gait impairments; consequently, stroke patients often have an unstable, inefficient walking pattern and a high risk for falls (see the sections Prevention of Falls and Mobility). More than half of stroke patients require an assistive device (cane, walker, wheelchair) to assist mobility, most frequently a cane.753 Studies that have assessed the immediate effects of different adaptive devices provided in random order have shown that ambulatory function (speed, step length, functional ambulation category) was improved with a cane after stroke.754,755 Patients felt that their walking, walking confidence, and walking safety improved and said they would rather walk with an assistive device than delay walking to achieve a normal gait pattern.755 Walking devices increase the base of support around a patient’s center of gravity and reduce the balance and effort needed to walk. Walking aids include (but are not limited to) the following:

- **Single-point cane**: a conventional cane that provides 1 point of contact and limited improvement in balance and stability.
- **Tripod and quad cane**: canes that have 3 or 4 points of contact and offer more stability than a single-point cane but are heavier, bulkier, and more awkward to use. A quad cane has been shown to reduce postural sway more than a single-point cane in patients with stroke.756
- **Two-wheeled walkers, 4-wheeled walkers, or rollators (ie, 4-wheeled walker with a seat)**: devices that require the use of both arms and legs. They support more body weight than a cane and are more energy efficient but cannot be used on stairs. They should be lightweight and foldable for use outside the home. Four-wheeled walkers may require hand-motor coordination to manage handbrakes on a downhill slope.

For individuals with stroke who cannot ambulate safely, a wheelchair can enhance mobility. Up to 40% of stroke patients have been reported to use a manual wheelchair at rehabilitation discharge.757 A wheelchair may be required when a patient is unable to ambulate or when there is concern about his/her ability to ambulate safely or functionally.758 The patient often propels the chair by using the less affected hand on 1 wheel and foot on the floor. Self-propulsion in a wheelchair early after a stroke has not been shown to be detrimental to muscle tone or functional outcomes.759 Many stroke survivors also use manual wheelchairs for longer-distance travel such as shopping or physician appointments although they are capable of short-distance ambulation within the home. In these situations, the wheelchair is typically propelled by a caregiver.

Although powered wheelchairs are less commonly used after stroke, many stroke patients can learn to use powered wheelchairs safely with appropriate training.760 Wheelchair designs vary greatly, and a wheelchair prescription should be specific to the patient’s needs and environment and patient and family/caregiver preferences. The prescription of a wheelchair (manual or powered) in the community can increase participation and improve quality of life.761,762

A common approach to managing the lower limb motor impairments resulting from a stroke is to use an orthotic device (an orthosis), most commonly an AFO. Meta-analyses have shown a favorable impact of lower limb orthoses on walking disability (speed), walking impairment (step/stride length), and balance (weight distribution in standing).559,605 However, the included studies examined only the immediate effects while the orthosis was worn.605 A recent meta-analysis and systematic review suggested the potential mechanism(s) associated with the above effects by demonstrating a positive effect of an AFO on ankle kinematics, knee kinematics in stance phase, kinetics, and energy cost.658 Two RCTs showed that after 3 months of AFO use, AFO users had better mobility while wearing the AFO. One small RCT found that although a dynamic hinged AFO improved ambulatory function over a standard AFO, it induced some dependence; the standard AFO group performed better after 3 months of use when walking without any orthosis. With respect to the patient’s perspective, it is important to determine whether an individual is willing to wear an AFO regularly. Considerations to improve compliance with using an AFO

<table>
<thead>
<tr>
<th>Recommendations: Upper Extremity Activity, Including ADLs, ADLs, Touch, and Proprioception (Continued)</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somatosensory retraining to improve sensory discrimination may be considered for stroke survivors with somatosensory loss.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>Bilateral training paradigms may be useful for upper limb therapy.</td>
<td>IIb</td>
<td>A</td>
</tr>
<tr>
<td>Acupuncture is not recommended for the improvement of ADLs and upper extremity activity.</td>
<td>III</td>
<td>A</td>
</tr>
</tbody>
</table>
Motor Impairment and Recovery: Deconditioning and Fitness After Stroke
People having sustained a stroke present with varying degrees of compromised cardiorespiratory fitness, as reflected in peak \( \dot{V}_{O_2} \) levels of 8 to 22 mL O\(_2\)-kg\(^{-1}\)-min\(^{-1}\) (an average of \(\approx 53\%\) of age- and sex-matched normative values).\(^{765}\) Given that 15 to 18 mL O\(_2\)-kg\(^{-1}\)-min\(^{-1}\) is deemed necessary for independent living, the state of fitness after a stroke is a significant health, functional, and quality-of-life issue.\(^{766}\) Multiple factors before stroke, at the time of stroke, and after stroke help explain this state. The result is often a profound and persistent deconditioned state that leads to further physical inactivity, reduced socialization, and heightened risk of further vascular events, including a second stroke.

The lifetime risk of stroke recurrence among people with stroke is \(\approx 30\%\), and the risk of either nonstroke vascular death or myocardial infarction is \(\approx 2\%\) per year.\(^{767}\) Recurrence of stroke has been found to vary by sex: 24% of women and 42% of men experience a recurrence within 5 years of onset.\(^{766,769}\) The reported rates of vascular risks are high among people who have a recurrence: The prevalence of hypertension (75%), ischemic heart disease (37%), hyperlipidemia (56%), atrial fibrillation (29%), and diabetes mellitus (24%) is significant in individuals who sustain a second stroke.\(^{770}\) For a comprehensive and timely set of evidence-based recommendations for all clinicians who manage secondary prevention, the reader is directed to the AHA/ASA guidelines for the prevention of stroke in patients with stroke and transient ischemic attack.\(^{206}\)

Activity level after stroke is an independent predictor of life satisfaction, after controlling for demographic variables and depression.\(^{771}\) Low levels of physical activity have been documented across the continuum of stroke severity and care, even among people who have had what is considered a mild stroke.\(^{772}\) A behavioral mapping study revealed that activity out of bed during acute stroke care (ie, <14 days after the onset of stroke) varied widely among the European countries studied, ranging between 2% and 56% of the total time of the observation periods.\(^{773}\) Stroke rehabilitation sessions have been reported to be of inadequate intensity to induce a cardiovascular training effect.\(^{774,775}\) with an average of 17 minutes spent in standing and walking per session.\(^{776}\) Daily ambulatory activity of community-dwelling stroke survivors has been reported to be 50%\(^{777}\) to 61%\(^{778}\) of that of nondisabled control subjects, less than that of older adults with other chronic health conditions of the musculoskeletal or cardiovascular system.\(^{779}\) At the same time, self-reports of physical activity among people with chronic stroke tend to be highly inflated.\(^{780}\)

Sedentary behavior is defined as a waking behavior such as sitting or lying that involves an energy expenditure of \(<1.5\) metabolic equivalents (METs; 1 MET is the amount of oxygen consumed while sitting at rest and is \(\approx 3.5\) mL O\(_2\)-kg\(^{-1}\)-min\(^{-1}\)). Less sedentary behavior has been found to be an independent predictor of successful aging among individuals \(\geq 45\) years of age.\(^{781}\) Moreover, prolonged bouts of sedentary behavior and total amount of physical inactivity appear to be independently related to risk factors associated with metabolic syndrome (eg, increased waist circumference, body mass index, triglycerides, and plasma glucose).\(^{782}\) To date, little research has been conducted on patterns of sedentary behavior after stroke. A cohort study reported that people after stroke (n=25) spent less time being physically active and had fewer breaks in sedentary behavior at 1 week, 3 months, and 6 months after stroke compared with nondisabled control subjects matched by age, sex, and body mass index.\(^{781}\)

Intervention strategies are needed to break the relentless poststroke cycle of reduced physical activity leading to further reductions in functional capacity and heightened risk of secondary complications. The central role that aerobic exercise plays in improving cardiorespiratory fitness is well known and strongly supported by evidence.\(^{783}\) It is now clear that people with mild or moderate stroke are capable of improving their exercise capacity through exercise or structured physical activity.\(^{784-786}\) Enhanced fitness enables individuals to engage in daily physical activities at a lower percentage of their maximal capacity and hence with a lower physiological burden.\(^{787}\) Exercise-induced gains in peak \(\dot{V}_{O_2}\) have been relatively modest, with the magnitude of improvement ranging from 0.3 METs\(^{788}\) to 1.2 METs\(^{789}\) in trials of individuals in the subacute poststroke period and averaging \(\approx 0.5\) METs in trials of individuals with chronic stroke. However, even modest improvements in exercise capacity are associated with reduced cardiocerebrovascular complications in people with coronary artery disease\(^{790}\) and increased survival (10%–25% reduction in mortality for every 1-MET increase in exercise capacity).\(^{791}\)

Emerging research suggests that aerobic exercise after stroke confers clinically meaningful health benefits in numerous physical and psychosocial domains that extend well beyond the cardiorespiratory system. At the impairment level, some evidence exists that exercise positively affect bone health\(^{792}\) (but not risk of fracture\(^{793}\)), fatigue,\(^{411}\) executive functioning and memory, depressive symptoms,\(^{794,795}\) and emotional well-being\(^{788}\) (see the earlier section on the benefits of exercise for poststroke depression). At the activity level, improvements have been noted in walking ability\(^{796}\) (endurance more than speed\(^{797}\)) and upper extremity muscle strength.\(^{680}\) At the participation level, preliminary evidence has reported an association between exercise training after

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**Table: Recommendations for Adaptive Equipment, Durable Medical Devices, Orthotics, and Wheelchairs**

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulatory assistive devices (eg, cane, walker) should be used to help with</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>gait and balance impairments, as well as mobility efficiency and safety, when</td>
<td></td>
<td></td>
</tr>
<tr>
<td>needed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AFOs should be used for ankle instability or dorsiflexor weakness.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Wheelchairs should be used for nonambulatory individuals or those with</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>limited walking ability.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptive and assistive devices should be used for safety and function if other</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>methods of performing the task/activity are not available or cannot be learned</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or if the patient’s safety is a concern.</td>
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</table>
Exercise Recommendations for Stroke Survivors provides the goal of stroke rehabilitation. Finally, a meta-analysis reported that exercise interventions during the chronic poststroke period can achieve low to moderate exercise intensities when playing an active video game (Nintendo Wii Sports). Furthermore, a recent trial involving people with subacute stroke demonstrated greater gains in peak VO₂ with a combination of robot-assisted gait training and conventional PT than conventional therapy alone.

There is some evidence that the combination of aerobic and strengthening exercises in nonstroke populations enhances health outcomes (eg, reducing resting blood pressure and metabolic syndrome risk factors). However, conclusions from a meta-analysis indicated the need for further investigation to determine whether combining aerobic and strengthening exercises bestows similar advantages in the stroke population. Since then, a small, single-cohort study involving individuals with chronic stroke reported improved muscle strength and walking endurance but no change in peak VO₂ after an 8-week program of lower extremity strength training at 85% to 95% of 1-repetition maximum.

Benefits derived from aerobic training are dose dependent. The appropriate total volume of exercise, achieved through various combinations of frequency, duration, and intensity, is key to attaining and maintaining cardiorespiratory fitness. Nevertheless, there appears to be a minimal threshold for each parameter to achieve the most favorable outcomes. The frequency of structured aerobic exercise should be at least 3 d/wk for a minimum of 8 weeks, with lighter forms of physical activity (eg, brisk walking, stair climbing) promoted on the other days of the week. The duration of each session should be at least 20 minutes in the training zone in addition to 3- to 5-minute periods of low-intensity warm-up and cool-down.

For very deconditioned individuals, including many people after stroke, exercise may be delivered in multiple bouts of ≤5 minutes in a single session or throughout the day.

Exercise intensity is the most challenging parameter to determine but also the most critical to ensure that a dose that is safe, attainable, and adequate to elicit a training effect. Factors that affect intensity are baseline fitness level, neurological and cardiac status, comorbidities, motivation, and goals of the program. Heart rate is typically used to establish and monitor training intensity, with resting rate measured after a minimum of 5 minutes of quiet sitting and exercise heart rate measured with an electronic device. It is important to note that β-blocker medication depresses the heart rate response to exercise and that atrial fibrillation (common after stroke) yields a chronically irregular ventricular rate, thus posing challenges in the prescription of exercise intensity. Various recommendations have been made on the appropriate exercise intensity for patients after stroke, including “moderate training intensities,” 40% to 70% of heart rate reserve (maximal heart rate minus resting heart rate), 50% to 80% of maximal heart rate. A meta-analysis concluded that for extremely unfit individuals, intensities as low as 30% of heart rate reserve can induce a cardiovascular training effect.
Chronic Care Management: Home- and Community-Based Participation

Because exercise confers health benefits even years after stroke, participation in physical activity should be encouraged regardless of how much time has elapsed since stroke onset. The effectiveness of exercise training in the chronic stages of stroke is no longer in question; in fact, the vast majority of fitness trials have involved people at this stage of stroke chronicity. Moreover, it has long been recognized that benefits of training decline significantly without ongoing participation in physical activity. Thus, physical activity designed to promote cardiovascular fitness should be an important aspect of community reintegration after stroke. However, adherence to regular physical activity is influenced by a host of individual factors (eg, stroke severity, preexisting/comorbid conditions, motivation, health beliefs, exercise history, fatigue, depression, adaptability, coping skills, cognition), social/cultural factors (eg, family support, social policies, professionals’ attitudes about exercise, social norms and stigmas), and environmental factors (eg, program costs, access to transportation, fitness facilities and equipment). These factors must be systematically addressed to achieve the goal of long-term commitment to healthy, active living behaviors among stroke survivors.

Strategies to instill long-term commitment to a physically active lifestyle should be initiated during formal stroke rehabilitation, but evidence to guide intervention is lacking. Considering the high likelihood of a presroke history of sedentary behavior, fostering exercise self-efficacy is particularly important to ease the transition from structured, institution-based aerobic training to home- and community-based physical activity. Incorporating principles of adult learning (eg, observation, practice, repetition, relevance) and self-management (eg, problem solving, goal setting, making choices, taking action, using available resources) is essential. Early participation in fitness training and education on lifestyle choices, risk factor reduction, and secondary prevention may facilitate uptake of healthy behaviors. Myths about exercise (exercise is unsafe, causes second stroke, increases fatigability) need to be dispelled in the process of rehabilitation. Most important, patients’ preferences concerning exercise must be sought out and respected. Finally, stroke survivors who are unable to exercise will need alternative solutions to maintain an active and engaged lifestyle.

The fitness program should be customized on the basis of the participant’s functional limitations, long-term health-related goals, and social and environmental factors. Periodic monitoring of the intensity of the program and the participant’s fitness level and adherence may be reasonable. Investigations of the effectiveness of predischarge counseling in increasing long-term adherence to activity after stroke have yielded mixed results. In addition, a self-guided stroke workbook did not elicit demonstrable changes in physical activity. It appears that passive approaches (professional advice, written material) alone are not adequate to increase physical activity after stroke. Given that the most common motivator to physical activity after stroke is the opportunity to meet other stroke survivors, together with the findings that stroke survivors report greater preferences for exercising in groups and at fitness centers, it is prudent to direct resources to facilitating participation in physical activity in community settings. Developing partnerships between healthcare professionals and fitness centers or community exercise programs could help to address a concern expressed by patients after stroke that exercise instructors must be suitably trained and knowledgeable about stroke. Integrated care models that include periodic liaison between care providers and patients after stroke via telephone or electronic follow-up may be the solution to providing ongoing support for physical activity.

<table>
<thead>
<tr>
<th>Recommendations: Chronic Care Management: Home- and Community-Based Participation</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>After successful screening, an individually tailored exercise program is indicated to enhance cardiorespiratory fitness and to reduce the risk of stroke recurrence.</td>
<td>I</td>
<td>A (for improved fitness); B (for reduction of stroke risk)</td>
</tr>
<tr>
<td>After completion of formal stroke rehabilitation, participation in a program of exercise or physical activity at home or in the community is recommended.</td>
<td>I</td>
<td>A</td>
</tr>
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</table>

Treatments/Interventions for Visual Impairments

Treatments and interventions for visual impairments after stroke focus on 3 areas: deficits in eye movements, deficits in visual fields, and deficits in visual-spatial or perceptual deficits. There have been 7 systematic reviews of treatments for visual impairments after stroke. These systematic reviews covered reports up to 2011. The literature is generally limited in this area, and the methodological quality was poor in general or poorly reported, providing insufficient high-quality evidence on which to reach generalizable conclusions. However, limited evidence suggested that compensatory scanning training is effective at improving scanning and reading outcomes but not improving visual field deficits. There was insufficient evidence of the impact of compensatory scanning training on ADLs. There was also insufficient evidence about the benefits of vision restoration therapy (restorative intervention) after stroke. Across these systematic reviews, 2 studies targeted eye movement deficits, 2 case studies and 1 nonrandomized prospective study assessed interventions for visual field cuts, and 3 studies dealt with perceptual deficits. In general, there was insufficient evidence to reach conclusions about the effectiveness of interventions for patients with any of these visual deficits after stroke. Barrett reviewed the behavioral optometry literature. Behavioral optometry proposes that eye and visual function can be improved through various vision therapy methods, including...
eye exercises and the use of lenses, prisms, filters, occluders, specialized instruments, and computer programs to improve vision skills such as eye movement control, eye focusing, and coordination. Barrett concluded that there is a paucity of controlled trials in the literature to support behavioral optometry approaches and that a large majority of behavioral management approaches are not evidence based. However, there was evidence supporting the use of eye exercises for treatment of convergence insufficiency, the use of yoked prisms in stroke patients with visual field cuts, and the use of vision rehabilitation of visual field defects (selecting areas of residual vision that are then stimulated during computer-assisted training to achieve visual field enlargement).

A number of studies included as part of a broader review dealing with rehabilitation of cognitive deficits focused on visual neglect, which is addressed elsewhere in this guideline. However, with regard to other forms of visual deficits, those studies concluded that systematic training of visual organization skills may be considered for individuals with visual perceptual deficits, without visual neglect, and after right hemispheric stroke as part of acute rehabilitation and that computer-based interventions intended to produce extension of damaged visual fields may be considered for people with traumatic brain injury or stroke.

In addition to those covered by the 7 systematic reviews, 3 studies dealt with treatments for visual impairments after stroke. Mödden et al concluded that computer-based compensatory therapy improved functional deficits after visual field loss compared with compensation strategies training (ie, standard OT). A 2010 study concluded that multimodal audiovisual exploration training is more effective than exploration training alone. Finally, a 2012 study reported that a virtual reality training group showed a significant difference in all Motor-Free Visual Perception Test raw scores and response times, with improvements in recognizing shapes, solving pictorial puzzles, and object perception.

The use of behavioral optometry approaches involving eye exercises and the use of lenses and colored filters to improve eye movement control, eye focusing, and eye coordination is not recommended.

### Hearing Loss

The healthcare provider's ability to effectively communicate with a patient who has had a stroke is essential to provide adequate patient care. Unfortunately, hearing impairment is common among stroke patients, and this may significantly affect communication. This impairment must be considered when communicating with patients to provide effective patient-centered care.

Hearing impairment is commonly associated with aging, and the associated communication difficulties are only further exacerbated after stroke. It has been reported that the most common type of communication impairment within an acute hospital stroke unit is a hearing impairment, with estimates that 67% to 90% of these patients have a mild or greater hearing impairment. Although a sudden onset of hearing loss resulting from a stroke is uncommon, stroke patients often have a preexisting or an undiagnosed hearing loss. In some instances, difficulty hearing may simply be caused by cerumen impaction or may be attributable to age-related hearing loss. Stroke patients with communication or cognitive impairments may be unable to relay information about their hearing history. Reports from family or significant others often give healthcare providers some indication of the patient’s hearing abilities before the stroke. It is recommended that any noticeable hearing impairment be assessed and documented to improve patient care. Edwards et al reported that 86% of stroke patients in acute care facilities had a hearing impairment that was not documented in their chart.

Amplification can often help patients who have had a stroke to overcome the barrier of a hearing impairment. One study reported that of 52 patients who had suffered a stroke and had a hearing impairment, 11 (21%) owned hearing aids. By verifying that the hearing aids or amplification devices are working and reminding the patients to wear them, healthcare providers will be able to better communicate with these patients. Unfortunately, not all patients with a hearing impairment have hearing aids. In this case, it is important to incorporate communication strategies such as looking at the

### Recommendations: Treatments/Interventions for Visual Impairments (Continued)

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<tr>
<th>For visual-spatial/perceptual deficits:</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multimodal audiovisual spatial exploration training appears to be more effective than visual spatial exploration training alone and is recommended to improve visual scanning</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>There is insufficient evidence to support or refute any specific intervention as effective at reducing the impact of impaired perceptual functioning.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>The use of virtual reality environments to improve visual-spatial/perceptual functioning may be considered.</td>
<td>IIb</td>
<td>B</td>
</tr>
<tr>
<td>The use of behavioral optometry approaches involving eye exercises and the use of lenses and colored filters to improve eye movement control, eye focusing, and eye coordination is not recommended.</td>
<td>III</td>
<td>B</td>
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</table>
patient when talking to him/her and minimizing the level of background noise.

<table>
<thead>
<tr>
<th>Recommendations: Hearing Loss</th>
<th>Class</th>
<th>Level of Evidence</th>
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<tbody>
<tr>
<td>If a patient is suspected of a hearing impairment, it is reasonable to refer to an audiologist for audimetric testing.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>It is reasonable to use some form of amplification (eg, hearing aids).</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>It is reasonable to use communication strategies such as looking at the patient when speaking.</td>
<td>IIa</td>
<td>C</td>
</tr>
<tr>
<td>It is reasonable to minimize the level of background noise in the patient’s environment.</td>
<td>IIa</td>
<td>C</td>
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### Transitions in Care and Community Rehabilitation

**Ensuring Medical and Rehabilitation Continuity Through the Rehabilitation Process and Into the Community**

The transition from inpatient care to home after a stroke can be difficult for patients and caregivers. Those patients who require ongoing rehabilitation after discharge should continue to be followed up by a care team with expertise in stroke rehabilitation whenever possible. Patients who do not require additional rehabilitation services and are discharged to home or who are profoundly and permanently disabled and discharged to a long-term care setting can be managed by a primary care provider.

One recent systematic review of 9 RCTs looked at the effectiveness of various models of primary care–based follow-up after stroke. The studies included interventions using stroke support workers, care coordinators, or case managers. As a result of the wide variability of the methodological quality of the studies, interpretation was limited. The authors noted that although patients and caregivers receiving follow-up were generally more satisfied with some aspects of communication and had a greater knowledge of stroke, there did not appear to be any gains in physical function, mood, or quality of life compared with those who did not.853 Another systematic review examining transitional care models after stroke or myocardial infarction showed that hospital-initiated transitional care could improve some outcomes in adults hospitalized for stroke or myocardial infarction.854

Although not specific to stroke, a 2012 Cochrane study to determine the effectiveness of discharge planning for patients moving from an acute hospital stay to a home setting evaluated the results of 24 RCTs comparing individualized discharge plans with routine discharge care that was not tailored to the individual patient. Using data from 8098 patients, the investigators found that hospital length of stay and hospital readmissions were “statistically significantly reduced for patients admitted to hospital with a medical diagnosis and who were allocated to discharge planning (mean difference length of stay −0.91, 95% CI −1.55 to −0.27, 10 trials; readmission rates RR 0.82, 95% CI 0.73 to 0.92, 12 trials).” For elderly patients with a medical condition, they found no significant difference between groups with respect to mortality (RR, 0.99; 95% CI, 0.78–1.25, 5 trials) or being discharged from hospital to home (RR, 1.03; 95% CI, 0.93–1.14, 2 trials). The authors concluded that a “discharge plan tailored to the individual patient probably brings about reductions in hospital length of stay and readmission rates for older people admitted to hospital with a medical condition” but that the impact of discharge planning on mortality, health outcomes, and cost remained unclear.855 For patients who have suffered a stroke and are being discharged from acute care, the discharge planning should include rehabilitation professionals who can identify long-term needs and help organize provision of those services.

Alternative methods of communication and support such as telephone visits, telehealth, or Web-based support are newer options that should be considered, particularly for patients in rural settings who may have difficulty traveling for medical care once they are discharged from formal rehabilitation services.856 These technologies can be used for long-distance counseling, problem solving, and educational sessions, as well as for transmitting critical data such as blood pressure readings, weight, or laboratory results.

### Social and Family Caregiver Support

As a result of the complexity of the disease, the deficits and disability, and the change in family and significant other dynamics, the caregiver and family are integral to the post-stroke treatment plan. A major challenge is that 12% to 55% of caregivers suffer from some emotional distress,209 most commonly depression.238 A growing body of research is focused on the caregiver’s quality of life and on treatment strategies to benefit both the caregiver and the stroke survivor.

Families and caregivers of stroke survivors sustain a significant impact on their psychosocial health. Worldwide, depression is observed not only in the patient but also in the caregiver. Untreated depression is associated with a lower quality of life and increased burden for the caregiver and survivor.867 In Korea, increased burden was related to increased patient depression and insufficient support. In contrast, an American study found that increased caregiver burden is more closely correlated with lack of time for self.858 Smith and colleagues890 found that the caregiver needs varied as a function of age. Younger caregivers want information and training and are more inclined to criticize the healthcare system, whereas older caregivers need support to maintain a positive outlook and are less inclined to criticize the healthcare system.

Since the previous guidelines published in 2005, many researchers have investigated the caregiver perspective and better understand the interventions most likely to improve quality of life and to decrease burden. The Cochrane Collaboration
found that information improved the patient’s and caregiver’s knowledge while also slightly decreasing patient depression. The most effective educational programs included active involvement and follow-up by the educator. Education programs for caregiver and stroke participant should include supportive problem solving and skill development,665 “how to’s” of physical care needs and financial assistance,662 medications,662 respite, domestic assistance, and reassurance.663 Ongoing support for the caregiver favorably affects the stroke survivor and caregiver. This support comes in many different actions. Steiner et al864 studied physical and emotional support, whereas Campos de Oliveira865 more clearly defined the support as a needed support structure. The caregivers need either family or friends to provide emotional and physical assistance, and the caregivers need the healthcare providers to help them establish and maintain this over time.866 Counseling can also be a helpful intervention.867 In summary, healthcare professionals need to consider the patient, along with a diverse set of support options and treatments for the family and primary caregiver.

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<tr>
<th>Recommendations: Social and Family Caregiver Support</th>
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<tbody>
<tr>
<td>It may be useful for the family/caregiver to be an integral component of stroke rehabilitation.</td>
<td>IIb</td>
<td>A</td>
</tr>
<tr>
<td>It may be reasonable that family/caregiver support include some or all of the following on a regular basis:</td>
<td>IIb</td>
<td>A</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Training</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Counseling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Development of a support structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial assistance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>It may be useful to have the family/caregiver involved in decision making and treatment planning as early as possible and throughout the duration of the rehabilitation process.</td>
<td>IIb</td>
<td>B</td>
</tr>
</tbody>
</table>

Referral to Community Resources

Successful transition to the community requires careful assessment of the match between patient needs and the availability of formal and informal resources. Referral to appropriate local community resources can help to support the needs and priorities of the patient and the family or caregiver. Some services can be organized and in place before hospital discharge, whereas referral to some community resources may be provided on transition to the community. A range of community resources are available that patients and their families/caregivers may desire to access immediately or in the future as their needs change.

Formal referral may be required for services such as vocational counseling, psychological services, social services, sexual health counseling, driver evaluation, or home environment assessment. Referral to a day service program may be appropriate for a patient who may benefit from a structured program and for caregivers who need respite time.

Multiple potential resources may assist stroke patients and their families/caregivers in the management of the long-term effects of stroke such as local stroke survivor and caregiver support groups, leisure and exercise programs, respite care, self-management programs, and home support (eg, Meals on Wheels).

More than 50% of stroke survivors require support with IADLs.668 A high proportion of stroke survivors 1 to 5 years after injury use community services, with the most frequently accessed being household services (housework, lawn/garden care, and Meals on Wheels) and then therapy services (eg, PT).668

Caregivers have identified that it is important to know what resources are available and to be able to access them.669 Stroke patients and their caregivers can be active in managing their chronic condition if they have appropriate information and resources. If stroke survivors and caregivers are to be active in their decision making and the management of the long-term effects of stroke, appropriate information delivered in a timely and effective format is necessary. It is critical that the process involve assessment of an individual’s needs, education about available resources, linking of patient and resources, referrals, and follow-up to ensure the individual receives the necessary services. Health providers may wish to use a checklist to identify whether referral to other services is warranted.870 A meta-analysis of 21 trials showed that the provision of information (including local resources) to patients and their caregivers may improve aspects of patient satisfaction, improve knowledge of stroke, and reduce patient depression scores.871

A systematic review872 and meta-analysis873 demonstrated the growing recognition that functional outcomes (including motor, cognitive, and psychosocial function) can be improved or at least maintained in chronic stroke with community interventions. In addition, a meta-analysis of 17 RCTs showed that lifestyle interventions (eg, health promotion or education, lifestyle counseling) may reduce the risks leading to another stroke or cardiovascular event.874 A meta-analysis of 8 RCTs showed that exercise referral schemes that provide a clear referral by primary care professionals to third-party professionals to increase exercise or physical activity can increase the number of participants who achieve 90 to 150 min/wk of moderate physical activity and reduce depressive symptoms in sedentary individuals with or without a medical diagnosis (obesity, hypertension, depression, diabetes mellitus).875 In a qualitative study, stroke survivors described great physical and psychological well-being after participation in an exercise referral scheme.876

<table>
<thead>
<tr>
<th>Recommendations: Referral to Community Resources</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>It is recommended that acute care hospitals and rehabilitation facilities maintain up-to-date inventories of community resources.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Patient and family/caregiver preferences for resources should be considered.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>It is recommended that information about local resources be provided to the patient and family.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>It is recommended that contact with community resources be offered through formal or informal referral.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Follow-up is recommended to ensure that the patient and family receive the necessary services.</td>
<td>I</td>
<td>C</td>
</tr>
</tbody>
</table>
Rehabilitation in the Community
The Centers for Medicare & Medicaid Services define community as one of the following settings: home, board and care, transitional living, intermediate care, or assisted living residence. More than 80% of the >6 million survivors of stroke in the United States live in the community, most of them at home, and the majority with some residual functional limitations. Studies have documented that 35% to 40% of individuals have limitations in basic ADLs 6 months after a stroke. More than 50% have limitations in ≥2 IADLs.

There is substantial evidence that rehabilitation services, particularly exercise-based programs, provided in the community after discharge from acute or institutional care can improve cardiovascular health and decrease the risk of cardiovascular events, leading to increased short-term survival rates for individuals who have experienced a stroke.

Other community-based intervention trials have demonstrated enhanced ambulation and mobility, better self-care, and greater functional independence.

Benefits associated with community- and home-based rehabilitation programs have been reported for a variety of outcomes, including reduced costs, decreased length of stay in hospitals or institutional settings, more opportunity for patient and family involvement in the treatment process, and less stress on caregivers and family members.

It has also been consistently reported that individuals recovering from a stroke and their family members or caregivers prefer home- or community-based rehabilitation programs over center- or institutionally located rehabilitation services for a variety of practical and personal reasons. Patient satisfaction with home-based rehabilitation programs is generally higher than for institutionally based alternatives. Because the potential for recovery exists regardless of age and time after stroke and because fewer financial resources appear to be dedicated to providing optimal care during the later phases of stroke recovery, family caregiver education and support are recommended. Intervention, referrals, and follow-up care based on detailed caregiver assessments conducted during the survivor’s inpatient stay are likely to smooth the transition of care to the home setting. There is growing evidence for the effectiveness of stroke family caregiver and dyad (caregiver and patient) interventions. Among the Class I, Level of Evidence A recommendations about caregiver and dyad interventions were the following: (1) Interventions that combine skill building with psycho-educational strategies should be chosen over interventions that only use psycho-educational strategies; (2) interventions that are tailored or individualized on the basis of the needs of stroke caregivers should be chosen over nontailored, one-size-fits-all interventions; (3) postdischarge assessments with tailored interventions based on changing needs should be performed to improve caregiver outcomes; (4) interventions that are delivered face to face or by telephone are recommended; and (5) interventions consisting of 5 to 9 sessions are recommended.

The ability to translate these findings into targeted intervention programs and guidelines for the care of individuals with stroke is complicated by several factors. There is substantial variability in the timing of the initiation of home-based treatment programs. Home-based rehabilitation may not be appropriate for all individuals with stroke, depending on level of severity, comorbidities, or the need for specialized treatment or equipment. Existing studies comparing community- and home-based rehabilitation vary substantially in the duration and intensity of the intervention and in the nature and complexity of the treatment programs provided. For example, some treatment programs are single interventions such as exercise; other programs involve multiple components requiring levels of specialized expertise.

Issues related to the fidelity and integrity of the treatment, patient safety, and the lack of equipment and capacity to provide selected interventions in a home or community setting have been identified as concerns associated with home-based rehabilitation. Research-based evidence on potential adverse effects associated with rehabilitation programs conducted in the home and community is limited.

The majority of trials and reviews of community-based rehabilitation programs have compared home-based intervention programs with programs provided in centers or hospital/clinic-based outpatient programs. Several studies published since the 2005 stroke rehabilitation clinical practice guidelines have examined a combination of ESD programs and community rehabilitation and compared these programs with standard inpatient and outpatient rehabilitation services. Langhorne and colleagues found that the combination of ESD and community rehabilitation reduced inpatient length of stay and hospital readmission rates and increased functional independence and the ability of patients to live at home and participate in the community.

A systematic review by Hillier and Inglis-Jassiem examined data comparing the benefits of home-based programs and programs in rehabilitation centers for individuals with stroke living in the community. Eleven trials met the inclusion criteria. Functional outcome data were pooled for the Barthel Index across the majority of the trials. Functional status was significantly improved for the home-based cohort at 6 weeks and 3 to 6 months. The difference between home-based and rehabilitation center groups was less clear after 6 months. Cost benefits and caregiver satisfaction were secondary measures and favored the home-based intervention trials.

A widely cited Cochrane Collaboration review examined therapy-based rehabilitation services for stroke patients at home (Outpatient Service Trialists). The review examined trials meeting the Cochrane Collaboration criteria and compared home-based therapy with conventional care or no care within 1 year of hospital discharge for individuals with stroke. The primary outcomes were adverse events, deterioration in ability to perform ADLs, and level of improvement in ADL outcomes. The authors concluded that home-based therapy reduced the odds of a poor outcome, that is, death or deterioration in the ability to perform ADLs. Patients in the home-based therapy program also demonstrated improved ADL abilities compared with individuals in the usual or no treatment groups.

The majority of trials and reviews examining community- and home-based rehabilitation programs in individuals with stroke have focused on functional, mobility, or motor outcomes. A recent meta-analysis by Graven and others examined the impact of community-based rehabilitation on reducing...
depression and increasing participation and health-related quality of life in individuals with stroke. The 54 studies included in the review were divided into 9 intervention categories. Analyses revealed significant reductions in depressive symptoms. The reduction in depressive symptoms was associated with exercise interventions. Treatments involving leisure and recreational activities showed moderate effects for the outcomes of participation and health-related quality of life. Comprehensive, multifactorial rehabilitation interventions demonstrated limited evidence for depression and participation but showed strong evidence for health-related quality-of-life outcomes.  

### Recommendations: Rehabilitation in the Community

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients with stroke receiving comprehensive ADL, IADL, and mobility assessments, including evaluation of the discharge living setting, should be considered candidates for community- or home-based rehabilitation when feasible. Exclusions include individuals with stroke who require daily nursing services, regular medical interventions, specialized equipment, or interprofessional expertise.</td>
<td>I</td>
<td>A</td>
</tr>
<tr>
<td>It is reasonable that caregivers, including family members, be involved in training and education related directly to home-based rehabilitation programs and be included as active partners in the planning and implementation or treatment activities under the supervision of professionals.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>A formal plan for monitoring compliance and participation in treatment activities may be useful for individuals with stroke referred for home- or community-based rehabilitation services. A case manager or professional staff person should be assigned to oversee implementation of the plan.</td>
<td>IIb</td>
<td>B</td>
</tr>
</tbody>
</table>

### Sexual Function

Sexuality is an important aspect of poststroke quality of life for both patients and their significant others. Although there is substantial individual variation, overall stroke survivors tend to experience a high prevalence of sexual dysfunction. Comorbid medical conditions (e.g., diabetes mellitus, hypertension, depression), medication side effects, stroke-related physical and functional deficits, lack of knowledge, and concerns about safety, role changes, and change in libido can affect the patient’s sexual function. Healthcare workers need to help the patient and significant other navigate through the issues surrounding sexual function.

Multiple studies indicate that stroke survivors and their significant others have concerns about sexuality but are frequently reluctant to ask their healthcare providers about these concerns.889 This reluctance may stem from the patient’s embarrassment or other cultural barriers, as well as a lack of knowledge on the part of the healthcare provider. The greater the patient’s disability is, the greater is the likelihood of sexual dysfunction and decreased sexual life satisfaction.890 Stroke survivors report a desire for more information about sexuality from healthcare providers, physicians in particular.891 It is important for the patient and significant other to know that sex is not contraindicated after stroke. The most common sexual dysfunctions after stroke are decreased libido, erection and ejaculation disorders in men, lubrication and orgasm in women, and self-image and role changes for both men and women. Interventions and education about sexuality that address these concerns such as positioning, timing, open communication, and functional treatments can be helpful. Additional training for healthcare providers on this topic, including methods of appropriately approaching patients and their partners to discuss sexuality, may be needed.892

### Recreational and Leisure Activity

Engagement in leisure and recreational pursuits is important to health.893–896 Active leisure and recreational activities have been targeted as particularly important.894,895,897 However, individuals with stroke are limited in their ability to engage in leisure and recreational activities, particularly active ones.779,898–900

In general, poststroke rehabilitation in the United States provides little attention to leisure and recreation.902 Individuals with stroke report that they engage in significantly fewer leisure and recreation activities than they did before the stroke.898,899 In addition, the leisure activities in which they do engage have shifted from active to sedentary activities such as television watching and reading.898 Limited research examines the efficacy of rehabilitation for increasing participation in leisure and recreation activities. However, several studies (1 qualitative study, 2 RCTs, and 2 systematic reviews) suggest that therapy targeted at leisure/recreation and the provision of some adaptive equipment may facilitate increased engagement in leisure or recreation activities.794,903,904,906 Although therapy was variable across the studies, in several, the therapy consisted of education about the importance of being physically active, education on community resources, and training in problem solving around barriers to being physically active.794,903 One study that showed that such programming facilitated long-term increased physical activity engagement offered this kind of programming during rehabilitation, suggesting that such programming could begin early during rehabilitation.908,909 It must be noted, however, that this study took place in Europe, involved much longer durations of rehabilitation than individuals experience in the United States, and involved individuals with a variety of disabling conditions (only 26% were individuals with stroke); in addition, results were not broken down by disability condition. The provision of a wheelchair may be critical because many individuals with stroke who are able to ambulate do not have the endurance to ambulate for long periods in the community.906
Return to Work

In the United States, ≈20% of strokes occur in individuals who are of vocational age.910 Vocational roles provide a social identity and contribute to increased self-esteem and life satisfaction.911 It is estimated that about one third of the economic burden of stroke through the year 2050 will be attributable to lost earnings after stroke.912

The percentage of individuals who were working before their stroke who return to work after stroke varies widely across studies, from 20%913 to 66%.914 This stems from large differences in sample characteristics, healthcare and social system differences in different countries, various definitions of work, and variable follow-up periods. It is clear, however, that a large percentage of individuals with stroke who are of vocational age do not return to work. It is estimated that one third of the $1.75 trillion in annual costs associated with stroke are attributable to lost earnings in the United States alone.912 The factors associated with return to work have also varied across different studies. Factors most frequently found to be associated with return to work are younger age, less severe impairments, independence in ADLs, good communication skills, good higher-level cognitive skills and processing speed, and a white collar profession.915–921 Some of those who do return to work have been able to return full-time to their previous jobs; some have required job modifications or alternative jobs; and others were able to return only part-time.980,981,991 The ability to resume driving may also be an important factor in being able to return to employment.915

Because several of the variables presenting barriers to return to work are modifiable, therapy targeted at vocational goals has the potential to increase return-to-work rates for individuals with stroke. However, no controlled trials have examined the efficacy or effectiveness of therapy targeted at vocational goals or vocational rehabilitation programs, and a structured review found insufficient evidence to support or refute the efficacy of any specific vocational rehabilitation program.922 Several case studies suggest that for some individuals, therapy targeted at vocational goals can result in successful return to work.923,924 Chan and colleagues925 reported that their vocational rehabilitation program facilitates 55% of their enrollees to return to work. However, the lack of enrollee description makes it unclear how to interpret their success rate because several studies have found similar return-to-work rates without formal vocational rehabilitation. Although evidence is limited, many clinicians advise that for individuals considering return to work, an assessment of cognitive, perception, physical, and motor abilities be performed to determine readiness and the needed accommodations to return to work. This assessment should be tailored to the individual’s needs and capabilities for the specified job situation and may include executive functions, high-level oral and written communication, and fatigue. Once performance under the best conditions has been assessed, further assessment under conditions of fatigue and stress may be useful to mimic potential job situations.

Discrimination against individuals with disabilities remains common in the workplace and may not be identified by the prospective employer as a reason for denying a disabled candidate employment. Familiarity with the provisions of the Americans With Disabilities Act and its requirements for “reasonable accommodation” is important for individuals seeking to return to a job after stroke or seeking a new position. Rehabilitation professionals can serve as a resource for motivated employers to help overcome workplace barriers for employees with disabilities.

Return to Driving

Driving is an essential IADL for many individuals in that it has a major impact on participation in activities outside the home.928 Between one third and two thirds of individuals after stroke resume driving after 1 year.927,928 However, because driving is a highly complex activity that requires skills in cognition, perception, emotional control, and motor control,929 the ability to drive is often affected by stroke.928 State law determines whether someone with a stroke is eligible to drive. The law concerning this topic varies by state. For example, in some states, individuals who have a neurological condition (stroke, traumatic brain injury, Parkinson disease, multiple sclerosis), among other non-neurological health conditions, are required to report their health condition to the appropriate state agency (eg, Department of Transportation or Department of Public Safety). After this reporting, the physician should assess patients’ physical or mental impairments that might adversely affect driving abilities. Each case must be evaluated individually because not all impairments may give rise to an obligation on the part of the physician. In other states without self-reporting, physicians must take several initial steps before reporting: have a tactful but candid discussion with the patient and family about the risks of driving, suggest to the patient that he or she seek further treatment such as substance abuse treatment or OT, and encourage the patient and the family to decide on a restricted driving schedule. Efforts made by physicians to inform patients and families, to advise them of their options, and to negotiate a workable plan may render reporting unnecessary. Physicians should use their best judgment
when determining when to report impairments that could limit a patient’s ability to drive safely. The physician’s role is to report medical conditions that would impair safe driving as dictated by his or her state’s mandatory reporting laws and standards of medical practice. Physicians should disclose and explain to their patients this responsibility to report. Physicians should protect patient confidentiality by ensuring that only the minimal amount of information is reported and that reasonable security measures are used in handling that information. Physicians should work with their state medical societies to create statues that uphold the best interests of patients and community and that safeguard physicians from liability when reporting in good faith.936 The appropriate state agency determines whether the individual is allowed to keep his/her license or obtain a restricted license or whether another option is necessary. However, the decision about return to driving should happen with the physiatrist or primary care provider, patient with stroke, and family. If necessary, a driving rehabilitation specialist can perform a formal driving evaluation. The ASA Driving after Stroke Web site provides information on life after stroke.934a

The majority of individuals who sustain a stroke want to and do return to driving within a year after stroke.927,928,931 Despite a significant number of individuals in whom driving ability is reduced928,932 and the incidence of reduced self-awareness of driving difficulties after stroke,933 very few individuals are ever formally assessed for driving, nor is return to driving discussed with them.927,928,934 This is clearly a neglected area in the current healthcare system surrounding rehabilitation services after stroke.

There are no standardized driving assessment batteries. Many assessments contain both neuropsychological tests and on-the-road testing. There is no clear consensus on whether neuropsychological tests adequately predict the ability to drive. Two recent reviews (1 systematic review,936 1 meta-analysis937) examined the ability of neuropsychological tests to predict on-the-road driving test performance or voluntary cessation of driving across 37 studies (8 overlapping studies). The only neuropsychological test that was a significant predictor of fitness to drive in both reviews was the Trail Making Test B. There is great variation across studies in sample selection and in which neuropsychological tests were used to predict fitness to drive. For example, finding no effect for vision is likely the result of a biased sample excluding subjects with visual impairments consistent with state laws restricting such individuals from driving.937 Driving simulators offer the ability to test an individual for fitness to drive in dynamic environments that are safer than on-the-road tests.938 One cautionary note is that currently few studies have tested to what degree (if any) driving simulator performance is a sufficient predictor of on-the-road driving to determine the safety of return to driving. One study of 23 participants939 showed that the simulator performance variables of complex reaction time and distance to collision were able to correctly classify 85% of the participants as fit to drive or not. Because there is no single set of neuropsychological tests that can accurately predict fitness to drive, an on-the-road driving test should also be strongly considered, especially for individuals who possess the cognitive ability and are eligible on the basis of local laws.

Several studies have shown that some individuals with stroke who are unable to pass fitness-to-drive tests can do so after intervention.938,940–942 Intervention programs may involve adaptive equipment and training for the specific impairments interfering with driving (eg, infrared controls for 1-handed driving, cognitive training, vision training) or simulator training, on-road training, or their combination. Although few studies have tested the efficacy of driving training on driving ability, 2 studies have found simulator training to be superior to traditional cognitive training.938,941 One study showed that visual training with the Dynavision system (Dynavision LLC, West Chester, OH) did not result in increased driving ability.943 Unfortunately, other studies that investigated vision training and showed improved driving-related visual skills did not include measures of actual driving ability.944 Thus, the evidence is insufficient to determine whether visual training improves driving performance in those individuals with insufficient visual skills. In general, studies examining the efficacy of driver training suffer from small, heterogeneous samples. In addition, intervention programs in these studies do not appear to be specific to the impairments of the participants.

<table>
<thead>
<tr>
<th>Recommendations: Return to Driving</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individuals who appear to be ready to return to driving, as demonstrated by successful performance on fitness-to-drive tests, should have an on-the-road test administered by an authorized person.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>It is reasonable that individuals be assessed for cognitive, perception, physical, and motor abilities to ascertain readiness to return to driving according to safety and local laws.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>It is reasonable that individuals who do not pass an on-the-road driving test be referred to a driver rehabilitation program for training.</td>
<td>IIa</td>
<td>B</td>
</tr>
<tr>
<td>A driving simulation assessment may be considered for predicting fitness to drive.</td>
<td>IIb</td>
<td>C</td>
</tr>
</tbody>
</table>

**Conclusions**

Stroke rehabilitation requires a sustained and coordinated effort from a large team, including the patient and his or her goals, family and friends, other caregivers (eg, personal care attendants), physicians, nurses, physical and occupational therapists, speech-language pathologists, recreation therapists, psychologists, nutritionists, social workers, and others. Communication and coordination among these team members are paramount in maximizing the effectiveness and efficiency of rehabilitation and underlie this entire guideline. Without communication and coordination, isolated efforts to rehabilitate the stroke survivor are unlikely to achieve their full potential.

The evidence base on specific stroke rehabilitation interventions has expanded considerably in recent years, although many gaps remain. In addition to summarizing the current evidence base, this document serves to highlight areas where additional research is needed to clarify the most effective treatment strategies.
Treatment gaps and future research directions identified include the following:

- Investigate multimodal interventions (eg, drug and therapy, brain stimulation, and therapy)
- Consider including multiple outcomes such as patient-centered, self-report outcomes in future intervention effectiveness trials (Patient Reported Outcomes Measurement Information System [PROMIS])
- Consider computer-adapted assessments for personalized and tailored interventions
- Explore effective models of care that consider stroke as a chronic condition rather than simply a single acute event
- Capitalize on newer technologies such as virtual reality, body-worn sensors, and communication resources, including social media
- Develop interventions for individuals with severe stroke
- Develop better predictor models to identify responders and nonresponders to different therapies

As systems of care evolve in response to healthcare reform efforts, postacute care and rehabilitation are often considered a costly area of care to be trimmed, but without recognition of their clinical impact and their ability to reduce the risk of downstream medical morbidity caused by immobility, depression, loss of autonomy, and reduced functional independence. The provision of comprehensive rehabilitation programs with adequate resources, dose, and duration is an essential aspect of stroke care and should be a priority in these redesign efforts. We hope that these guidelines help inform these efforts.

### Appendix 1. Structure and Organization of Stroke Rehabilitation Care in the United States

<table>
<thead>
<tr>
<th>Setting</th>
<th>Admission</th>
<th>Median Length of Stay</th>
<th>Specialist Involvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute inpatient facility (hospital)</td>
<td>Near onset</td>
<td>4 d for ischemic stroke</td>
<td>Major: MD, RN More limited: OT, PT, SLT, SW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7 d for hemorrhagic stroke</td>
<td></td>
</tr>
<tr>
<td>IRF</td>
<td>5–7 d</td>
<td>15 d (range, 8–30 d)</td>
<td>Major: MD, RN, OT, PT, SLT More limited: SW</td>
</tr>
<tr>
<td>SNF</td>
<td>5–7 d</td>
<td>Highly variable (maximum, 100 d)</td>
<td>Major: LPN/LVN, NA, OT, PT, SLT More limited: MD, RN</td>
</tr>
<tr>
<td>Long-term care (nursing home)</td>
<td>Highly variable</td>
<td>Prolonged and highly variable</td>
<td>Major: LPN/LVN, NA More limited: RN, OT, PT, SLT</td>
</tr>
<tr>
<td>Long-term care hospital</td>
<td>Variable</td>
<td>25-d average (required)</td>
<td>Major: RN, MD More limited: OT, PT, SLT</td>
</tr>
<tr>
<td>HHCA</td>
<td>Variable (typically 5–30 d)</td>
<td>Maximum 60-d episode</td>
<td>Major: NA, RN More limited: OT, PT, SLT, MD</td>
</tr>
<tr>
<td>Outpatient office</td>
<td>Variable (typically 5–30 d)</td>
<td>Variable</td>
<td>Major: OT, PT, SLT, MD</td>
</tr>
</tbody>
</table>

HHCA indicates home healthcare agency; IRF, inpatient rehabilitation facility; LPN/LVN, licensed practical or vocational nurse; MD, medical doctor; NA, nurse assistant; OT, occupational therapist; PT, physical therapist; RN, registered nurse (preferably with training in rehabilitation); SLT, speech-language therapist; SNF, skilled nursing facility; and SW, social worker. Modified from Miller et al. Copyright © 2010, American Heart Association, Inc.

### Appendix 2. Recommended* Measures Table

<table>
<thead>
<tr>
<th>Construct/Measure</th>
<th>Comments</th>
<th>Approximate Time to Administer, min</th>
<th>References for Further Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impairment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Paresis/strength</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motricity Index</td>
<td>Consists of strength testing via manual muscle testing at 3 key UE segments and 3 key LE segments; yields a score from 0–100 indicating strength of each limb</td>
<td>&lt;5 for UE; &lt;5 for LE</td>
<td>294–299</td>
</tr>
<tr>
<td>Muscle strength</td>
<td>Via manual muscle testing, graded on a 0–5 scale or handheld dynamometry</td>
<td>&lt;5</td>
<td></td>
</tr>
<tr>
<td>Grip, pinch dynamometry</td>
<td>Grip and pinch dynamometers are available in most rehabilitation clinics and hospitals; normative data are available for comparison</td>
<td>&lt;5</td>
<td></td>
</tr>
<tr>
<td>Tone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Modified Ashworth scale</td>
<td>Quantifies spasticity on a scale measuring resistance to passive movement from 0–4, with higher numbers indicating greater severity; can assess at all joints or only a few</td>
<td>10</td>
<td>294, 298, 299</td>
</tr>
</tbody>
</table>

(Continued)
### Appendix 2. Continued

<table>
<thead>
<tr>
<th>Construct/Measure</th>
<th>Comments</th>
<th>Approximate Time to Administer, min</th>
<th>References for Further Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sensorimotor impairment measures</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fugl-Meyer</td>
<td>Quantifies sensorimotor impairment of the UE (0–66 points) and LE (0–34 points) on separate subscales; items are rated on ability to move out of abnormal synergies</td>
<td>25</td>
<td>298–302</td>
</tr>
<tr>
<td>Chedoke McMaster Stroke Assessment, impairment inventory</td>
<td>Quantifies impairments in 6 dimensions of shoulder pain, postural control, arm, hand, leg, and foot, each on a 7-point scale, with higher scores equalling less impairment</td>
<td>45</td>
<td></td>
</tr>
<tr>
<td><strong>Activity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UE function</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Action Research Arm Test</td>
<td>Criteria based with 19 items; scores are from 0–57, with normal=57; allows observation of multiple grasps, grips, and pinches</td>
<td>10</td>
<td>294, 298–300, 302–306</td>
</tr>
<tr>
<td>Box and Block Test</td>
<td>Score is the number of blocks moved in 1 min; higher scores equal better performance; normative data are available for comparison</td>
<td>&lt;5</td>
<td></td>
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<tr>
<td>Chedoke Arm and Hand Activity Index</td>
<td>Criterion based with functional items requiring bilateral UE movement; available in 7-, 8-, 9-, and 13-item versions</td>
<td>25</td>
<td></td>
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<tr>
<td>Wolf Motor Function Test</td>
<td>Time- and criterion-based scores on 15 items; contains some isolated joint movements and some functional tasks</td>
<td>15</td>
<td></td>
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<tr>
<td><strong>Balance</strong></td>
<td></td>
<td></td>
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<tr>
<td>Berg Balance Scale</td>
<td>Criterion-based assessment of static and dynamic balance; widely used in multiple settings</td>
<td>15</td>
<td>307–311</td>
</tr>
<tr>
<td>Functional Reach Test</td>
<td>A single-item test that measures how far one can reach in standing; normative data are available for comparison</td>
<td>&lt;5</td>
<td></td>
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<tr>
<td><strong>Mobility</strong></td>
<td></td>
<td></td>
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<tr>
<td>Walking speed†</td>
<td>Brief and widely used; categories based on speed are: &lt;0.4 m/s=household ambulation 0.4–0.8 m/s=limited community ambulation &gt;0.8 m/s=community ambulation; normative data available for comparison</td>
<td>&lt;5</td>
<td>307, 308, 312–314</td>
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<tr>
<td>Timed Up and Go</td>
<td>Quantifies more than straight walking, including sit/stand and a turn; scored by time to complete; criterion values available for comparison</td>
<td>&lt;5</td>
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<tr>
<td>6-Min walk test</td>
<td>Quantifies walking endurance; normative and criterion values for community ambulation distances available</td>
<td>&lt;10</td>
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<tr>
<td>Functional ambulation category</td>
<td>Classification made after observation or self-report of walking ability; 6-point scale with higher equals better walking ability; this tool allows assessment of walking ability in people who are not independent ambulators</td>
<td>&lt;5</td>
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<tr>
<td>Observational gait analysis</td>
<td>Commonly used in many clinics to plan treatment programs; several standardized formats are available; appropriate to use in conjunction with one of the above more quantifiable measures</td>
<td>5</td>
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<tr>
<td><strong>Participation</strong></td>
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<td></td>
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<tr>
<td>Self-reported impairments, limitations, and restrictions</td>
<td></td>
<td></td>
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<tr>
<td>Stroke Impact Scale: Strength, Mobility, ADL, and Hand Function subscales</td>
<td>These 4 subscales measure different aspects of physical performance; people rate their perceived ability to do different items; each subscale ranges from 0–100, with higher scores indicating better abilities</td>
<td>5 per subscale</td>
<td>294, 304, 307, 315</td>
</tr>
<tr>
<td>Motor Activity Log</td>
<td>14 or 28 questions about how the affected UE is used in daily life; scores range from 0–5, with 5 equal to similar to before the stroke</td>
<td>20</td>
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<tr>
<td>Activities-specific Balance Confidence Scale</td>
<td>16 questions in which people with stroke rate their balance confidence during routine activities; scores range from 0–100, with higher scores indicating more confidence</td>
<td>20</td>
<td>316–319</td>
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Appendix 2. Continued

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<th>Construct/Measure</th>
<th>Comments</th>
<th>Approximate Time to Administer, min</th>
<th>References for Further Information</th>
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Technology for monitoring activity and participation

- Accelerometers, step activity monitors, pedometers: Numerous commercially available options; issues to consider when purchasing: cost, expected wear and tear, accompanying software, ease of use, wearing comfort; pedometers are the most economic option but need to be checked for ability to register steps of individuals with slow walking speeds.

<5 to don/doff; additional processing time

7, 294, 321–328, 350

ADL indicates activity of daily living; LE, lower extremity; and UE, upper extremity.

*Note that it is recommended that clinicians select a single measure for each construct; it is often unnecessary to use >1 measure.

†Generally tested on 5- or 10-m walkways.

Disclosures

Writing Group Disclosures

<table>
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<tbody>
<tr>
<td>Carolee J. Winstein</td>
<td>University of Southern California</td>
<td>NIH (U01 award, NINDS/NICHD support); NIH (R01-NICHD HD065438)†</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>St. Jude Medical Business Services, Inc*</td>
<td>None</td>
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<tr>
<td>Joel Stein</td>
<td>Columbia University</td>
<td>Tyromotion, Inc.<em>; Myomo Inc.</em>; Tibion (now Alter-G)*; Nextra, Inc.†</td>
<td>None</td>
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<td>Ross Arena</td>
<td>University of Illinois Chicago</td>
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<tr>
<td>Barbara Bates</td>
<td>VAMC Physical Medicine and Rehabilitation</td>
<td>None</td>
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<tr>
<td>Leora R. Cherney</td>
<td>Rehabilitation Institute of Chicago for Aphasia Research and Treatment</td>
<td>NIDCD (NIH): principal investigator on grants 1R01DC011754 and 1R21 DC009876†; NIDILRR-HHS (principal investigator on grants H133E01101, H133P20013, and a subproject on H133E130019)†</td>
<td>None</td>
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<td>Rehabilitation Institute of Chicago†</td>
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<tr>
<td>Steven C. Cramer</td>
<td>University of California, Irvine</td>
<td>NIH†</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>Personal RN†</td>
<td>MicroTransponder*, Dart Neuroscience*, Roche*, RAND Corporation*</td>
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<tr>
<td>Frank Deruyter</td>
<td>Duke University</td>
<td>NIDRR†</td>
<td>None</td>
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<td>Janice J. Eng</td>
<td>University of British Columbia</td>
<td>Canadian Institutes of Health Research (peer-reviewed grants related to stroke rehabilitation)*</td>
<td>None</td>
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<td>Beth Fisher</td>
<td>University of Southern California</td>
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<tr>
<td>Richard L. Harvey</td>
<td>Rehabilitation Institute of Chicago</td>
<td>Nexstim Corporation*</td>
<td>None</td>
<td>None</td>
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<td>None</td>
<td>St. Jude Medical*; Nexstim Corporation†</td>
<td>None</td>
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<tr>
<td>Catherine E. Lang</td>
<td>Washington University School of Medicine (St. Louis)</td>
<td>NIH (grant to test interventions for individuals with stroke); NIH (coinvestigator on grant investigating brain connectivity after stroke)<em>; Barnes Jewish Hospital Foundation</em>; NIH (coinvestigator on grant to investigate postacute rehabilitation for general medical population)*</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>None</td>
<td>NeuroRehab, Inc*; Rehabilitation Institute of Chicago’s NIDRR National Center for Rehabilitation Robotics*; Centers of Excellence in Stroke Collaborative Research for Regeneration, Resilience, and Secondary Prevention*; American Heart/American Stroke Association*; Bugher Foundation*</td>
<td>Royalties for book, AOTA Press Inc*</td>
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<tr>
<td>Marilyn MacKay-Lyons</td>
<td>Dalhousie University School of Physiotherapy</td>
<td>None</td>
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<tr>
<td>Kenneth J. Ottenbacher</td>
<td>University of Texas at Galveston</td>
<td>NIH (principal investigator)<em>; NIDILRR (principal investigator)</em></td>
<td>None</td>
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<td>Sue Pugh</td>
<td>Johns Hopkins Bayview Medical Center</td>
<td>None</td>
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<td>Mathew J. Reeves</td>
<td>Michigan State University</td>
<td>None</td>
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<td>Lorie G. Richards</td>
<td>University of Utah</td>
<td>NIH (R21- principal investigator of pending grant to run a small clinical trial of sildenafil in stroke rehabilitation)<em>; NIH (RO1 coinvestigator on grant to develop magnetic resonance imaging methods to predict who benefits from motor rehabilitation after stroke)</em></td>
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<td>William Stiers</td>
<td>Johns Hopkins University School of Medicine</td>
<td>None</td>
<td>None</td>
<td>National Stroke Association*</td>
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<td>Richard D. Zorowitz</td>
<td>Medstar National Rehabilitation Network</td>
<td>Nexstim*; SPR Therapeutics*</td>
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<td>Allergan, Inc.<em>; Avanir Pharmaceuticals</em></td>
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*This table represents the relationships of writing group members that may be perceived as actual or reasonably perceived conflicts of interest as reported on the Disclosure Questionnaire, which all members of the writing group are required to complete and submit. A relationship is considered to be “significant” if (a) the person receives $10,000 or more during any 12-month period, or 5% or more of the person’s gross income; or (b) the person owns 5% or more of the voting stock or share of the entity, or owns $10,000 or more of the fair market value of the entity. A relationship is considered to be “modest” if it is less than “significant” under the preceding definition.

*Modest.
†Significant.

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<td>Wuwei Feng</td>
<td>Medical University of South Carolina</td>
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<td>Walter N. Kernan</td>
<td>Yale University School of Medicine</td>
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<td>Barbara J. Lutz</td>
<td>University of North Carolina–Wilmington</td>
<td>PCORI (consultant on a PCORI grant comparing outcomes for stroke patients receiving care from an inpatient rehabilitation hospital and subsacute care)*</td>
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<td>Stephen Page</td>
<td>Ohio State University Medical Center</td>
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<td>Elliot J. Roth</td>
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*Modest.
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Guidelines for Adult Stroke Rehabilitation and Recovery: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association


on behalf of the American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Quality of Care and Outcomes Research

Stroke. 2016;47:e98-e169; originally published online May 4, 2016;
doi: 10.1161/STR.0000000000000098

Stroke is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/47/6/e98

An erratum has been published regarding this article. Please see the attached page for:
/content/48/2/e78.full.pdf
/content/48/12/e369.full.pdf

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Correction to: Guidelines for Adult Stroke Rehabilitation and Recovery: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

In the article by Weinstein et al, “Guidelines for Adult Stroke Rehabilitation and Recovery: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association,” which published ahead of print May 4, 2016, and appeared in the June 2016 issue of the journal (Stroke. 2016;47:e98-e169. DOI: 10.1161/STR.0000000000000098), a correction was needed.

On page e98, above the byline, the following information has been added: “Accepted by the American Speech-Language-Hearing Association.”

This correction has been made to the current online version of the article, which is available at http://stroke.ahajournals.org/content/47/6/e98.full.
Correction to: Guidelines for Adult Stroke Rehabilitation and Recovery: A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

In the article by Weinstein et al, “Guidelines for Adult Stroke Rehabilitation and Recovery: A Guideline for Healthcare Professionals from the American Heart Association/American Stroke Association,” which published online May 4, 2016, and appeared in the June 2016 issue of the journal (Stroke. 2016;47:e98-e169. DOI: 10.1161/STR.0000000000000098), a correction was needed.

The guidelines stimulated considerable discussion, particularly regarding the issue of postacute care selection. Therefore, an addendum is provided to clarify and expand some of these recommendations and provide further guidance on this important aspect of poststroke rehabilitative care.

The addendum for this article is available at http://stroke.ahajournals.org/lookup/suppl/doi:10.1161/STR.0000000000000098/-/DC3. The full article is available at http://stroke.ahajournals.org/content/47/6/e98.
成人卒中康复和恢复指南

Guidelines for Adult Stroke Rehabilitation and Recovery

A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

端注：本指南旨在为成人卒中康复治疗的最佳临床实践进行概述。

方法：撰写组成员是由委员会主席根据在相关专业领域做出的前期工作所提名，并得到了美国心脏协会卒中委员会下属的科学声明监督委员会和稿件监督委员会的同意。通过电子检索截止到 2014 年以前的医学文献，撰写组回顾了有关成人卒中康复治疗的文章。指南的证据采纳遵循美国心脏学会的要求，并根据美国心脏协会 / 美国心血管病学会及其增补的疗效确定性水平和证据水平方案对证据进行分级。这份指南接受了美国心脏学会内外同行广泛的评议以及卒中委员会领导组和科学声明监督委员会的评审，并被美国心脏学会的科学咨询和协调委员会所批准。

结论：卒中后的康复需要一个庞大的团队长期协作的努力，这个团队包括患者本人及他（她）的目标、家庭和朋友、其他照顾者（如个体化的照料人员）、医生、护士、物理和作业治疗师、语言病理专家、娱乐治疗师、心理专家、营养师、社会工作者和其他人。团队成员之间的交流和协作对最大化康复治疗的效果和效率非常重要，并且也整个指南的核心。如果没有交流和协作，通过单方面的措施对卒中患者进行康复并不可能发挥最大的作用。

关键词：美国心脏协会科学声明；锻炼；瘫痪；功能恢复；康复；卒中

(Stroke. 2016;47:e98–e169. 四川大学华西医院神经内科 郭毅佳 译 何俐 校)
成人脳卒中のリハビリテーションと回復に関するガイドライン

Guidelines for Adult Stroke Rehabilitation and Recovery
A Guideline for Healthcare Professionals From the American Heart Association/American Stroke Association

Carolee J. Weinstein, PhD, PT, Chair; Joel Stein, MD, Vice Chair; Ross Arena, PhD, PT, FAHA; Barbara Bates, MD, MBA; Leora R. Cherney, PhD; Steven C. Cramer, MD; Frank Deruyter, PhD; Janice J. Eng, PhD, BSc; Beth Fisher, PhD, PT; Richard L. Harvey, MD; Catherine E. Lang, PhD, PT; Marilyn Mackay-Lyons, BSc, MScPT, PhD; Kenneth J. Ottenbacher, PhD, OTR; Sue Pugh, MSN, RN, CNS-BC, CRNN, CNRN, FAHA; Mathew J. Reeves, PhD, DVM, FAHA; Lorie G. Richards, PhD, OTR/L; William Stiers, PhD, ABPP (RP); Richard D. Zorowitz, MD; on behalf of the American Heart Association Stroke Council, Council on Cardiovascular and Stroke Nursing, Council on Clinical Cardiology, and Council on Quality of Care and Outcomes Research

このガイドラインは脳卒中後の回復過程にある成人患者に対する最善のリハビリテーション介入法の提供を目的とする。包括的リハビリテーションは脳卒中ケアに重要な一つで、リハビリテーションによって可動性の低下、うつ状態および要介護状態による疾病リスクを軽減し、機能的自立性の低下を防止する。

このガイドラインは電子版英文Stroke誌本年6月号（2016; 47: e98 - e169）に掲載された。内容的には2014年までの医学論文を検索し、米国心臓協会（AHA）のエビデンスクラスタク分類を用いて推奨を提供している。

AHAのエビデンス分類については、Stroke日本語版Vol.10, No.4, 2015, p29-32の「脳内出血の管理に関するガイドライン」を参照していただきたい。本ガイドラインは1)リハビリテーションプログラム、2)合併症の予防と管理、3) International Classification of Functioning, Disability, and Health (ICF)の身体機能に重点をおいた評価、4) ICFの活動レベルに重点をおいた感覚運動系障害と活動性（治療と介入）、5) ICFの参加レベルに重点をおいた医療の移行と地域社会におけるリハビリテーション、の5項目に区分されているが、70ページのガイドラインに表が40掲載されており、ここでは、3)身体機能障害の評価法と4)その治療と管理法についてのみ紹介し、各推奨も原則としてクラス1（推奨）とクラス3（施行すべきでない）に限定して表1～表18に記載するが、表の番号は日本語版独自のものである。

1. リハビリテーション プログラム: 脳卒中後は患者、家族、介護者を含めた、医師、看護師、理学療法士、作業療法士、言語聴覚療法士、臨床心理士、栄養士、ソーシャルワーカーなど各種専門職による組織で協調的なリハビリテーションが重要である。急性期には入院施設でのリハビリテーション、慢性期以降は外来または在宅リハビリテーションが勘められる。

2. 合併症の予防と管理：脳卒中急性期合併症の予防と管理は、過去に脳梗塞がStroke 2013;44:870-947に、脳内出血がStroke 2015;46:2032-2060に、くも膜下出血がStroke 2012;43:1711-1737に記載されている。本ガイドラインでは脳梗塞の予防、深部静脈血栓の予防、尿失禁と便失禁の予防、失眠症、肩関節症の予防と治療、自立機能、転倒の予防、尿失禁の予防、うつ状態と他の精神症状、骨粗鬆症について記載されている。

3. 身体機能障害の評価：脳卒中後のリハビリテーションには、全体的な評価が必要であり、基本的な日常生活活動（ADL）と、より高度な自立性が必要な手段のADL（IADL）を含めた機能評価が強調される（表1）。脳卒中後に運動機能障害が顕著に見られるものが推奨クラスはIIbと低い（表2）。理由としては、施設で観察される機能と施設外での日常生活活動の違いや、自己評価のバイアスなどが指摘されており、最近、機器を用いた客観的な評価によるデータが蓄積されている。コミュニケーション機能は日常生活に重要で、障害が長期に続く可能性があるため、早期の全体的評価と生活の質（QOL）向上的検討が必要である（表3）。認知・記憶機能の障害でも脳卒中後に長期化することが多く、不良な長期予後、高度の機能障害、施設入所につながる（表4）。

めった感覚障害（表5）は日常生活や地域活動の制限と結びつくので，存在すれば対応する必要がある。
4. 感覚運動系障害と活動性：本項目には日常生活に支障をきたす感覚運動系障害を主にその治療/介助方法が述べられている。個々の機能障害は英文原著の順に推奨を紹介する。唾下障害の検査，管理，栄養サポートは脳卒中後の認知症，脳炎，良性の防止に重要で，早期の嚥下スクリーミング，必要に応じた器具による嘔下障害の病態解析，適切な嚥下訓練と嚥下食を含む治療計画を推奨している。また経口摂取が困難な症例には早期の経管栄養，必要に応じた経皮的胃造設術（PEG）が推奨される（表6）。認知機能障害の非薬物療法には注意力，処理速度，実行機能，記憶，言語，知覚の障害が対象となる。
認知機能のリハビリテーションには伝統的な非薬物療法に重点がおかれ，認知機能の回復または再構築，代償手段の獲得，適応技術や適合器具による自立性の改善が目標とされ，無作為化比較試験（RCT）はまだ限られている（表7）。認知機能障害の薬物療法のうちdextroamphetamine, メチルフェニデート，モダフィニル，アトモセチンが適宜，うつ状態，疲労感などに試されているが，認知機能ではあまり検討されていない。ドのごベ，リバスタチン，抗うつ薬も試されているが，効果は確立していない（表8）。四肢の失行により日常生活を自立性で妨げられるが，療養に関する研究は限られている（表9）。半側空間無視は脳卒中後のリハビリテーションの妨げになり，時間経過ごと改善しうるが，長期間残存し日常生活を妨げることが多い。
リハビリテーションはボトムアップ方式とトップダウン方式により左側空間への注意喚起の改善，無視の代償手段確立を目的とするが，これまでの臨床試験は質的にも量的にも不充分である（表10）。コミュニケーション障害には失語，認知コミュニケーション障害，構音障害，発語失行が含まれ，コミュニケーションの回復，代償手段の確立が目標とされる（表11）。失語に対しては，早期の言語療法が中等度から重度の失語の転帰を改善するとのRCTがあり，慢性期（＞6ヶ月）でも言語療法が有効であるとの系統的レビューがある。また患者の希望をする介護者の訓練も有効である。薬物治療や脳刺激療法の有効性は確立されていない（表12）。運動性発語障害には構音障害と発語失行があり，社会的活動，心理的満足感，QOLに影響を及ぼす。治療として行動療法から電子デバイスまであり，個々の患者の状態を考慮して選択する必要がある（表13）。嚥下は入浴，衣服着脱などの制限や疼痛からADLを制限し，介助量を増加させ，QOLを低下させる。ボツリヌス毒素注射は上肢の筋縮によく使われているが，作業療法や理学療法と比較した費用効果は不明である。選択された下肢筋へのボツリヌス毒素注射も下肢の筋鑑を軽減させる。パテロフェン，ドニトロメタなどの抗筋縮薬は全般性筋縮をある程度軽減させるが，睡眠懸念や疲労感による用量制限がある。重症の全般性筋縮では，他の治療法が無効ならば，パテロフェンの骨内投与が考慮される（表14）。バランスと運動失調はADLの進行，移動，自立性的妨げとなり，バランスの自覚を失うと活動性が低下する。臨床的評価により適切な訓練方法が決まるが，系統的レビューでは転倒が不均一であり，RCTではバランス訓練の器具やプログラムが比較されたが，特に有効な治療法は決まっていない。運動失調は急性期リハビリテーション中に改善することが多く，片麻痺を伴わない失調の転倒は比較的良好とされる（表15）。可動性/歩行障害は重篤な脳卒中後遺症であり，歩行の回復がリハビリテーションの主眼となりえる。
立位，座位，階段昇降，歩いす移乗，車いす移動などが歩行関連動作に含まれる。系統的レビューによると，集中的，反復的な課題訓練により，歩行，歩行関連動作，ADLの転帰改善が示されているが，トレッドミルや電動器具支援による歩行訓練の効果については評価が進行中である。それ以外にも電気刺激，バイオフィードバック，薬物治療から仮想現実にいたる多様な手法が試みられている（表16）。ADL，IADL，誘触，固有受容器感覚を含む上肢機能障害は頻回にみられ，多くは不全麻痺である。上肢麻痺から完全に復活する症例は少なく，多くは上肢の機能障害，活動の制限，社会生活の制限が続く。リハビリテーションは，訓練によりその動作が改善するとの前提により，課題に特化した訓練または機能的課題の訓練による運動機能の習得と再習得に集中され，非麻痺側上肢を抑制する制御誘起運動療法（CIMIT）や神経筋電気刺激（NMES）のような介入療法と組み合わせて使われる。CIMITは手首と手指の伸展が可能な症例で上肢の動きとQOLを改善させると，より重篤な麻痺では回復の可能性は低く，様々なロボットによる治療法が使われているが，通常の上肢リハビリテーションと比較した利点は不明である。仮想現実とビデオゲームは上肢運動を増強させる可能性を有する。その他，体性感覚刺激，非侵襲的脳刺激（経頭蓋磁気刺激，経頭蓋直流刺激[iTCS]）などが上肢の運動療法に併用されるが，有効性は未定である（表
17. 適応器具、耐久性医療用具、装具、車いすは多くの患者に必要となる。日常生活に関係した様々な上下肢の適応器具と用具が存在するが、どれが必要かは個々の患者の機能障害、適応能力、住環境などにより決まる。多くの脳卒中の患者が動きに何らかの支援器具を必要とするが、程度により杖、歩行器を選択し、安全に歩行できない患者は車いすで可動性を高める。また下肢の運動障害には膝下装具（AFO）で代表される装着装具が使われ、効果が示されている（表18）。これにより、本項目では運動障害と回復、脳卒中の心効果不全と健康、慢性期の管理：在宅、地域社会における運動、視力障害、難聴といった項目が検討されている。

5. 運動の移行と地域社会でのリハビリテーション：急性期病院から自宅へ退院する患者と介護者は色々な問題が起こりやすいが、病院主導の移行ケアプランが脳卒中患者の転帰を改善させる。退院後リハビリテーションの継続が必要な患者には、可能な限り脳卒中リハビリテーションに精通した医療従事者を含むリハビリテーションを継続すべきであるが、退院後リハビリテーションが必要としない患者や、重度で長期の障害により慢性療養施設へ移る患者には一次医療従事者による医療を提供する。本項目では、社会的および家族内介護者のサポート、地域社会資源（人材、財源等）への紹介、地域社会でのリハビリテーション、性的機能、レクリエーションと余暇、職場復帰、無障の再開につき述べられている。

（文責：柳原武彦）

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<th>身体障害およびリハビリテーションの必要性の評価</th>
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<td>エビデンスのクラスとレベル</td>
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<tr>
<td>1. すべての脳卒中患者に対して、急性期病院からの退院前に日常生活動作（ADL）/手段的日常生活動作（IADL）、コミュニケーション能力、機能的可動性の判定を、所見と医療の移行および退院プランに取り入れることが推奨される。</td>
<td>クラスI：エビデンスレベルB</td>
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<tr>
<td>2. 急性期後リハビリテーション施設または高度養護施設（SNF）から退院して地域での自立生活に戻るすべての脳卒中患者に対して、退院後の生活環境に直接関連したADL/IADL評価が推奨される。</td>
<td>クラスI：エビデンスレベルB</td>
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<td>3. 後遺症として機能障害がある急性脳卒中患者に対して、リハビリテーションを専門とする臨床医による機能的評価が推奨される。</td>
<td>クラスI：エビデンスレベルC</td>
</tr>
<tr>
<td>4. 急性期後リハビリテーションの必要性の判断は、残存する神経障害、活動制限、認知・コミュニケーション-心理的状態、諮詢機能、発症前の機能と併存症状、家族・介護者のサポート体制、家族・介護者の脳卒中後患者に対する介護の必要性に対応できる能力、地域社会生活への復帰の可能性、リハビリテーションへの参加能力の評価に基づくべきである。</td>
<td>クラスI：エビデンスレベルC</td>
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<th>表2</th>
<th>運動障害、活動性、可動性の評価</th>
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<tr>
<td>1. 標準的評価尺度による運動障害の評価（麻痺／筋力、筋緊張、各筋の動き、協調運動）が有用かもしれない。</td>
<td>クラスIa：エビデンスレベルC</td>
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<table>
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<tr>
<th>表3</th>
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<tr>
<td>推 奥</td>
<td>エビデンスのクラスとレベル</td>
</tr>
<tr>
<td>1. コミュニケーション能力の評価は、面接、会話、観察、標準化テストまたは非標準化項目から構成され、発話、言語、認知・コミュニケーション、言語づかい（pragmatic）、読書、書字能力を評価し、コミュニケーションの長所と短所を明らかにし、有用な代替方法を特定すべきである。</td>
<td>クラスI：エビデンスレベルB</td>
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<th>表4</th>
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<td>推 奥</td>
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<tr>
<td>1. すべての脳卒中患者に対して、退院前に認知障害のスクリーニングを行うことが推奨される。</td>
<td>クラスI：エビデンスレベルB</td>
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<tr>
<th>表5</th>
<th>感覚障害（触覚、視覚、聴覚を含む）</th>
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<tr>
<td>推 奥</td>
<td>エビデンスのクラスとレベル</td>
</tr>
<tr>
<td>1. 脳卒中患者では感覚障害（触覚、視覚、聴覚を含む）の評価の適応があるだろう。</td>
<td>クラスIa：エビデンスレベルB</td>
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表6 暴下障害のスクリーニング、管理、栄養サポート

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<th>推薦項目</th>
<th>エビデンスのクラスとレベル</th>
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<tbody>
<tr>
<td>1. 急性脳卒中患者に対して、脱水、栄養失調、脱水素の合併症を引き起こす可能性がある暴下障害または尿嚙を発見するため、早期の暴下障害のスクリーニングが推奨される。</td>
<td>クラス1：エビデンスレベルB</td>
</tr>
<tr>
<td>2. 患者が飲食または薬剤の経口服用を開始する前に暴下の評価を推奨される。</td>
<td>クラス1：エビデンスレベルB</td>
</tr>
<tr>
<td>3. 脳卒中後4の誘発性障害のリスクを低減するため、口腔衛生プロトコールを実施すべきである。</td>
<td>クラス1：エビデンスレベルB</td>
</tr>
<tr>
<td>4. 安全に暴下できない患者では、脳卒中発症後7日以内に胃管栄養（経鼻栄養胃）を開始すべきである。</td>
<td>クラス1：エビデンスレベルA</td>
</tr>
<tr>
<td>5. 安全に暴下できない患者における短期間（2～3週間）の栄養サポートには、経鼻胃栄養を使用すべきである。</td>
<td>クラス1：エビデンスレベルB</td>
</tr>
<tr>
<td>6. 長期間にわたり安全な暴下が不可能な患者では、気管皮膚チューブを造設すべきである。</td>
<td>クラス1：エビデンスレベルB</td>
</tr>
<tr>
<td>7. 薬物療法、神経筋電気刺激療法（NMES）、脚底電気刺激療法、身体刺激療法、経頭蓋直流刺激療法（IDCS）、脊髄電気刺激療法は、有用性が明らかになっていないため、現時点では推奨されない。</td>
<td>クラスIII：エビデンスレベルA</td>
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</tbody>
</table>

表7 記憶障害を含む認知障害の非薬物療法

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<tr>
<td>1. 認知活動への関与を増やすような豊かな環境が推奨される。</td>
<td>クラス1：エビデンスレベルA</td>
</tr>
<tr>
<td>2. 言語に基づく複雑な注意力（作業記憶）を改善するための左脳側前頭葉皮質の脳損傷（IDCS）はまだ実験段階である。</td>
<td>クラスIII：エビデンスレベルB</td>
</tr>
</tbody>
</table>

表8 注意障害を含む認知障害を改善するための薬物療法

<table>
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<tr>
<th>推薦項目</th>
<th>エビデンスのクラスとレベル</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 脳卒中後認知障害の治療におけるdextroamphetamine、メチルフェニダート、モダフィニル、アトモキセチンの有用性は明らかになっていない。</td>
<td>クラスIIa：エビデンスレベルC</td>
</tr>
</tbody>
</table>

表9 四肢の失行

<table>
<thead>
<tr>
<th>推薦項目</th>
<th>エビデンスのクラスとレベル</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 失行のための戦略訓練またはジェスチャー訓練を考慮しても良いだろう。</td>
<td>クラスIIa：エビデンスレベルB</td>
</tr>
</tbody>
</table>

表10 半側空間無視または半側無関心

<table>
<thead>
<tr>
<th>推薦項目</th>
<th>エビデンスのクラスとレベル</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 無視症状を改善するため、プリズム適応、視野探索練習、視運動性刺激、仮想現実、四肢活性化、心像（mental image）形成、頭部振動刺激とプリズム適応の併用等の反復したトップダウン式およびボトムアップ式の介入を行うことが妥当である。</td>
<td>クラスIIa：エビデンスレベルA</td>
</tr>
</tbody>
</table>

表11 認知・コミュニケーション障害

<table>
<thead>
<tr>
<th>推薦項目</th>
<th>エビデンスのクラスとレベル</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 認知・コミュニケーション障害に対する介入は、オーダーメードであり、訓練、理解、認識の表現、言葉づかい（pragmatics）に影響を及ぼす劣るなコミュニケーションの障害や、注意力、記憶、実行能力を持つコミュニケーションを推奨する、あるいはその根拠にある認知障害を目標とするものであれば考慮することが妥当である。</td>
<td>クラスIIa：エビデンスレベルB</td>
</tr>
</tbody>
</table>

表12 失語

<table>
<thead>
<tr>
<th>推薦項目</th>
<th>エビデンスのクラスとレベル</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 失語の患者には言語療法が推奨される。</td>
<td>クラスIIa：エビデンスレベルA</td>
</tr>
<tr>
<td>2. 失語の治療には言語相手の訓練を含めるべきである。</td>
<td>クラスIIa：エビデンスレベルB</td>
</tr>
<tr>
<td>3. 行動言語療法の補助としての脳刺激療法は実験的であるとみられるため、現時点での日常使用は推奨されない。</td>
<td>クラスIII：エビデンスレベルB</td>
</tr>
</tbody>
</table>
表13 運動性発話障害：構音障害および発語失行

<table>
<thead>
<tr>
<th>推奨</th>
<th>エビデンスのクラスとレベル</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 運動性発話障害に対する介入は、個々の症例にオーダーメイドであるべきであり、行動的手段および呼吸、発声、発音、余儀を含む発話の生理的サポート、および音量、速度、音律のような発話全体を目標とする戦略を含めることがができる：</td>
<td>クラスⅠ：エビデンスレベルB</td>
</tr>
<tr>
<td>2. 発話を補助するために拡大・代替コミュニケーション機器および方法を用いるべきである。</td>
<td>クラスⅠ：エビデンスレベルC</td>
</tr>
</tbody>
</table>

表14 原因

<table>
<thead>
<tr>
<th>推奨</th>
<th>エビデンスのクラスとレベル</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 上肢筋のボツリヌス毒素の局所注射は短縮を軽減し、受動的または筋動的可動域を改善し、身支度、衛生、上肢のポジショニングを改善するために推奨される。</td>
<td>クラスⅠ：エビデンスレベルA</td>
</tr>
<tr>
<td>2. 下肢筋へのボツリヌス毒素の局所注射は、歩行機能を妨げる短縮を軽減するために推奨される。</td>
<td>クラスⅠ：エビデンスレベルA</td>
</tr>
<tr>
<td>3. 脳卒中後の手首および指の短縮の予防を目的とした副木およびテーピングの使用は推奨されない。</td>
<td>クラスⅢ：エビデンスレベルB</td>
</tr>
</tbody>
</table>

表15 バランスおよび運動失調

<table>
<thead>
<tr>
<th>推奨</th>
<th>エビデンスのクラスとレベル</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. バランスが悪い、バランスへの自信が薄い、転倒の恐怖感がある、もしくは転倒のリスクがある脳卒中患者には、バランスの訓練プログラムを提供すべきである。</td>
<td>クラスⅠ：エビデンスレベルA</td>
</tr>
<tr>
<td>2. 脳卒中患者では、バランスの改善に適切である場合、補助器具または装具を防患し、装着させるべきである。</td>
<td>クラスⅠ：エビデンスレベルA</td>
</tr>
<tr>
<td>3. 脳卒中患者では、バランス、バランスへの自信、転倒リスクを評価すべきである。</td>
<td>クラスⅠ：エビデンスレベルC</td>
</tr>
</tbody>
</table>

表16 可動性

<table>
<thead>
<tr>
<th>推奨</th>
<th>エビデンスのクラスとレベル</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 脳卒中後に歩行制限があるすべての患者に、集中的、反復的な可動性の課題訓練が推奨される。</td>
<td>クラスⅠ：エビデンスレベルA</td>
</tr>
<tr>
<td>2. 治療可能な歩行障害（例、下垂足）にある患者では、下垂足を代償し、可動性と麻痺した足首と脚の運動力学、速度、歩行のエネルギーコストを改善するため、脳卒中後の短下肢装具（AFO）が推奨される。</td>
<td>クラスⅠ：エビデンスレベルA</td>
</tr>
<tr>
<td>3. 運動機能回復を促進するためのdextroamphetamineまたはメチルフェニデートの使用は推奨されない。</td>
<td>クラスⅢ：エビデンスレベルB</td>
</tr>
</tbody>
</table>

表17 日常生活動作（ADL）、手袋の日常生活動作（IADL）、触感、固有受容性感情を含む上肢活動性

<table>
<thead>
<tr>
<th>推奨</th>
<th>エビデンスのクラスとレベル</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 機能的課題を訓練すべきである（すなわち、課題特有の訓練）。その際、訓練は、個々の能力に負荷をかけるためグレード化し、反復的訓練し、頻繁に異なる課題に進むべきである。</td>
<td>クラスⅠ：エビデンスレベルA</td>
</tr>
<tr>
<td>2. 頻繁に脳卒中患者過なニーズと最終的退院設定に合わせた日常生活動作（ADL）訓練を受けるべきである。</td>
<td>クラスⅠ：エビデンスレベルA</td>
</tr>
<tr>
<td>3. 頻繁に脳卒中患者過なニーズと最終的退院設定に合わせた手袋の日常生活動作（IADL）訓練を受けるべきである。</td>
<td>クラスⅠ：エビデンスレベルB</td>
</tr>
<tr>
<td>4. 日常生活動作（ADL）および上肢活動性の改善に減治療は推奨されない。</td>
<td>クラスⅢ：エビデンスレベルA</td>
</tr>
</tbody>
</table>

表18 適応器具、耐久性医療用具、装具、車いす

<table>
<thead>
<tr>
<th>推奨</th>
<th>エビデンスのクラスとレベル</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 歩行とバランス障害、さらに必要に応じて、移動操作および安全性を支援するために、歩行補助器具（杖、歩行器）を使用すべきである。</td>
<td>クラスⅠ：エビデンスレベルB</td>
</tr>
<tr>
<td>2. 不安定な足踏または骨盤筋力低下には、短下肢装具（AFO）を使用すべきである。</td>
<td>クラスⅠ：エビデンスレベルB</td>
</tr>
<tr>
<td>3. 不安定な足踏または歩行能力が低下している患者群手車を使用すべきである。</td>
<td>クラスⅠ：エビデンスレベルC</td>
</tr>
<tr>
<td>4. 他に課題／活動進行の方法がない、学習できない、もしくは患者の安全性が懸念される場合、安全と機械的に適応器具および補助装具を使用すべきである。</td>
<td>クラスⅠ：エビデンスレベルC</td>
</tr>
</tbody>
</table>
Addendum: Levels of Postacute Rehabilitation Care

Guidelines for Adult Stroke Rehabilitation and Recovery: A Guideline for Healthcare Professionals
From the American Heart Association/American Stroke Association

The American Heart Association/American Stroke Association (AHA/ASA) stroke rehabilitation guidelines\(^1\) have stimulated considerable discussion, particularly on the issue of postacute care selection. This addendum is intended to clarify and expand some of these recommendations to provide further guidance on this important aspect of poststroke rehabilitative care.

**Postacute Care**

Stroke survivors who are unable to return home because of residual disability or nursing and medical needs after stroke are typically admitted to either an acute inpatient rehabilitation facility (IRF) or a skilled nursing facility (SNF) and occasionally to other types of postacute facilities such as a long-term acute care hospital. The selection of postacute facility type has been shown to vary considerably geographically\(^2\)-\(^4\) and to be influenced by the proximity of the nearest IRF to the patient’s residence.\(^5\)

**Benefits of Acute Inpatient Rehabilitation Care**

Multiple observational studies have found improved outcomes for patients receiving care in an IRF compared with SNF care.\(^6\)-\(^18\) These studies are all limited by their observational nature, but the consistency of the finding supports the recommendation in the AHA/ASA stroke rehabilitation guidelines that patients who are eligible for and have access to IRF care receive this care. However, this recommendation does not explicitly address the appropriate use of SNFs for many stroke patients. SNFs are an important and highly used component of postacute care for stroke survivors in the United States. Accordingly, this addendum is intended to clarify this issue in particular and to address other issues of overlap between levels of care.

**Role of SNFs**

As discussed in the original guidelines, there are substantial numbers of stroke survivors who are inappropriate for IRFs and are typically admitted to SNFs for postacute care. These include individuals whose rehabilitation potential is limited, those who cannot tolerate an intensive rehabilitation program because of frailty or comorbidities, and those who do not require an intensive hospital-level rehabilitation program because of mild stroke–related disability or whose medical needs are relatively straightforward. Moreover, the geographic distribution of IRFs is less extensive than that of SNFs; therefore, a portion of stroke survivors lack convenient geographic access to IRFs. In addition, post-hospitalization rehabilitative care in an IRF and rehabilitative care in an SNF are not mutually exclusive. In a common sequence of care, a stroke survivor will undergo the first phase of his or her rehabilitation at an IRF and then transition to an SNF before returning to the home setting. Lastly, certain health insurance plans lack coverage for IRFs or use criteria that favor care in SNFs, limiting access for these individuals to IRF care. For all of these reasons, between \(\approx 20\%\)\(^19\) and \(31\%\)\(^8\) of stroke survivors receive postacute care in SNFs, which provide essential care and support during their recuperation and rehabilitation from stroke.

<table>
<thead>
<tr>
<th>Recommendations: Skilled Nursing Facility</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNF care can be useful for individuals who: (1) are unable to return directly home after hospitalization for a stroke and do not qualify for acute inpatient rehabilitation because of limited rehabilitation potential or inability to tolerate intensive rehabilitation; (2) do not require an intensive rehabilitation program; or, (3) lack geographic access to IRF care.</td>
<td>IIa</td>
<td>C</td>
</tr>
</tbody>
</table>

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Recommendations: Skilled Nursing Facility

<table>
<thead>
<tr>
<th>Recommendations</th>
<th>Class</th>
<th>Level of Evidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNF care can be useful for individuals who have completed a course of rehabilitation in an IRF but are unable to return directly home afterward because of ongoing rehabilitation needs, medical requirements, or personal care needs.</td>
<td>IIA</td>
<td>C</td>
</tr>
</tbody>
</table>

**Overlap Between SNFs and IRFs**

Although IRFs and SNFs must meet certain minimum standards based on regulatory requirements for the Medicare program, there is considerable variation in the services provided, particularly among SNFs, with some providing services in excess of the minimum requirements. It is unknown which aspects of IRF care result in the better outcomes observed in studies comparing these 2 levels of care. Possible contributors include the amount of physical, occupational, and speech therapy provided; the number of hours of care provided by a registered nurse per day; the frequency and type of physician visits; the background and skills of the clinicians; the regularly occurring interdisciplinary team conferences; or other factors. Thus, at this time, we are unable to determine what enhancements to basic SNF care might result in outcomes comparable to those of IRF care. We also acknowledge gaps in the types of postacute care available in the United States, particularly for patients who are not medically complex enough to qualify for long-term acute care but are too medically unstable for an SNF yet cannot tolerate the intensity of rehabilitation required for admission to an IRF.

The overlapping capabilities and patient populations between different postacute levels of care are receiving considerable attention at the federal level. The Improving Medicare Post-Acute Care Transformation Act of 2014 (HR 4994) is a law intended to change and improve Medicare's postacute care services and how they are reported. The purpose of this bill is to establish a common data set and outcome measures for all postacute providers and, ultimately, a common payment methodology based on patient characteristics rather than the setting where the postacute care is provided. Combined with relaxation of some regulatory requirements associated with these levels of care, a blurring of the distinctions between these levels of care may occur in the coming years.

**References**


