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Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery, and Community Participation following Stroke. *Part One: Rehabilitation and Recovery Following Stroke;* 6th Edition Update 2019

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Abstract

The sixth update of the *Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery, and Reintegration following Stroke. Part one: Rehabilitation and Recovery Following Stroke* is a comprehensive set of evidence-based guidelines addressing

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issues surrounding impairments, activity limitations, and participation restrictions following stroke. Rehabilitation is a critical component of recovery, essential for helping patients to regain lost skills, relearn tasks, and regain independence. Following a stroke, many people typically require rehabilitation for persisting deficits related to hemiparesis, upper-limb dysfunction, pain, impaired balance, swallowing, and vision, neglect, and limitations with mobility, activities of daily living, and communication. This module addresses interventions related to these issues as well as the structure in which they are provided, since rehabilitation can be provided on an inpatient, outpatient, or community basis. These guidelines also recognize that rehabilitation needs of people with stroke may change over time and therefore intermittent reassessment is important. Recommendations are appropriate for use by all healthcare providers and system planners who organize and provide care to patients following stroke across a broad range of settings. Unlike the previous set of recommendations, in which pediatric stroke was included, this set of recommendations includes primarily adult rehabilitation, recognizing many of these therapies may be applicable in children. Recommendations related to community reintegration, which were previously included within this rehabilitation module, can now be found in the companion module, *Rehabilitation, Recovery, and Community Participation following Stroke. Part Two: Transitions and Community Participation Following Stroke*.

Keywords
Stroke rehabilitation, practice guidelines, stroke unit, early supported discharge, spasticity, dysphagia, aphasia, visual perception

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Introduction

Globally, new data from the Global Burden of Disease reports one in four people will have a stroke in their lifetime.[1] In 2013, stroke was the second most common cause of all deaths (11.8%), behind ischemic heart disease (14.8%).[2] In 2017, the age standardized mortality rate for stroke was 80.5 per 100,000 population, representing a 13.6% decline since 2007.[3] The drop in mortality rate can be attributed, in part, to advancements in acute stroke care interventions and rapid systems response. However, stroke incidence has not declined to the same extent. For example, in Canada, the decrease in mortality from 1990 to 2016 was 38.3%, while the decrease in stroke incidence was only 17.2%.[4] As a consequence, stroke remains a leading cause of adult disability, with over 400,000 people living with its effects in Canada.[5] By 2038, the number of Canadians living with the effects of stroke is expected to increase to between 654,000 and 726,000.[5] Rehabilitation, which can best be described as a progressive, dynamic, goal-orientated process aimed at enabling a person with impairment to achieve their pre-stroke level of physical and social functioning, can commence as soon as the patient is medically stable. Rehabilitation programs can be offered in a variety of settings, depending on the initial stroke severity, individual progress, and availability, and include inpatient rehabilitation units, outpatient and ambulatory care clinics, community clinics, and recreation centers.

The rehabilitation process offers people with stroke their best opportunity for optimal recovery. Generally, complete recovery from a minor stroke can be expected within six months, while recovery from a more extensive stroke may be incomplete and take years. In some cases, people may reach a plateau in their recovery that can last months or longer; however, improvements in activity and participation are still possible at any time. Rehabilitation services and resources should be made available when needed for people recovering from stroke in Canada and elsewhere. However, the availability of stroke rehabilitation services can be quite limited outside large urban centers, and, where available, are often provided by general rehabilitation therapists, who may lack specialized stroke expertise.[6] The lack of services or funded services, putting people, especially between 18 and 64 years, in a situation to either seek private services that can be costly, or forgo supervised therapy and potentially not meet their rehabilitation and recovery potential.

The 2019 update of the Canadian Stroke Best Practice Recommendations (CSBPR): *Rehabilitation and Recovery following Stroke* module is a comprehensive summary of current evidence-based recommendations, focusing primarily on the management of people who have already had a moderately or severely disabling stroke. People with milder stroke or transient ischemic attack may not require as intense a rehabilitation plan, which can only be determined after appropriate assessment and goal setting.

The evidence for stroke rehabilitation continues to grow with an estimated 2400 randomized controlled trials (RCTs) of which almost two-thirds of studied interventions deal with motor recovery. There are challenges as half of the RCTs have less than 35 participants at study initiation and only one quarter are

multi-centered trials. The majority of studies are single-site RCTs, often with usual care controls. Larger multi-centered trials with active controls are needed. Many of the interventions for which good evidence exists are not integrated into clinical practice.

The theme of this edition of the CSBPR is *Partnerships and Collaborations*, which stresses the importance of integration and coordination across the healthcare system to ensure timely and seamless care of stroke patients to optimize recovery and outcomes. The importance of a coordinated and organized multidisciplinary approach to guide screening, assessment, and management decisions is emphasized throughout these guidelines. The CSBPR is appropriate for use by clinicians who care for people with stroke and their families, across multiple settings.

What's new in 2019?

The most notable change in this module is the removal of the section which detailed the social impacts of stroke on patients and family members. Topics related to return to work and driving, the pursuit of leisure activities, and issues surrounding sexuality are now included in a separate, companion module, entitled *Rehabilitation, Recovery and Reintegration following Stroke Part Two: Transitions and Community Participation following Stroke*. A section on pediatric stroke rehabilitation has also been removed and will be included in a separate module on pediatric stroke care across the continuum, including rehabilitation.

Most of the updates in this module pertain to recommendations related to upper-limb rehabilitation and mobility, informed by new evidence, or a re-evaluation of older evidence, as these are the areas where the most evidence is found. For upper extremity rehabilitation, new recommendations have been provided to address those persons who are unable to produce any voluntary muscle activity in the affected upper limb, which focus on compensatory techniques using the non-paretic arm and associated adaptive equipment to enable basic activities of daily living (ADL). More specific recommendations now discourage the use of slings except in the flaccid stage, encourage the use of taping of a hemiplegic shoulder to reduce pain, and a recommendation to elevate the arm when at rest to reduce hand edema. For the lower extremity, more detailed recommendations are now provided related to biofeedback and balance training. Gait aid recommendations have now been integrated into lower-limb gait training, balance, and aerobic training, rather than being a specific subheading of recommendations. In areas where insufficient evidence exists, a new classification section, entitled clinical considerations, has been added to each section, representing recommendations based on weaker evidence and/or expert consensus-based practices.

Guideline development methodology

The CSBPR development and update process follows a rigorous framework adapted from the Practice Guideline Evaluation and Adaptation Cycle[7,8] and addresses all criteria defined within the AGREE Trust model.[9] The CSBPR *Rehabilitation and Recovery following Stroke* Sixth Edition 2019 module supersedes all recommendations contained in the CSBPR Managing Stroke Transitions of Care 2015 Fifth Edition module.

The methodology has been used in previously published updates[6,10] and can be found on our Canadian Stroke Best Practices website at www.strokebestpractices.ca. An interdisciplinary group of experts in the area of rehabilitation was convened and participated in reviewing, drafting, and revising all recommendation statements. Selected members of the group, considered to be experts in their fields, have conducted clinical trials on the topics addressed in this module and have extensive publication records. The writing group included stroke neurologists, a geriatric psychiatrist, a clinical pharmacologist, neuropsychologists, physiotherapists, occupational therapists, a speech-language pathologist (SLP), a family physician, nurses, people with stroke, and evidence-based methodology experts. This interdisciplinary approach, which ensured that all perspectives were considered in the development of the recommendations, mitigated the risk of potential or real conflicts of interest from individual members. The module contents were reviewed by a group of people with stroke, their families, and caregivers.

A systematic literature search was conducted by experienced personnel to identify evidence for each topic area addressed in the current module. The literature for this module was updated to June 2019. The writing group was provided with comprehensive evidence tables that included summaries of all high-quality studies identified through the literature searches (evidence tables are available at www.strokebestpractices.ca). Systematic reviews, meta-analyses, RCTs, and observational studies were included, where available. The writing group discussed and debated the value of the evidence and, through consensus, developed a set of proposed recommendations. Through their discussions, additional research may have been identified and included in the evidence tables if consensus on the value of the research was achieved.

All recommendations were assigned a level of evidence ranging from A to C, according to the criteria defined in Table 1. The authors recognize that for many of the topics and associated recommendations for transitions and community participation, there is a paucity

Table 1. Summary of criteria for levels of evidence reported in the *Canadian Best Practice Recommendations for Stroke Care* (update 2019)

Level of evidence	Criteria
A	Evidence from a meta-analysis of randomized controlled trials or consistent findings from two or more randomized controlled trials. Desirable effects clearly outweigh undesirable effects or undesirable effects clearly outweigh desirable effects.
B	Evidence from a single randomized controlled trial or consistent findings from two or more well-designed non-randomized and/or non-controlled trials, and large observational studies. Desirable effects outweigh or are closely balanced with undesirable effects or undesirable effects outweigh or are closely balanced with desirable effects.
C	Writing group consensus and/or supported by limited research evidence. Desirable effects outweigh or are closely balanced with undesirable effects or undesirable effects outweigh or are closely balanced with desirable effects, as determined by writing group consensus. Recommendations assigned a Level-C evidence may be key system drivers supporting other recommendations, and some may be expert opinion based on common, new, or emerging evidence or practice patterns.

Source: adapted from Guyatt GH, Cook DJ, Jaeschke R, Pauker SG and Schünemann HJ. Grades of recommendation for antithrombotic agents: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (8th edition). *Chest* 2008; 133: 123S–131S.

of Level A evidence. RCTs are difficult to conduct in this area of care, and the evidences for most of the recommendations included in this module are based on qualitative and observational studies and expert opinion. People with stroke, families, and caregivers have expressed, through formal and informal assessment, that transitions in care, resuming life roles, and increasing community participation represent some of the greatest challenges faced after stroke. The CSBPR are responsive to this need; inclusion of some recommendations based on expert opinion and experience are intended to facilitate a holistic approach to person and family-centered care to promote optimal outcomes and highlight the importance of further research into this important aspect of stroke care. When developing and including "C-Level" recommendations, consensus was obtained among writing group members and validated through the internal and external review process. This level of evidence was used cautiously, and only when there was a lack of stronger evidence for topics considered important system drivers for stroke care. In some sections, the expert writing group felt there was additional information that should be included. Since these statements did not meet the criteria to be stated as recommendations, they were included under the term, *clinical considerations*, with the goal of providing additional guidance or clarity in the absence of evidence.

After a draft set of recommendations was developed, they underwent an internal review conducted by the Canadian Stroke Best Practices and Quality Advisory Committee, followed by external review from several Canadian and international experts who were not involved in any aspects of the guideline development. All feedback received was given careful consideration during the editing process. All recommendations are also accompanied by five additional supporting sections devoted to: the rationale (i.e. the justification for the inclusion of the selected topics), system implication (to ensure the structural elements and resources are available to achieve recommended levels of care), performance measures (to monitor care delivery and patient outcomes), a list of implementation resources, and a summary of the evidence on which the recommendations were based. Brief summaries of current research evidence are provided at the beginning of each section below. More detailed evidence summaries and links to all evidence tables, and additional knowledge translation information for the recommendations included in this publication, can be found at: www.strokebestpractices.ca. For a more detailed description of the methodology on the development and dissemination of the CSBPR, please refer to the CSBPR Overview and Methodology documentation available on the Canadian stroke best practices website at: www.strokebestpractices.ca. The CSBPR continue to be a work in progress. They are regularly updated every two to three years; whereby new recommendations are created and old ones revised or deleted, in response to new evidence.

Recommendations for Rehabilitation and Recovery following Stroke

Part A. Organization of a stroke rehabilitation system for optimal service delivery

Section 1: Recommendations on initial stroke rehabilitation assessment

Comprehensive assessments of a patient's functional and cognitive status conducted within the first few

days following a stroke are required to develop an individualized rehabilitation care plan. These assessments, which should be conducted using a standardized approach with validated tools, should include an evaluation of a person's ability to perform basic self-care activities (such as dressing, grooming, personal hygiene, feeding, functional mobility, and communication) and to identify potential discharge needs. Admission to an interprofessional program should be limited to patients who have more than one type of disability and who require the services of two or more rehabilitation disciplines. Three important factors influencing the decision to accept a patient for inpatient rehabilitation include pre-morbid cognition, pre-morbid mobility, and pre-morbid communication.[11] Patients with a single disability can usually benefit from outpatient or community-based services, and generally may not require an interdisciplinary program.

Section 1 Recommendations

1.0 All patients with acute stroke should be assessed to determine the severity of stroke and early rehabilitation needs.

(i) All patients ***admitted to hospital*** with acute stroke should have an initial assessment, conducted by rehabilitation professionals, as soon as possible after admission (Evidence Level A).
   a. The core rehabilitation professional team should include physiatrists, or other physicians with expertise/core training in stroke rehabilitation, occupational therapists, physiotherapists, SLPs, nurses, social workers, and dietitians (Evidence Level A). The patient and family are also included as part of the core team (Evidence Level C).
   b. Additional team members may include recreation therapists, psychologists, vocational therapists, educational therapists, kinesiologists, rehabilitation therapy assistants, and pharmacists. (Evidence Level C).
   c. All professional members of the rehabilitation team should have specialized training in stroke care and recovery (Evidence Level A).
   d. All professional team members should be trained in supported conversation to be able to interact with patients with communication limitations such as aphasia (Evidence Level B).

(ii) Initial screening and assessment should ideally be commenced within 48 h of admission by rehabilitation professionals in direct contact with the patient (Evidence Level C).
   a. Initial assessment may include: an evaluation of patient function, safety, physical readiness, and ability to learn and participate in rehabilitation therapies (Evidence Level C).
   b. It is reasonable to consider issues related to transition planning during the initial rehabilitation assessment (Evidence Level C).

(iii) Assessments of impairment, functional activity limitations, role participation restrictions, and environmental factors should be conducted using standardized, valid assessment tools (Evidence Level B); tools should be adapted for use with patients who have communication differences or limitations where required (Evidence Level B). *Refer to* Table 1: *Stroke rehabilitation screening and assessment tools, available at* www.strokebestpractices.ca

(iv) For patients who do not initially meet criteria for rehabilitation, weekly reassessment of rehabilitation needs may be considered weekly during the first month, and at intervals as indicated by their health status thereafter (Evidence Level C). *Refer to Box One for more information available at* www.strokebestpractices.ca

(v) All patients who present with acute stroke or TIA who are ***not admitted to hospital*** should be screened for the need to undergo a comprehensive rehabilitation assessment to determine the scope of deficits from index stroke event and any potential rehabilitation requirements (Evidence Level C).
   a. Priority screening areas, including evaluation of safety (cognition, fitness to drive), swallowing, communication, and mobility, should be completed by a clinician with expertise in stroke rehabilitation where feasible *before the patients leave the emergency* department or in the primary care setting (Evidence Level C). *Refer to CSBPR Secondary Prevention of Stroke module available at* www.strokebestpractices.ca.

b. Additional screening of impairments, including onset of depression, cognitive ability, functional activity limitations, role participation restrictions, environmental factors, and the presence of modifiable stroke risk factors (such as lifestyle behaviors) should be considered within two weeks of stroke onset (Evidence Level C).

(vi) Once a patient with stroke has undergone assessments, a standardized approach is recommended to determine the appropriate setting for rehabilitation (inpatient, outpatient, community, and/or home-based settings) (Evidence Level C).
   a. This standardized criteria for admission to any rehabilitation setting is ideally communicated to all referring centers and services (Evidence Level C).

Section 2: Recommendations on stroke rehabilitation unit care

Based on the most recent update of the Stroke Unit Trialists' Collaboration (SUTC) Cochrane review (2013) on organized inpatient care[12] including the results of 28 trials, the benefits of stroke unit care are firmly established. Patients who receive stroke unit care, characterized by an experienced interprofessional stroke team, dedicated to the management of stroke patients, often located within a geographically defined space, are more likely to survive, return home, and regain independence compared to patients who receive less organized forms of care. While the SUTC review included a variety of service delivery models, encompassing acute and rehabilitation care, in a subgroup analysis of three trials that compared stroke rehabilitation units specifically versus an alternative service, the odds of death at end of follow-up were reduced significantly. Although the odds of death or institutionalization dependency, death or dependency, and hospital length of stay (LOS) were not reduced, small sample sizes may have driven the null result.

Section 2 Recommendations

2.1 Stroke rehabilitation unit care

(i) All people who require inpatient rehabilitation following stroke should be treated on a specialized stroke rehabilitation unit (Evidence Level A), characterized by the following elements:
   a. Rehabilitation care is formally coordinated and organized (Evidence Level A).
   b. The rehabilitation unit is geographically defined (Evidence Level A).
   c. The rehabilitation unit is staffed by an interdisciplinary rehabilitation team with expertise/core training in stroke rehabilitation consisting of physicians (i.e. physiatrist, neurologist, or other physicians with training in stroke rehabilitation), nurses, physiotherapists, occupational therapists, SLPs, social workers, and clinical dietitians (Evidence Level A).
   d. Additional members of the interdisciplinary team may include pharmacists, transition planners, neuropsychologists, palliative care specialists, recreation and vocational therapists, kinesiologists, therapy assistants, spiritual care providers, peer supporters, and stroke recovery group liaisons (Evidence Level C).
   e. People with stroke, their families, and caregivers should have early and active involvement in the rehabilitation process (Evidence Level B).
   f. The interdisciplinary rehabilitation team follows evidence-based best practices as defined by current consensus-based clinical practice guidelines (Evidence Level B).
   g. Transition and discharge planning is initiated on admission to the unit (Evidence Level B).
   h. Education for the person who experienced a stroke, the family, and caregivers is provided both formally and informally, with consideration given to individual and group settings as appropriate (Evidence Level A).
   i. All team members should be trained and capable of interacting with people with communication limitations such as aphasia, by using supported conversation techniques (Evidence Level C).

(ii) People with moderate or severe stroke, who are ready for rehabilitation and have goals amenable to rehabilitation, should be given an opportunity to participate in inpatient stroke rehabilitation (Evidence Level A).

(iii) Where admission to a stroke rehabilitation unit is not possible, inpatient rehabilitation provided on a general rehabilitation unit is the next best alternative (i.e. where interdisciplinary care is provided to patients disabled by a range of disorders including stroke), where a physiatrist, occupational therapist, physiotherapist, and SLP are available on the unit or by consultation (Evidence Level B).
   a. Patients treated on general rehabilitation units should receive the same levels of care and interventions as patients treated on stroke rehabilitation units, as described in section 2.1 ((i) and (ii)).

2.2 Stroke rehabilitation team

Note: Applicable for all stroke rehabilitation settings (acute care hospital, outpatient clinic, community-based services, and programs)

2.2 Stroke rehabilitation should be delivered by an interdisciplinary team of health professionals, experienced in providing post-stroke care, regardless of where services are provided, to ensure consistency, and reduce the risk of complications (Evidence Level B).

(i) The interdisciplinary rehabilitation team should assess patients within 48 h of admission and together with the patient and family develop and document a comprehensive individualized rehabilitation plan which reflects the severity of the stroke and the needs and goals of the patient, the best available research evidence, and clinical judgment (Evidence Level C).

(ii) Stroke unit teams should conduct at least one formal interdisciplinary meeting per week to identify ongoing or new rehabilitation problems, set goals, monitor progress, and plan discharge for patients on the unit (Evidence Level B). Individualized rehabilitation plans should be regularly updated based on review of patient status (Evidence Level C).

(iii) Clinicians should consider use of standardized, valid assessment tools to evaluate the patient's stroke-related impairments, functional activity limitations, and role participation restrictions. Tools should be adapted for use in patients with communication limitations due to aphasia (Evidence Level C). *Refer to Table 1: Stroke rehabilitation screening and assessment tools, available at* www.strokebestpractices.ca

(iv) Personal factors (such as coping) and environmental factors could also be considered. (Evidence Level C).

Section 3: Recommendations on delivery of inpatient stroke rehabilitation

Early mobilization post stroke is intended to reduce the risk of medical complications, including deep vein thrombosis, pressure sores, painful shoulders, and respiratory infections. The potential benefits of very early mobilization (VEM) have been examined in several RCTs, with ambiguous results. The results of these trials have suggested harm[13] and equivalence between treatment and control groups.[14] While the results of a recent Cochrane review indicated that VEM within 24–48 h resulted in significantly decreased lengths of hospital stay and higher Barthel Index scores, the odds of death or poor outcome (dependency or institutionalization) were not reduced.[15] Moreover, data trends indicated that prolonged mobilizations were harmful. The main results of the A Very Early Rehabilitation Trial suggested that patients in the VEM group had significantly lower odds of a favorable outcome,[13] although subgroup analysis of the same trial were more nuanced.[16] Keeping time to first mobilization and frequency constant, every extra five minutes of out-of-bed activity per day reduced the odds of a favorable outcome and reduced the odds of walking unassisted for 50 m. However, regardless of group assignment, increasing the frequency of out-of-bed sessions improved the odds of favorable outcome by 13% and improved the odds of walking 50 m unassisted by 66%.[16]

Adequate intensity of therapy is another important element associated with successful inpatient rehabilitation outcomes. Greater levels (dose) of therapy during inpatient rehabilitation have been shown to increase Functional Independence Measure (FIM) gains.[17,18] In a systematic review, a large increase in additional therapy (≥240% of standard dose) was associated with significantly greater improvements in measures of upper and lower-limb activity.[19]

Section 3 Recommendations

(i) All patients with stroke should receive rehabilitation therapy as early as possible once they are medically stable and able to participate in active rehabilitation (Evidence Level A).

(ii) Early prolonged mobilization of patients within the first few days after a stroke, especially a severe stroke, is not recommended (Evidence Level A).

(iii) Earlier mobilization may be reasonable for select patients with acute stroke (for instance, people with more mild strokes or transient ischemic attack) but caution is advised, and clinical judgment should be used (Evidence Level C).

(iv) Once deemed to be medically and neurologically stable, patients should receive a recommended three hours per day of direct task-specific therapy, five days a week, delivered by the interdisciplinary stroke team (Evidence Level C); more therapy results in better outcomes (Evidence Level A).

(v) Individualized rehabilitation plans should include a patient-centered approach, shared decision-making, culturally appropriate, and agreed-upon goals and preferences of the patient, family, caregivers, and the healthcare team (Evidence Level C).

(vi) Patients should receive rehabilitation therapies of appropriate intensity and duration, individually designed to meet their needs for optimal recovery and tolerance levels (Evidence Level A).

(vii) Therapy should include repetitive and intense use of patient-valued tasks that challenge the patient to acquire the necessary skills needed to perform functional tasks and activities (Evidence Level A).

(viii) The team should promote the practice and transfer of skills gained in therapy into the patient's daily routine during inpatient stay (Evidence Level A) and continue after discharge to the community (Evidence Level C).

(ix) A pre-transition (discharge to another setting) needs assessment should be conducted to ensure a smooth transition from rehabilitation back to the community (Evidence Level B).

(x) Elements of transition planning may include:
   a. A home visit by a healthcare professional, ideally conducted before discharge, for patients where the stroke rehabilitation team and/or family have concerns regarding changes in functional, communication, and/or cognitive abilities that may affect patient safety (Evidence Level C).
   b. Assessment of the safety of the patient's home environment and the need for equipment and home modification (Evidence Level C).
   c. Caregiver education, training, and access to resources to assist the patient with ADL and increase the patient's level of independence (Evidence Level B).

(xi) Patients in stroke rehabilitation should be considered for referral to transition planners (such as stroke navigators) where these roles are available (Evidence Level B). *Refer to Transitions and Community Participation module for additional information*[20]

Section 4: Recommendations on outpatient and in-home stroke rehabilitation (including early supported discharge)

Outpatient therapy is often required following discharge from acute and/or rehabilitation inpatient services to help patients continue to make gains toward their rehabilitation goals. Continuing therapy may take several forms, depending on resource availability and patient considerations and include such models as hospital-based "day" hospital programs, community-based programs, or home-based rehabilitation. There is strong evidence based on the results from the Outpatient Service Trialists (2003)[21] that any form of

continuing rehabilitation therapy is superior to no additional therapy. At the end of scheduled follow-up, outpatient therapy was associated with significantly reduced odds of a poor outcome, greater improvements in ADL, extended ADL, and mood scores compared with usual care. The authors estimated that for every 100 persons with stroke in the community receiving therapy-based rehabilitation services, seven (95% confidence interval (CI): 2–11) patients would avoid a poor outcome. In terms of establishing the relative superiority of outpatient-based rehabilitation programs compared with continued inpatient services, the differences between service models appears minimal.[22]

Some patients with mild impairments can be safely transferred back to their homes to commence or continue their rehabilitation and achieve outcomes that are as good as or better than those that would have been attained had they participated in an inpatient rehabilitation program. This form of service provision, known as early-supported discharge (ESD), may be desirable where resources exist and may have the added benefit of being less costly. The effectiveness of ESD programs following acute stroke has been evaluated most comprehensively by the Early Supported Discharge Trialists. In the most updated version of the review,[23] ESD services were associated with a reduction in the odds of death or dependency at the end of scheduled follow-up (OR = 0.80, 95% CI: 0.67–0.95). The associated number needed to treat per 100 patients was 5. The benefits were greatest among patients with mild–moderate disability. ESD services were also associated with greater patient satisfaction and a significantly shorter LOS (MD = –5.5, 95% CI: −2.9 to −8.2 days).

Section 4 Recommendations

4.1 Outpatient and in-home rehabilitation

(i) Following stroke, people with ongoing rehabilitation goals should continue to have access to specialized stroke services after leaving hospital (Evidence Level A).
   a. This should include facility-based outpatient services and/or in-home rehabilitation services (Evidence Level A).

(ii) Outpatient and/or in-home rehabilitation services should be provided by specialized interdisciplinary team members as appropriate to patient needs and in consultation with the patient and family (Evidence Level C).
   a. Services should ideally begin within 48 h of discharge from an acute hospital or within 72 h of discharge from inpatient rehabilitation (Evidence Level C).

(iii) The choice of setting for outpatient and/or in-home rehabilitation service delivery should be based on patient functional rehabilitation needs, participation-related goals, availability of family/social support, patient and family preferences (Evidence Level C).
   a. Patients and families should be involved in their management, goal setting, and transition planning (Evidence Level A).

(iv) Outpatient and/or in-home rehabilitation services should include the same elements as coordinated inpatient rehabilitation services (Evidence Level B), and include:
   a. An interdisciplinary stroke rehabilitation team (Evidence Level A).
   b. A case coordination approach including regular team communication to discuss assessment of new clients, review client management, goals, and plans for discharge or transition (Evidence Level B).
   c. Therapy provided for a minimum of 45 min per day (Evidence Level B) per required discipline, 2–5 days per week, based on individual patient needs and goals (Evidence Level A); ideally for at least eight weeks (Evidence Level C).
   d. Interprofessional care planning and communication is essential to ensure continuity of care, patient safety, and to reduce risk of complications and adverse events during stroke care, particularly at transition points (Evidence Level C). *Refer to Transitions and Community Participation Module, Section 3 for more information.*[20]

(v) At any point in their recovery, people with stroke with change in functional status and who would benefit from additional rehabilitation services should be offered a further period of outpatient rehabilitation if they meet the requirements outlined in *Box one: Eligibility and criteria for stroke rehabilitation*, available at www.strokebestpractices.ca (Evidence Level B).

4.2 Early supported discharge (ESD)

(i) Early supported discharge services, designed to reduce length of hospital stay and still provide same intensity of inpatient rehabilitation, are an acceptable form of rehabilitation and should be offered to a select group of patients when available and provided by a well-resourced, coordinated specialized team (Evidence Level A).

(ii) Criteria for ESD candidacy include:
   a. Mild to moderate disability (Evidence Level A);
   b. Ability to participate in rehabilitation from the point of discharge (Evidence Level A);
   c. Medically stable, availability of appropriate nursing care, necessary resources, and support services (e.g. family, caregivers, and home care services) (Evidence Level A).

(iii) ESD services should be provided within 48 h of discharge from an acute hospital or within 72 h of discharge from inpatient rehabilitation (Evidence Level C).

(iv) Services should be provided five days per week at the same level of intensity as they would have received in the inpatient setting to meet patient needs (Evidence Level B). *Refer to Section 3 for more information.*
   a. Where possible, it should be provided by the same team that provided inpatient rehabilitation to ensure smooth transition (Evidence Level A).
   b. Where different therapists are providing the home-based rehabilitation, close communication with the hospital-based rehabilitation team is important during the transition and processes to facilitate communication should be implemented (Evidence Level C).

Part B. Providing stroke rehabilitation to address physical, functional, cognitive and emotional issues to maximize participation in usual life roles

Section 5: Management of upper extremity following stroke

Section 5.1: Recommendations on management of the upper extremity following stroke—General principles and therapies

One of the most common deficits following stroke is the reduction of arm, hand and wrist arm function due to weakness or hemiplegia, which limits function. The resulting impairments reduce a person's ability to perform basic ADLs and may cause pain and reduced range of motion (ROM). While almost three-quarters of persons with stroke will present with upper-limb impairment, only 5–20% of persons can expect to achieve full functional recovery six months following stroke.[24] Persons who experience mild to moderate upper extremity paresis acutely following stroke have a good prognosis for functional recovery, with 71% achieving some dexterity at six months after stroke.[25] However, the prognosis for persons with severe impairment initially is poor with 62% failing to achieve some dexterity at six months after stroke.[26]

While rehabilitation of the upper limb following stroke is a complex process, many therapeutic approaches, techniques, and treatment modalities recommended below are available. Some interventions have a stronger evidence base to support their use than others. Factors that may influence the selection of treatment options include their availability within the facility, therapist training, and the appropriateness for the individual patient and the targeted deficit.

Section 5.1 Recommendations

Evidence Grading System*: For the purposes of these recommendations, "**early**" refers to strength of evidence for therapies applicable to patients who are less than six months post stroke, and "**late**" refers to strength of evidence for therapies applicable to patients who are more than six months from index stroke event.*

A. General principles

(i) Patients should engage in training that is meaningful, engaging, repetitive, progressively adapted, task-specific, and goal-oriented in an effort to enhance motor control and restore sensorimotor function (Evidence Level: Early-Level A; Late-Level A).

(ii) Training should encourage the use of patients' affected limb during functional tasks and be designed to simulate partial or whole skills required in ADL (e.g. folding, buttoning, pouring, and lifting) (Evidence Level: Early-Level A; Late-Level A).

B. Specific therapies

Note: Selection of appropriate therapies will differ between patients and depend on the severity of the impairment. This should be considered when establishing individualized rehabilitation plans.

(i) **ROM exercises** (passive and active assisted) that includes placement of the upper limb in a variety of appropriate and safe positions within the patient's visual field should be provided (Evidence Level C). *Refer to Recommendation "Recommendations on management of shoulder pain and complex regional pain syndrome (CRPS) following stroke" for additional information.*

(ii) Following assessment to determine if they are suitable candidates, patients should be encouraged to engage in **mental imagery** to enhance upper-limb, sensorimotor recovery (Evidence Level: Early-Level A; Late-Level B).

(iii) **Functional Electrical Stimulation (FES**) targeted at the wrist and forearm muscles should be considered to reduce motor impairment and improve function (Evidence Level: Early-Level A; Late-Level A).

(iv) **Traditional or modified constraint-induced movement therapy** should be considered for a select group of patients who demonstrate at least 20° of active wrist extension and 10° of active finger extension, with minimal sensory deficits and normal cognition (Evidence Level: Early-Level A; Late-Level A).

(v) **Mirror therapy** should be considered as an adjunct to motor therapy for patients with very severe paresis. It may help to improve upper extremity motor function and ADLs (Evidence Level: Early-Level A; Late-Level A).

(vi) Despite mixed evidence, **sensory stimulation** (e.g. transcutaneous electrical nerve stimulation, acupuncture, biofeedback) can be considered as an adjunct to improve upper extremity function (Evidence Level B).

(vii) **Virtual reality**, including both immersive technologies such as head mounted or robotic interfaces and non-immersive technologies such as gaming devices can be used as adjunct tools to other rehabilitation therapies as a means to provide additional opportunities for engagement, feedback, repetition, intensity, and task-oriented training (Evidence Level: Early-Level A; Late-Level A).

(viii) Therapists should consider **supplementary training programs** aimed at increasing the active movement and functional use of the affected arm between therapy sessions, e.g. Graded Repetitive Arm Supplementary Program suitable for use during hospitalization and at home (Evidence Level: Early-Level B; Late-Level C).

(ix) **Strength training** should be considered for persons with mild to moderate upper extremity impairment for improvement in grip strength (Evidence Level: Early-Level A; Late-Level A). Strength training does not aggravate tone or pain (Evidence Level A).

(x) **Bilateral arm training** is not recommended over unilateral arm training to improve upper extremity motor function (Evidence Level A).

(xi) **Non-invasive brain stimulation, including** repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) could be considered as an adjunct to upper extremity therapy (Evidence Level A (rTMS); Evidence Level B (tDCS)).

(xii) For patients who are unable to produce any voluntary muscle activity in the affected upper limb, the patient (and caregiver) should be taught **compensatory techniques** and be provided with adaptive equipment to enable basic ADLs (Evidence Level B).
   a. It is reasonable to continue teaching compensatory techniques until the patient can manage basic ADLs independently or until recovery of active movement occurs (Evidence Level C).

(xiii) Retraining trunk control should accompany functional training of the affected upper extremity (Evidence Level C).

C. Adaptive devices

(i) Adaptive devices designed to improve safety and function may be considered if other methods of performing specific functional tasks are not available or tasks cannot be learned (Evidence Level C).

(ii) Functional dynamic orthoses may be offered to patients to facilitate repetitive task-specific training (Evidence Level B).

Section 5.2: Recommendations on ROM and spasticity in the shoulder, arm, and hand

Spasticity, which is relatively common among persons who develop paresis following stroke, can be painful, interfere with functional recovery, and hinder rehabilitation efforts. If not managed appropriately, stroke survivors may experience a loss of ROM at involved joints, which can result in contracture. Permanent loss of joint ROM has been reported to occur as early as three to six weeks following stroke.[27] Although it is common in clinical practice to use range-of-motion or stretching exercises and splints to prevent or treat spasticity or contracture following stroke, there is a lack of evidence supporting their benefit.[28] While treatment with botulinum toxin-type A (BTX-A) can reduce focal spasticity in the finger, wrist, and elbow and may reduce pain,[29] it remains uncertain whether there is also improvement in upper-limb function.[30,31] After initial rehabilitation is completed, ongoing monitoring should be built into follow-up protocols and systems to identify changes in spasticity in need of treatment. For complex cases of spasticity management, a referral to a physician with knowledge of the comprehensive treatment options of spasticity is strongly advised as new therapies are emerging for select patients.

Section 5.2 Recommendations

***Definition**: For the purposes of these recommendations "**early**" refers to strength of evidence for therapies applicable to patients who are less than six months post stroke, and "**late**" refers to strength of evidence for therapies applicable to patients who are more than six months from index stroke event.*

(i) Spasticity and contractures may be managed by antispastic pattern positioning, range-of-motion exercises, and/or stretching (Evidence Levels: Early-Level C; Late-Level C).
   a. Routine use of splints is not recommended (Evidence Levels: Early-Level A; Late-Level B).
   b. In some select patients, the use of splints may be useful and should be considered on an individualized basis (Evidence Level C). A plan for monitoring the splint for effectiveness should be implemented and followed (Evidence Level C).

(ii) Chemo-denervation using botulinum toxin can be used to increase ROM and decrease pain for patients with focal symptomatically distressing spasticity (Evidence Levels: Early-Level B; Late-Level A).

(iii) Oral medications can be considered for the treatment of disabling spasticity, but side effects of fatigue and drowsiness are common and the benefits for treating spasticity appear to be marginal:
   a. Tizanidine can be used to treat more generalized, disabling spasticity (Evidence Levels: Early-Level C; Late-Level B).
   b. Baclofen can be used as a lower cost alternative to treat more generalized disabling spasticity (Evidence Levels: Early-Level C; Late-Level C).
   c. Benzodiazepines should be avoided due to sedating side effects, which may impair recovery (Evidence Level: Early-Level C; Late-Level C).

Section 5.3: Recommendations on management of shoulder pain and complex regional pain syndrome (CRPS) following stroke

The incidence of shoulder pain following stroke has been reported to be approximately 30% during the first year,[32,33] although estimates vary widely from study to study. Shoulder pain has been associated with impaired arm movement, reduced participation in rehabilitation activities, longer lengths of hospital stay,[34] and reduced quality of life (QoL).[35] Since shoulder pain is difficult to treat once it is established, prevention, initiated early post stroke, is emphasized. Improper handling, positioning, and transferring can exert stress on the shoulder with negative consequences, and should be avoided.

Section 5.3 Recommendations

Definition: *For the purposes of these recommendations "**early**" refers to strength of evidence for therapies applicable to patients who are less than six months post stroke, and "**late**" refers to strength of evidence for therapies applicable to patients who are more than six months from index stroke event.*

Note: Causes of shoulder pain may be due to the hemiplegia itself, injury or acquired orthopedic conditions due to compromised joint and soft tissue integrity and spasticity.

A. Prevention of hemiplegic shoulder pain and subluxation

(i) Joint protection strategies should be applied during the early or flaccid stage of recovery to prevent or minimize shoulder pain and injury. These include:
   a. Positioning and supporting the arm during rest (Evidence Level B).
   b. Protecting and supporting the arm during functional mobility; avoid pulling on the affected arm (Evidence Level C).
   c. Protecting and supporting the arm during wheelchair use; examples include using a hemi-tray, arm trough, or pillow (Evidence Level C).
   d. The use of slings should be discouraged with the exception of the flaccid stage given it may discourage arm use, inhibit arm swing, contribute to contracture formation, and decrease body image (Evidence Level C).

(ii) For patients with a flaccid arm (i.e. Chedoke–McMaster Stroke Assessment Impairment Inventory <3) electrical stimulation should be considered (Evidence Levels: Early-Level B; Late-Level B).

(iii) Overhead pulleys should not be used (Evidence Level A).

(iv) The arm should not be moved passively beyond 90 degrees of shoulder flexion or abduction, unless the scapula is upwardly rotated and the humerus is laterally rotated (Evidence Level B).

(v) Healthcare staff, patients, and family should be educated to correctly protect, position, and handle the involved arm (Evidence Level A).
   a. For example, careful positioning and supporting the arm during assisted moves such as transfers; avoid pulling on the affected arm (Evidence Level C).

B. Assessment of hemiplegic shoulder pain

(i) The assessment of the painful hemiplegic shoulder could include evaluation of tone, active movement, changes in length of soft tissues, alignment of joints of the shoulder girdle, trunk posture, levels of pain, orthopedic changes in the shoulder, and impact of pain on physical and emotional health (Evidence Level C).

C. Management of hemiplegic shoulder pain

(i) Treatments for hemiplegic shoulder pain related to limitations in ROM may include **gentle** stretching and mobilization techniques, and typically involves increasing external rotation and abduction (Evidence Level B).

a. Active ROM should be increased gradually in conjunction with restoring alignment and strengthening weak muscles in the shoulder girdle (Evidence Level B).

(ii) Taping of the affected shoulder has been shown to reduce pain (Evidence Level A).

(iii) If there are no contraindications, analgesics (such as ibuprofen or narcotics) can be considered for pain relief on an individual case basis (Evidence Level C).

(iv) Injections of botulinum toxin into the subscapularis and pectoralis muscles could be used to treat hemiplegic shoulder pain thought to be related to spasticity (Evidence Level B).

(v) Subacromial corticosteroid injections can be used in patients when pain is thought to be related to injury or inflammation of the subacromial region (rotator cuff or bursa) in the hemiplegic shoulder (Evidence Level B).

Note: For additional information on pain management, refer to Section 9.

D. Hand edema

(i) For patients with hand edema, the following interventions may be considered:
a. Active, active-assisted, or passive ROM exercises (Evidence Level C).
b. When at rest, the arm should be elevated if possible (Evidence Level C).
c. Retrograde massage (Evidence Level C).
d. Gentle grade 1–2 mobilizations for accessory movements of the hand and fingers (Evidence Level C).

(ii) There is insufficient evidence for or against compression garments, e.g. compression gloves (Evidence Level C).

E. Complex Regional Pain Syndrome (CRPS) (also known as Shoulder-Hand Syndrome or Reflex Sympathetic Dystrophy)

(i) **Prevention**: Active, active-assisted, or passive ROM exercises can be used to prevent CRPS (Evidence Level C).

(ii) **Diagnosis** should be based on clinical findings including pain and tenderness of metacarpophalangeal and proximal interphalangeal joints and can be associated with edema over the dorsum of the fingers, trophic skin changes, hyperaesthesia, and limited ROM (Evidence Level C).

(iii) A triple phase bone scan (which demonstrates increased periarticular uptake in distal upper extremity joints) can be used to assist in diagnosis (Evidence Level C).

(iv) **Management**: An early course of oral corticosteroids, starting at 30–50 mg daily for 3–5 days, and then tapering doses over 1–2 weeks can be used to reduce swelling and pain (Evidence Level B).

Section 6: Management of the lower extremity following stroke

Section 6.1: Recommendations on balance and mobility

Following stroke, motor impairment can negatively affect balance and the ability to ambulate. Contributing factors include hemiparesis, hemiplegia, sensory disturbances, ataxia, apraxia, spasticity, cognitive impairments, and visual perceptual deficits, among others. Approximately 35% of survivors with initial paralysis of the leg do not regain useful function, and 20–25% of all survivors are unable to walk without full physical assistance.[36] In this update of the CSBPR recommendations for rehabilitation, as with upper-extremity motor function, a wide range of treatment options are suggested, many of which are supported by strong (i.e. A level) evidence. New additions to the list of recommendations include FES to improve gait, which may help to increase gait speed,[37] and the additions of force platform biofeedback, virtual reality, and the use of balance boards to improve balance.

Section 6.1 Recommendations

***Definition**: For the purposes of these recommendations "**early**" refers to strength of evidence for therapies applicable to patients who are less than six months post stroke, and "**late**" refers to strength of evidence for therapies applicable to patients who are more than six months from index stroke event.*

A. General considerations

(i) Patients should participate in training that is meaningful, engaging, progressively adaptive, intensive, task-specific, and goal-oriented in an effort to improve transfer skills and mobility (Evidence Level: Early-Level A; Late-Level A).

B. Lower-limb gait training

(i) Strength training should be considered for persons with mild to moderate impairment in lower extremity function in both subacute (Evidence Level C) and chronic phases (Evidence Level B) of recovery. Strength training does not affect tone or pain (Evidence Level A).

(ii) Task and goal-oriented training that is repetitive and progressively adapted should be used to improve performance of selected lower-extremity tasks such as sit to stand, walking distance, and walking speed (Evidence Level: Early-Level A; Late-Level A).

(iii) Treadmill-based gait training (with or without body weight support) should be used to enhance walking speed, and distance walked as an adjunct to over-ground training or when over-ground training is not available or appropriate (Evidence Level: Early-Level A; Late-Level A).

(iv) Electromechanical (robotic) assisted gait training devices could be considered for patients who would not otherwise practice walking. They should not be used in place of conventional gait therapy (Evidence Level: Early-Level A; Late-Level A).

(v) Rhythmic auditory stimulation should be considered for improving gait parameters in stroke patients, including gait velocity, cadence, stride length, and gait symmetry (Evidence Level A).

(vi) Virtual reality training (such as non-immersive technologies) could be considered as an adjunct to conventional gait training (Evidence Level B).

(vii) Mental practice should be considered as an adjunct to lower extremity motor retraining (Evidence Level A).

(viii) FES should be used to improve strength and function (gait) in selected patients, but the effects may not be sustained (Evidence Level: Early-Level A; Late-Level A).

(ix) Biofeedback, in the form of visual and/or auditory signals to indicate unequal weight bearing and timing, can be used to enhance gait training and improve functional recovery (Evidence Level B).

(x) The need for gait aids, wheelchairs, and other assistive devices should be evaluated on an individual basis (Evidence Level: Early-Level C; Late-Level C).
   a. Prescription and/or acquisition of an assistive device should be based on anticipation of a long-term need (Evidence Level: Early-Level C; Late-Level C).
   b. Once provided, patients should be reassessed, as appropriate, to determine if changes are required or equipment can be discontinued (Evidence Level: Early-Level C; Late-Level C).

(xi) Ankle-foot orthoses should be used on selected patients with foot drop following proper assessment and with follow-up to verify its effectiveness (Evidence Level: Early-Level A; Late-Level A).

C. Balance

(i) Therapists should consider both voluntary and reactive balance control within their assessment and treatment (Evidence Level C).

(ii) The following therapies should be considered to improve balance following stroke:
   a. Trunk training/seated balance training (Evidence Level: Early-Level A; Late-Level A).
   b. Standing practice (i.e. sit-to-stand practice) (Evidence Level: Early-Level A).
   c. Force platform biofeedback (Evidence Level: Early-Level A; Late-Level A) and task-oriented training with or without multisensory intervention (Evidence Level: Late-Level A).
   d. Partial body weight support treadmill training (Evidence Level: Early-Level B).
   e. Balance training combined with virtual reality in the late phase of stroke (Evidence Level A), but not in the early phase of stroke (Evidence Level A).
   f. The use of unstable surfaces and balance boards (Evidence Level: Late-Level A).
   g. Cycling (Evidence Level: Early-Level B; Late-Level B).
   h. Aquatic balance training (Evidence Level: Late-Level B).
   i. Tai Chi (Evidence Level B).
   j. Balance training combined with visual feedback, motor imagery training, and whole-body vibration do not improve balance outcomes (Evidence Level: Early-Level A).

D. Aerobic training

(i) Once medically stable, patients should be screened for ability to participate in aerobic exercise by appropriately qualified health care professionals with expertise in aerobic training (Evidence Level C).
   a. A medical history and physical examination should be performed to identify factors that require special consideration or constitute a contraindication to aerobic exercise (Evidence Level: Early-Level B; Late-Level B).
   b. An exercise stress test with electrocardiogram, and monitoring of blood pressure and subjective symptoms, should be considered particularly for patients with a known history of cardiovascular disease (Evidence Level: Early-Level C; Late-Level C).
   c. If the target intensity of the planned program is light (i.e. <40–45% of predicted heart rate reserve), a clinical submaximal test (e.g. six-minute walk test) may be adequate to evaluate readiness for aerobic training (Evidence Level: Early-Level C; Late-Level C).

(ii) Individually tailored aerobic training involving large muscle groups should be incorporated into a comprehensive stroke rehabilitation program to enhance cardiovascular endurance and cognitive function (Evidence Level: Early-Level A; Late-Level A).
   a. To achieve a training effect, patients should participate in aerobic exercise at least three times weekly for a minimum of eight weeks, progressing as tolerated to 20 min or more per session, exclusive of warm-up and cool-down (Evidence Level: Early-Level B; Late-Level B).
   b. Heart rate and blood pressure should be monitored during training to ensure safety and attainment of target exercise intensity (Evidence Level: Early-Level A; Late-Level A).

(iii) To ensure long-term maintenance of health benefits, a planned transition from structured aerobic exercise to more self-directed physical activity at home or in the community should be implemented (Evidence Level: Early-Level A; Late-Level A).
   a. Strategies to address specific barriers to physical activity related to patients, health care providers, family, and/or the environment should be employed (Evidence Level: Early-Level A; Late-Level A).

Section 6.2: Recommendations on lower limb spasticity following stroke

Spasticity in the lower limb can also negatively affect balance and mobility following stroke. Spasticity appears to be less common in the lower extremity, compared with the upper extremity.[38,39] The prevalence of lower-limb spasticity following stroke was estimated to be one-third, based on results of a systematic review.[40] At four months post stroke, spasticity in the lower extremity was found to affect the hip (50%), knee (54%), and ankle (66%).[41] Lower-limb spasticity is manifested most commonly as equinovarus foot deformity, a condition characterized by the development of reduced ankle dorsiflexion, accompanied by forefoot inversion. Typically, this affects the swing phase of the stride such that the forefoot strikes the ground first instead of the heel. In the *late* stage of stroke, treatment with BTX-A has been shown to reduce spasticity in both the upper and lower extremity but may not improve function.[42] As with upper arm spasticity (Section "*Recommendations on* ROM *and spasticity in the shoulder, arm and hand*"), after initial rehabilitation is completed, ongoing monitoring should be built into follow-up protocols and systems to identify changes in spasticity in need of treatment. For complex cases of spasticity management, a referral to a physician with knowledge of the comprehensive treatment options of spasticity is strongly advised as new therapies are emerging for select patients.

Section 6.2 Recommendations

(i) Spasticity and contractures may be managed by antispastic pattern positioning, range-of-motion exercises, and/or stretching (Evidence Level: Early-Level C; Late-Level B).

(ii) Chemo-denervation using botulinum toxin can be used to reduce spasticity, increase ROM, and improve gait, for patients with focal symptomatically distressing spasticity (Evidence Level: Early-Level C; Late-Level A).
   a. Note, caution should be taken when delivering botulinum toxin in the early phase while patients are still recovering.

(iii) Oral medications can be considered for the treatment of disabling spasticity; however, side effects of fatigue and drowsiness are common and benefits for treating spasticity tend to be marginal.
   a. Tizanidine can be used to treat more generalized, disabling spasticity (Evidence Levels: Early-Level C; Late-Level B).
   b. Baclofen can be used as a lower cost alternative to treat more generalized disabling spasticity (Evidence Levels: Early-Level C; Late-Level C).
   c. Benzodiazepines should be avoided due to sedating side effects, which may impair recovery (Evidence Level: Early-Level C; Late-Level C).

(iv) Intrathecal Baclofen should be considered for specific cases of severe intractable and disabling/painful spasticity (Evidence Level: Late-Level B).

Section 6.3: Recommendations on falls prevention and management

Cognitive impairment and physical disabilities place persons with stroke at higher risk of falling.[43] During rehabilitation, unsafe gait, wheelchair confinement, and hemineglect have also been found to be significant risk factors for falling.[44] During hospitalization for stroke rehabilitation, estimates of the percentage of fallers during inpatient hospitalization range from 16.3%[45] to 39%.[46] Almost two-thirds of falls occurred during the first two weeks after admission. Once discharged home, estimates among community ambulators vary from 23%[47] to 73%.[48] Persons who fall during inpatient rehabilitation are more likely to fall once returning home.[48] Patients at highest risk of falling need to be

identified as soon as possible so that appropriate preventative measures can be taken.

Section 6.3 Recommendations

(i) Following stroke, all patients should be screened for fall risk by an experienced clinician at admission, at all transition points, after a fall, and/or whenever there is a change in health status (Evidence Level C). *Refer to Section 6.1C for recommendations regarding balance.*

(ii) Screening should include identification of medical, functional, cognitive, and environmental factors associated with risk of falling and fall injuries (e.g. orthostatic hypotension, dehydration, muscle weakness, and osteoporosis) (Evidence Level B).

(iii) Those identified as being at risk for falls should undergo a comprehensive interdisciplinary assessment that includes medical and functional history and evaluation of mobility, vision, perception, cognition, cardiovascular status, and environment (Evidence Level C).

(iv) Based on risk assessment findings, an individualized falls prevention plan should be implemented for each patient (Evidence Level B).
   a. The patient, family, and caregiver should be made aware of the patient's increased risk for falls and given a list of precautions to reduce their risk of falling (Evidence Level B).
   b. The patient, family, and caregiver should receive skills training to enable them to safely transfer and mobilize the patient (Evidence Level B). This should include what to do if a fall occurs and how to get up from a fall (Evidence Level C).
   c. The patient, family, and caregiver should receive education regarding suitable gait aids, footwear, transfers, and wheelchair use, considering the healthcare and community environment (Evidence Level B).
   d. Bed and chair alarms should be provided for patients at high risk for falls according to local fall prevention protocols (Evidence Level C).

(v) If a patient experiences a fall, they should be assessed for possible injury prior to an assessment of the circumstances surrounding the fall should be conducted to identify precipitating factors. Pre-existing falls prevention plans should be modified to reduce the risk of further falls (Evidence Level C).

Note: For treatment strategies for risks of falling (e.g. leg weakness, impaired balance, visual disturbances, cognitive impairment, sensory loss), refer to appropriate topics within this module.

Section 7: Recommendations on assessment and management of dysphagia and malnutrition following stroke

Dysphagia is common following stroke and is associated with an increased risk of medical complications, including pneumonia, and malnutrition, which can in turn lead to increased mortality, morbidity, and institutionalization.[49] Within the first seven days of stroke, the reported estimates of dysphagia, identified based on clinical, non-instrumental screening, and assessments, range from 29% to 67%.[50] The risk of pneumonia has been shown to be three times higher when patients are dysphagic.[50] While screening protocols for dysphagia are standard practice and included in many guidelines, the evidence of their effectiveness is lacking. In a recent systematic review,[51] Smith et al. reported that, based on the results from three RCTs, the percentage of patients who received dysphagia screening and developed pneumonia was not significantly lower, compared with patients in a control group who were not screened. In terms of interventions, while texture-modified diets and thickened liquids remain the mainstay of management, there is mounting evidence that swallowing therapy in many forms, including behavioral interventions, electrical stimulation, pharmacological agents, acupuncture, and non-invasive brain stimulation, can help to restore swallowing ability.[52]

Patients with dysphagia often do not receive sufficient caloric intake, which may lead to malnutrition and poorer outcomes. While oral supplementation can reduce the caloric/protein deficit in patients who are malnourished or at risk of malnutrition, routine supplementation has not been shown to improve functional outcome.[53] For patients who are unable to

maintain their nutritional status by oral intake, enteral feeding should be considered. The use of percutaneous endoscopic gastrostomy feeding tubes can reduce the risk of blocked or leaking feeding tubes, compared with or nasogastric (NG) tubes, but does not reduce the risk of mortality, death, or dependency or the risk of pneumonia.[54]

Section 7 Recommendations

7.1 Dysphagia

(i) Patients should be screened for swallowing impairment before any oral intake (e.g. medications, food, liquid) by an appropriately trained professional using a valid screening tool (Evidence Level B).

(ii) Abnormal results from the initial or ongoing swallowing screens should prompt referrals to a SLP, occupational therapist, dietitian, or other trained dysphagia clinicians for more detailed bedside swallowing assessment and management of swallowing, feeding, nutritional, and hydration status (Evidence Level C).
   a. An individualized management plan should be developed to address therapy for dysphagia, dietary needs, and specialized nutrition plans (Evidence Level C).

(iii) Videofluoroscopic swallow study (VSS, VFSS) or fiberoptic endoscopic examination of swallowing (FEES) should be performed on all patients considered at high risk for oropharyngeal dysphagia or poor airway protection, based on results from the bedside swallowing assessment, to guide dysphagia management (e.g. therapeutic intervention) (Evidence Level B).

(iv) Based on the videofluoroscopic swallow study (VSS, VFSS, MBS) or FEES, restorative swallowing therapy and/or compensatory techniques to optimize the efficiency and safety of the oropharyngeal swallow mechanism, should be implemented with monitoring and reassessment as required (Evidence Level B).
   a. Restorative therapy may include lingual resistance, breath holds, and effortful swallows (Evidence Level B).
   b. Compensatory techniques may address posture, sensory input with bolus, volitional control, and texture modification (Evidence Level B).

(v) Patients, families, and caregivers should receive education on swallowing, prevention of aspiration, and feeding recommendations (Evidence Level C).

(vi) To reduce the risk of aspiration pneumonia, patients should be permitted and encouraged to feed themselves whenever possible (Evidence Level C).

(vii) Patients should be given meticulous mouth and dental care and educated in the need for good oral hygiene to further reduce the risk of pneumonia (Evidence Level B).

7.2 Nutrition and hydration

(i) Patients should be screened for malnutrition, ideally within 48 h of inpatient rehabilitation admission using a valid screening tool (Evidence Level C).
   a. Patients can be rescreened for changes in nutritional status regularly throughout inpatient admission and prior to discharge, as well as periodically in outpatient and community settings (Evidence Level C).
   b. Results from the screening process can be used to guide appropriate referral to a dietitian for further assessment and ongoing management of nutritional and hydration status (Evidence Level C).

(ii) Stroke patients with suspected nutritional concerns, hydration deficits, dysphagia, or other comorbidities who may require nutritional intervention should be referred to a dietitian (Evidence Level B). Dietitians provide recommendations on:
   a. Meeting nutritional and fluid needs orally while supporting alterations in food texture and fluid consistency recommended by a SLP or other trained professional (Evidence Level B).
   b. Enteral nutrition support in patients who cannot safely swallow or meet their nutrient and fluid needs orally (Evidence Level B).

c. NG feeding tubes should be replaced by a gastric-jejunum tube if the patient requires a prolonged period of enteral feeding (Evidence Level B).

(iii) The decision to proceed with enteral nutrition support, i.e. tube feeding, should be made as early as possible after admission, usually within the first three days of admission in collaboration with the patient, family (or substitute decision maker), and the interdisciplinary team (Evidence Level B).

Section 8: Recommendations on rehabilitation of visual perceptual deficits

The overall prevalence of visual impairment early after stroke is estimated to be 65% (19–92%), using the results of 61 studies included in a recent systematic review.[55] There are several perceptual problems which can occur after stroke, the most recognized of which is visual inattention/neglect. Other perceptual problems include agnosia, visual hallucinations, and image movement problems. Persons with visual impairments tend to have had more disabling strokes[56] and are more commonly associated with right-sided lesions. Visual problems may negatively impact participation in rehabilitation programs, the ability to perform ADL, and quality of life, resulting in loss of independence, social isolation, impaired mobility, and depression.[57] There are a variety of interventions that can be used to address the consequences of stroke-induced visual sequelae, including *top-down* approaches (e.g. visual scanning, feedback or cueing, virtual reality, and mental practice), whose focus is remediation of the deficit, and *bottom-up* approaches (e.g. prisms, half-field, eye-patching, limb activation), aimed at compensation.

Section 8 Recommendations

(i) All patients with stroke should be screened for visual, visual motor, and visual perceptual deficits as a routine part of the broader rehabilitation assessment process (Evidence Level C).

(ii) Patients with suspected perceptual impairments (visuospatial impairment, agnosias, body schema disorders, and apraxias) should be assessed using validated tools (Evidence Level C).

(iii) Patients, families, and caregivers should receive education on visual-spatial neglect and treatment recommendations (Evidence Level C).

(iv) Visual scanning techniques should be used to improve perceptual impairments caused by neglect (Evidence Level B).

(v) Virtual reality or computer-based interventions for neglect should be used to improve visual perception and alleviate right-hemisphere bias (Evidence Level B).

(vi) There is insufficient evidence to recommend for or against limb activation to improve neglect (Evidence Level B).

(vii) There is conflicting evidence on the effectiveness of prism glasses and eye-patches for improving neglect (Evidence Level B).

(viii) Patients with suspected limb apraxia should be treated using errorless learning, gesture training, and graded strategy training (Evidence Level B).

(ix) Mirror therapy: Mirror therapy appears to improve neglect (Evidence Level B) and may be considered as an intervention for unilateral inattention (Evidence Level B).

(x) Mirror therapy combined with limb activation: Combining mirror therapy with limb activation appears to be more effective than limb activation alone at improving neglect (Evidence Level B).

Refer to CSBPR Transitions and Community Participation Section 4 for information on return to driving[20]

Section 9: Recommendations on rehabilitation to improve central pain

Central post-stroke pain (CPSP) is a neurological disorder, characterized by constant or intermittent pain in a body part occurring, often associated with sensory abnormalities that correspond to the brain territory that has been injured.[58] The prevalence of CPSP, although difficult to estimate due to a lack of a gold standard for diagnosis, is estimated to be between 1% and 12%.[59] The prevalence of CPSP is particularly high after lateral medullary infarction or lesions in the ventroposterior part of the thalamus.[59] The time between stroke and pain onset varies, but development of CPSP occurs most often within the first few months. Central pain is one of the most difficult types of pain to treat. Antidepressants and antiepileptics are used most frequently for the treatment of neuropathic pain, despite little published RCT evidence of their effectiveness.[60–62]

Section 9 Recommendations

(i) Patients with persistent Central Post Stroke Pain (CPSP) should receive a trial of low-dose, centrally acting analgesics (Evidence Level C):
   a. Patients should receive an anticonvulsant (such as gabapentin or pregabalin) as a first-line treatment for central nervous system pain (Evidence Level C).
   b. Patients should receive a tricyclic antidepressant (e.g. amitriptyline) or a Serotonin-norepinephrine Reuptake Inhibitor (particularly duloxetine) as second-line treatment (Evidence Level C).
   c. Treatment for patients resistant to first- and second-line treatment can include opioids or tramadol (Evidence Level C). Caution is advised for the use of opioids as there is a significant risk of physical dependency.

(ii) An individualized patient-centered approach for management of central pain syndromes should be implemented by an interdisciplinary team that includes healthcare professionals with expertise in mental health and central pain management (Evidence Level C).

Section 10: Recommendation on rehabilitation to improve language and communication

Aphasia, an acquired communication disorder that impairs the ability to process language, speak, and understand others, affects 21–38% of stroke survivors.[63] Aphasia is associated with increased length of hospital stay, inpatient complications, overall neurological disability, mortality, and discharge disposition.[63] The presence of aphasia is often associated with greater levels of disability[64] and increasing age.[65] Symptoms tend to improve over time. At six months, aphasia was completely resolved in 74% of persons and in 90% of persons with mild initial disability (National Institutes of Health Stroke Scale (NIHSS) < 5).[66] The main treatment for aphasia is speech and language therapy, whereby the person relearns and practices language skills and learns to use other ways to communicate. More intense therapy has been shown to be more effective for improving functional communication.[67]

Section 10 Recommendations

(i) All health care providers working with persons with stroke across the continuum of care should undergo training about aphasia and other communication disorders, including the recognition of the impact of aphasia and methods to support communication such as Supported Conversation for Adults with Aphasia (SCA™) (Evidence Level C).

Note: Other communication disorders may include: dysarthria, apraxia of speech, and cognitive communication deficits.

(ii) All stroke patients should be screened for communication disorders, ideally by a Speech Language Pathologist, and using a valid screening tool (Evidence Level C).
   a. If a Speech Language Pathologist is not available, this should be done by another appropriately trained professional (Evidence Level C).

(iii) Patients with any suspected communication deficits should be referred to a SLP for assessment in the following areas using valid and reliable methods: comprehension, verbal production, reading, writing, speech/voice, and cognitive-communication (Evidence Level C).

(iv) Persons with aphasia should have early access to a combination of intensive speech and language therapy and communication therapy according to their needs, goals, and impairment severity (Evidence Level B).

(v) Treatment to improve functional communication can include language therapy focusing on:
   a. Production and/or comprehension of words, sentences, and discourse (including reading and writing) (Evidence Level C).
   b. Conversational treatment (Evidence Level C).
   c. Constraint-induced language therapy (Evidence Level B).
   d. Use of non-verbal strategies, assistive devices, and technology (e.g. iPads, Tablets, other computer-guided therapies) which can be incorporated to improve communication (Evidence Level C).
   e. Use of computerized language therapy to enhance benefits of other therapies (Evidence Level C).

(vi) Appropriate patients should be assessed for their potential to benefit from using augmentative alternative communication (e.g. iPad, tablet, electronic devices, alphabet board) or other communication support tools (Evidence Level C).

(vii) Treatment to improve functional communication should include supported conversation techniques for potential communication partners of the person with aphasia (Evidence Level A).

(viii) Treatment for aphasia may include group therapy and conversation groups. Groups can be used to supplement the intensity of therapy during hospitalization and/or as continuing therapy following discharge (Evidence Level B).

(ix) All information intended for patient use should be available in aphasia-friendly formats (Evidence Level C).

(x) Families of persons with aphasia should be engaged in the entire process from screening through intervention, including family education and training in supported communication (Evidence Level C). *Refer to CSBPR Mood, Cognition and Fatigue following Stroke module, Section 1 for additional information on aphasia and depression.*[68]

(xi) The impact of aphasia on functional activities, participation, and QoL, including the impact on relationships, vocation, and leisure, should be assessed and addressed across the continuum of care (Evidence Level C). *Refer to CSBPR Transitions and Community Participation following Stroke module, Recommendation 4 for additional information.*[20]

Summary

The 2019 update of the CSBPR: *Rehabilitation, Recovery and Reintegration following Stroke. Part One: Rehabilitation and Recovery following Stroke* provides a set of evidence-based statements developed for healthcare professionals and system leaders to help guide the rehabilitation process post stroke across settings, and to ensure the necessary structures and resources are in place. The recommendations emphasize the importance of screening and assessment practices as a component of care. There are many effective rehabilitation interventions available, supported by a strong evidence base, from which to select from when making treatment decisions.

For overall comprehensive recovery, rehabilitation must occur in parallel to the implementation of secondary prevention strategies, such as blood pressure control, lipid management, and antithrombosis management for people with ischemic stroke. Within rehabilitation settings, the interdisciplinary team should work in tandem with stroke prevention services to ensure optimal prevention is in place, and any outstanding issues regarding etiology or future risk are addressed.

In addition, the rehabilitation needs of people with stroke often change over time, both in the early recovery period and at later stages of recovery. Recovery, plateaus, and then new progress may be experienced. Reassessment of functional changes and ongoing

rehabilitation needs are important elements of follow-up care across settings. This ongoing monitoring enables early identification of changes, enabling teams to act in a timely way for the prevention of future complications and functional decline. Those who participated on our Community Consultation and Review Panel for these recommendations frequently vocalized challenges and frustration when trying to gain access to further rehabilitation services months after the initial therapy was completed. They also noted that education throughout recovery was very valuable to them; it helped people with stroke, their families, and caregivers to set realistic expectations for recovery and prepare for return to their community.

Additional interventions that increase access to rehabilitation care that have not been included in this update involve the use of *Telerehabilitation* modalities, which can be used to improve upper arm motor function.[69] A series of recent Canadian studies has suggested telerehabilitation services work best when augmenting face-to-face rehabilitation or when other options are not available,[70] addressing resource gaps in more rural and remote communities.

The CSBPR continue to be a work in progress. They are regularly updated every two to three years; whereby new recommendations are created and old ones revised or deleted, in response to new evidence.

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Author contributions

Robert Teasell (First author) and Nancy M. Salbach (Co-first author) are co-chairs of the Rehabilitation and Recovery following Stroke expert writing group and lead authors contributing to all aspects of the development, data analysis, writing, editing, and final approval of this manuscript; M. Patrice Lindsay is corresponding author, senior editor of the guidelines and this manuscript, involved in all aspects of scientific literature review, writing group deliberations, external review process, manuscript preparation, and a writer of supplementary documentation. Andrea de Jong is the stroke best practices project lead and supported the internal and external review process and the final revisions of the guidelines and manuscript, and a writer of supplementary documentation. Anita Mountain and Jill Cameron are co-chairs of the Transitions, Participation and Reintegration Following Stroke expert writing group and contributed directly to the development of several recommendations included in this module. Nicole E. Acerra, Diana Bastasi, Sherri Carter, Joyce Fung, Mary-Lou Halabi, Jocelyn Harris, Esther Kim, Andrea Noland, Sepideh Pooyania, Annie Rochette, Bridget Stack, Erin Symcox, Debbie Timpson, Suja Varghese and Sue Verrilli are all members of Rehabilitation and Recovery following Stroke expert writing group and contributed by reviewing, analyzing, and discussing the evidence and collectively finalizing the wording of all included recommendations. Norine Foley conducted the evidence searches and completed the evidence tables and evidence summaries supporting this guideline update and contributed to writing of this manuscript. Jerome Iruthayarajah conducted some of the evidence searches and completed evidence tables. Gord Gubitz, Leanne K. Casaubon, and Dar Dowlatshahi are senior leaders of the stroke best practices and quality advisory committee and provided inputs throughout development of the recommendations, reviewed the manuscript, and provided inputs and feedback.

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References

1. Lindsay MP, Norrving B, Sacco RL, et al. World Stroke Organization (WSO): Global Stroke Fact Sheet 2019. *Int J Stroke* 2019; 14: 806–817.
2. Feigin VL, Norrving B and Mensah GA. Global burden of stroke. *Circ Res* 2017; 120: 439–448.
3. GBD 2017 Causes of Death Collaborators. Global, regional, and national age-sex-specific mortality for 282 causes of death in 195 countries and territories, 1980–2017: a systematic analysis for the Global Burden of Disease Study 2017. *Lancet* 2018; 392: 1736–1788.
4. GBD 2016 Stroke Collaborators. Global, regional, and national burden of stroke, 1990-2016: a systematic analysis for the Global Burden of Disease Study 2016. *Lancet Neurol* 2019; 18: 439–458.
5. Krueger H, Koot J, Hall RE, O'Callaghan C, Bayley M and Corbett D. Prevalence of individuals experiencing the effects of stroke in Canada: trends and projections. *Stroke* 2015; 46: 2226–2231.
6. Cameron JI, O'Connell C, Foley N, et al. Canadian Stroke Best Practice Recommendations: managing transitions of care following Stroke, Guidelines Update 2016. *Int J Stroke* 2016; 11: 807–822.
7. Graham ID, Harrison MB, Brouwers M, Davies BL and Dunn S. Facilitating the use of evidence in practice: evaluating and adapting clinical practice guidelines for local use by health care organizations. *J Obstet Gynecol Neonatal Nurs* 2002; 31: 599–611.
8. Vernooij RW, Alonso-Coello P, Brouwers M and Martínez García LCheckUp Panel. Reporting items for updated clinical guidelines: checklist for the reporting of updated guidelines (CheckUp). *PLoS Med* 2017; 14: e1002207.
9. Brouwers MC, Kho ME, Browman GP, et al. AGREE II: advancing guideline development, reporting and evaluation in health care. *CMAJ* 2010; 182: E839–E842.
10. Hebert D, Lindsay MP, McIntyre A, et al. Canadian stroke best practice recommendations: stroke rehabilitation practice guidelines, update 2015. *Int J Stroke* 2016; 11: 459–484.
11. Hakkennes S, Hill KD, Brock K, Bernhardt J and Churilov L. Selection for inpatient rehabilitation after severe stroke: what factors influence rehabilitation assessor decision-making? *J Rehabil Med* 2013; 45: 24–31.
12. Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst Rev* 2013; Cd000197.
13. AVERT Trial Collaboration group. Efficacy and safety of very early mobilisation within 24 h of stroke onset (AVERT): a randomised controlled trial. *Lancet* 2015; 386: 46–55.
14. Sundseth A, Thommessen B and Ronning OM. Outcome after mobilization within 24 hours of acute stroke: a randomized controlled trial. *Stroke* 2012; 43: 2389–2394.
15. Langhorne P, Collier JM, Bate PJ, Thuy MN and Bernhardt J. Very early versus delayed mobilisation after stroke. *Cochrane Database Syst Rev* 2018; CD006187.
16. Bernhardt J, Churilov L, Ellery F, et al. Prespecified dose-response analysis for A Very Early Rehabilitation Trial (AVERT). *Neurology* 2016; 86: 2138–2145.
17. Wang H, Camicia M, Terdiman J, et al. Daily treatment time and functional gains of stroke patients during inpatient rehabilitation. *PM R* 2013; 5: 122–128.
18. Imura T, Nagasawa Y, Fukuyama H, Imada N, Oki S and Araki O. Effect of early and intensive rehabilitation in acute stroke patients: retrospective pre-/post-comparison in Japanese hospital. *Disabil Rehabil* 2018; 40: 1452–1455.
19. Schneider EJ, Lannin NA, Ada L and Schmidt J. Increasing the amount of usual rehabilitation improves

activity after stroke: a systematic review. *J Physiother* 2016; 62: 182–187.
20. Mountain A, Lindsay MP, Teasell R, et al. Canadian Stroke Best Practice Recommendations: Rehabilitation, Recovery and Community Participation following Stroke. Part Two: Transitions and Community Participation Following Stroke. *Int J Stroke*, Epub ahead of print. DOI: 10.1177/1747493019897847.
21. Outpatient Service Trialists Therapy-based rehabilitation services for stroke patients at home. *Cochrane Database Syst Rev* 2003; Cd002925.
22. Hillier S and Inglis-Jassiem G. Rehabilitation for community-dwelling people with stroke: home or centre based? A systematic review. *Int J Stroke* 2010; 5: 178–186.
23. Langhorne P and Baylan S. Early supported discharge services for people with acute stroke. *Cochrane Database Syst Rev* 2017; 7: Cd000443.
24. Nakayama H, Jorgensen HS, Raaschou HO and Olsen TS. Recovery of upper extremity function in stroke patients: the Copenhagen Stroke Study. *Arch Phys Med Rehabil* 1994; 75: 394–398.
25. Nijland RH, van Wegen EE, Harmeling-van der Wel BC and Kwakkel GEPOS Investigators. Presence of finger extension and shoulder abduction within 72 hours after stroke predicts functional recovery: early prediction of functional outcome after stroke: the EPOS cohort study. *Stroke* 2010; 41: 745–750.
26. Kwakkel G, Kollen BJ, van der Grond J and Prevo AJ. Probability of regaining dexterity in the flaccid upper limb: impact of severity of paresis and time since onset in acute stroke. *Stroke* 2003; 34: 2181–2186.
27. Kuo C-L and Hu G-C. Post-stroke spasticity: a review of epidemiology, pathophysiology, and treatments. *Int J Gerontol* 2018; 12: 280–284.
28. Harvey LA, Katalinic OM, Herbert RD, Moseley AM, Lannin NA and Schurr K. Stretch for the treatment and prevention of contractures. *Cochrane Database Syst Rev* 2017; 1: Cd007455.
29. Wissel J, Ganapathy V, Ward AB, et al. OnabotulinumtoxinA improves pain in patients with post-stroke spasticity: findings from a randomized, double-blind, placebo-controlled trial. *J Pain Symptom Manage* 2016; 52: 17–26.
30. Ward AB, Wissel J, Borg J, et al. Functional goal achievement in post-stroke spasticity patients: the BOTOX(R) Economic Spasticity Trial (BEST). *J Rehab Med* 2014; 46: 504–513.
31. Shaw LC, Price CI, van Wijck FM, et al. Botulinum Toxin for the Upper Limb after Stroke (BoTULS) Trial: effect on impairment, activity limitation, and pain. *Stroke* 2011; 42: 1371–1379.
32. Adey-Wakeling Z, Arima H, Crotty M, et al. Incidence and associations of hemiplegic shoulder pain poststroke: prospective population-based study. *Arch Phys Med Rehabil* 2015; 96: 241–247.e241.
33. Lindgren I, Jönsson AC, Norrving B and Lindgren A. Shoulder pain after stroke: a prospective population-based study. *Stroke* 2007; 38: 343–348.
34. Roy C, Sands MR, Hill LD, Harrison A and Marshall S. The effect of shoulder pain on outcome of acute hemiplegia. *Clin Rehabil* 1995; 9: 21–27.
35. Adey-Wakeling Z, Liu E, Crotty M, et al. Hemiplegic shoulder pain reduces quality of life after acute stroke: a prospective population-based study. *Am J Phys Med Rehabil* 2016; 95: 758–763.
36. Hendricks HT, van Limbeek J, Geurts AC and Zwarts MJ. Motor recovery after stroke: a systematic review of the literature. *Arch Phys Med Rehabil* 2002; 83: 1629–1637.
37. Howlett OA, Lannin NA, Ada L and McKinstry C. Functional electrical stimulation improves activity after stroke: a systematic review with meta-analysis. *Arch Phys Med Rehabil* 2015; 96: 934–943.
38. Sommerfeld DK, Eek EU, Svensson AK, Holmqvist LW and von Arbin MH. Spasticity after stroke: its occurrence and association with motor impairments and activity limitations. *Stroke* 2004; 35: 134–139.
39. Watkins CL, Leathley MJ, Gregson JM, Moore AP, Smith TL and Sharma AK. Prevalence of spasticity post stroke. *Clin Rehabil* 2002; 16: 515–522.
40. Martin A, Abogunrin S, Kurth H and Dinet J. Epidemiological, humanistic, and economic burden of illness of lower limb spasticity in adults: a systematic review. *Neuropsychiatr Dis Treat* 2014; 10: 111–122.
41. Wissel J, Schelosky LD, Scott J, Christe W, Faiss JH and Mueller J. Early development of spasticity following stroke: a prospective, observational trial. *J Neurol* 2010; 257: 1067–1072.
42. Rosales RL, Efendy F, Teleg ES, et al. Botulinum toxin as early intervention for spasticity after stroke or non-progressive brain lesion: A meta-analysis. *J Neurol Sci* 2016; 371: 6–14.
43. Xu T, Clemson L, O'Loughlin K, Lannin NA, Dean C and Koh G. Risk factors for falls in community stroke survivors: a systematic review and meta-analysis. *Arch Phys Med Rehabil* 2018; 99: 563–573.e565.
44. Nyberg L and Gustafson Y. Using the Downton index to predict those prone to falls in stroke rehabilitation. *Stroke* 1996; 27: 1821–1824.
45. Czernuszenko A and Czlonkowska A. Risk factors for falls in stroke patients during inpatient rehabilitation. *Clin Rehabil* 2009; 23: 176–188.
46. Nyberg L and Gustafson Y. Patient falls in stroke rehabilitation. A challenge to rehabilitation strategies. *Stroke* 1995; 26: 838–842.
47. Lim JY, Jung SH, Kim WS and Paik NJ. Incidence and risk factors of poststroke falls after discharge from inpatient rehabilitation. *PM R* 2012; 4: 945–953.
48. Forster A and Young J. Incidence and consequences of falls due to stroke: a systematic inquiry. *BMJ* 1995; 311: 83–86.
49. Cohen DL, Roffe C, Beavan J, et al. Post-stroke dysphagia: a review and design considerations for future trials. *Int J Stroke* 2016; 11: 399–411.
50. Martino R, Foley N, Bhogal S, Diamant N, Speechley M and Teasell R. Dysphagia after stroke: incidence, diagnosis, and pulmonary complications. *Stroke* 2005; 36: 2756–2763.

51. Smith EE, Kent DM, Bulsara KR, et al. Effect of dysphagia screening strategies on clinical outcomes after stroke: a systematic review for the 2018 guidelines for the early management of patients with acute ischemic stroke. *Stroke* 2018; 49: e123–e128.
52. Bath PM, Lee HS and Everton LF. Swallowing therapy for dysphagia in acute and subacute stroke. *Cochrane Database Syst Rev* 2018; 10: Cd000323.
53. Dennis MS, Lewis SC and Warlow C. Routine oral nutritional supplementation for stroke patients in hospital (FOOD): a multicentre randomised controlled trial. *Lancet* 2005; 365: 755–763.
54. Gomes Jr. CA, Andriolo RB, Bennett C, et al. Percutaneous endoscopic gastrostomy versus nasogastric tube feeding for adults with swallowing disturbances. *Cochrane Database Syst Rev* 2015; Cd008096.
55. Hepworth L, Rowe F, Walker M, et al. Post-stroke visual impairment: a systematic literature review of types and recovery of visual conditions. *Ophthal Res* 2015; 5: 1–43.
56. Jones SA and Shinton RA. Improving outcome in stroke patients with visual problems. *Age Ageing* 2006; 35: 560–565.
57. Hepworth L and Rowe F. Visual impairment following stroke – the impact on quality of life: a systematic review. *Ophthal Res* 2016; 5: 1–15.
58. Andersen G, Vestergaard K, Ingeman-Nielsen M and Jensen TS. Incidence of central post-stroke pain. *Pain* 1995; 61: 187–193.
59. Klit H, Finnerup NB and Jensen TS. Central post-stroke pain: clinical characteristics, pathophysiology, and management. *Lancet Neurol* 2009; 8: 857–868.
60. Leijon G and Boivie J. Central post-stroke pain – a controlled trial of amitriptyline and carbamazepine. *Pain* 1989; 36: 27–36.
61. Vestergaard K, Andersen G, Gottrup H, Kristensen BT and Jensen TS. Lamotrigine for central poststroke pain: a randomized controlled trial. *Neurology* 2001; 56: 184–190.
62. Vranken JH, Dijkgraaf MG, Kruis MR, van der Vegt MH, Hollmann MW and Heesen M. Pregabalin in patients with central neuropathic pain: a randomized, double-blind, placebo-controlled trial of a flexible-dose regimen. *Pain* 2008; 136: 150–157.
63. Lazar RM and Boehme AK. Aphasia as a predictor of stroke outcome. *Curr Neurol Neurosci Rep* 2017; 17: 83.
64. Wade DT, Hewer RL, David RM and Enderby PM. Aphasia after stroke: natural history and associated deficits. *J Neurol Neurosurg Psychiatry* 1986; 49: 11–16.
65. Engelter ST, Gostynski M, Papa S, et al. Epidemiology of aphasia attributable to first ischemic stroke: incidence, severity, fluency, etiology, and thrombolysis. *Stroke* 2006; 37: 1379–1384.
66. Maas MB, Lev MH, Ay H, et al. The prognosis for aphasia in stroke. *J Stroke Cerebrovasc Dis* 2012; 21: 350–357.
67. Brady MC, Kelly H, Godwin J, Enderby P and Campbell P. Speech and language therapy for aphasia following stroke. *Cochrane Database Syst Rev* 2016; Cd000425.
68. Lanctot KL, Lindsay MP, Smith EE, et al. Canadian Stroke Best Practice Recommendations: Mood, Cognition and Fatigue following Stroke, 6th edition update 2019. *Int J Stroke*, Epub ahead of print 21 Jun 2019. DOI: 10.1177/1747493019847334.
69. Cramer SC, Dodakian L, Le V, et al. Efficacy of home-based telerehabilitation vs in-clinic therapy for adults after stroke: a randomized clinical trial. *JAMA Neurol*, Epub ahead of print 24 June 2019. DOI: 10.1001/jamaneurol.2019.1604.
70. Caughlin S, Mehta S, Corriveau H, et al. Implementing telerehabilitation after stroke: lessons learned from Canadian trials. *Telemed J E Health*, Epub ahead of print 9 September 2019. DOI: 10.1089/tmj.2019.0097.