International Journal of Stroke
WSO

International Journal of Stroke
2016, Vol. 11(4) 459–484

DOI: 10.1177/1747493016643553
wso.sagepub.com
SAGE

Canadian stroke best practice recommendations: Stroke rehabilitation practice guidelines, update 2015

Debbie Hebert[1,2], M Patrice Lindsay[2,3], Amanda McIntyre[4,5], Adam Kirton[6,7], Peter G Rumney[8], Stephen Bagg[9], Mark Bayley[1,2], Dar Dowlatshahi[10], Sean Dukelow[7], Maridee Garnhum[11], Ev Glasser[3], Mary-Lou Halabi[12], Ester Kang[13], Marilyn MacKay-Lyons[14], Rosemary Martino[2], Annie Rochette[15], Sarah Rowe[16], Nancy Salbach[2], Brenda Semenko[17], Bridget Stack[18], Luchie Swinton[19], Valentine Weber[20], Matthew Mayer[3], Sue Verrilli[21], Gabrielle DeVeber[2,22], John Andersen[23], Karen Barlow[7,24], Caitlin Cassidy[4], Marie-Emmanuelle Dilenge[25,26], Darcy Fehlings[2,8], Ryan Hung[8], Jerome Iruthayarajah[4], Laura Lenz[27], Annette Majnemer[25,26], Jacqueline Purtzki[28,29], Mubeen Rafay[30], Lyn K. Sonnenberg[23,31], Ashleigh Townley[7], Shannon Janzen[4], Norine Foley[32,33] and Robert Teasell[4,5,33]

Abstract

Stroke rehabilitation is a progressive, dynamic, goal-orientated process aimed at enabling a person with impairment to reach their optimal physical, cognitive, emotional, communicative, social and/or functional activity level. After a stroke, patients often continue to require rehabilitation for persistent deficits related to spasticity, upper and lower extremity dysfunction, shoulder and central pain, mobility/gait, dysphagia, vision, and communication. Each year in Canada 62,000 people experience a stroke. Among stroke survivors, over 6500 individuals access in-patient stroke rehabilitation and stay a median of 30 days (inter-quartile range 19 to 45 days). The 2015 update of the *Canadian Stroke Best Practice Recommendations: Stroke Rehabilitation Practice Guidelines* is a comprehensive summary of current evidence-based

[1]Toronto Rehabilitation Institute, University Health Network, Toronto, Ontario, Canada
[2]University of Toronto, Toronto, Ontario, Canada
[3]Heart and Stroke Foundation Canada, Ottawa, Canada
[4]St. Joseph's Healthcare – Parkwood Institute, London, ON, Canada
[5]Lawson Health Research Institute, London, ON, Canada
[6]Calgary Paediatric Stroke Program, Department of Paediatrics, University of Calgary, Calgary, Canada
[7]University of Calgary, Calgary, Canada
[8]Holland Bloorview Kids Rehabilitation Hospital, Toronto, Canada
[9]Queen's University, Ontario, Canada
[10]The Ottawa Hospital, University of Ottawa, Ottawa, Canada
[11]Queen Elizabeth Hospital, Charlottetown, Prince Edward Island, Canada
[12]Alberta Health Services, Stroke Program, Edmonton Zone, Edmonton, Canada
[13]Saskatoon Health Region, Saskatchewan, Canada
[14]Dalhousie University, Nova Scotia, Canada
[15]Université de Montréal, Quebec, Canada
[16]GF Strong Rehabilitation Centre, Vancouver, British Columbia, Canada
[17]Health Sciences Centre, University of Manitoba, Manitoba, Canada
[18]Horizon Health Network, New Brunswick, Canada
[19]Cardiovascular Health & Stroke Strategic Clinical Network, Alberta Health Services, Alberta, Canada
[20]Montreal Neurological Hospital, Montreal, Canada
[21]Northeastern Ontario Stroke Network, Ontario, Canada
[22]Hospital for Sick Children, Toronto, Ontario, Canada
[23]Glenrose Rehabilitation Hospital, University of Alberta, Alberta, Canada
[24]Alberta Children's Hospital, Calgary, Alberta, Canada
[25]Montreal Children's Hospital, Montreal, Canada
[26]McGill University, Montreal, Canada
[27]Canadian Paediatric Stroke Support Association, Ontario, Canada
[28]BC Children's Hospital, Vancouver, British Columbia, Canada
[29]Faculty of Medicine, University of British Columbia, Canada
[30]Children's Hospital, University of Manitoba, Manitoba, Canada
[31]Stollery Children's Hospital, Edmonton, Canada
[32]workHORSE Consulting Limited, London, Ontario, Canada
[33]Department of Physical Medicine and Rehabilitation, Schulich School of Medicine and Dentistry, Western University, London, ON, Canada

Corresponding author:
Patrice Lindsay, Heart and Stroke Foundation, 222 Queen Street, Suite 1402, Ottawa, Ontario K1P 5V9, Canada.
Email: plindsay@hsf.ca

recommendations for all members of multidisciplinary teams working in a range of settings, who provide care to patients following stroke. These recommendations have been developed to address both the organization of stroke rehabilitation within a system of care (i.e., Initial Rehabilitation Assessment; Stroke Rehabilitation Units; Stroke Rehabilitation Teams; Delivery; Outpatient and Community-Based Rehabilitation), and specific interventions and management in stroke recovery and direct clinical care (i.e., Upper Extremity Dysfunction; Lower Extremity Dysfunction; Dysphagia and Malnutrition; Visual-Perceptual Deficits; Central Pain; Communication; Life Roles). In addition, stroke happens at any age, and therefore a new section has been added to the 2015 update to highlight components of stroke rehabilitation for children who have experienced a stroke, either prenatally, as a newborn, or during childhood. All recommendations have been assigned a level of evidence which reflects the strength and quality of current research evidence available to support the recommendation. The updated Rehabilitation Clinical Practice Guidelines feature several additions that reflect new research areas and stronger evidence for already existing recommendations. It is anticipated that these guidelines will provide direction and standardization for patients, families/caregiver(s), and clinicians within Canada and internationally.

Keywords
Stroke, transient ischemic attack, rehabilitation, therapy, adults, pediatrics, guidelines

Received: 12 December 2015; accepted: 8 March 2016

Introduction

Stroke Rehabilitation is a progressive, dynamic, goal-orientated process aimed at enabling a person with impairment to reach their optimal physical, cognitive, emotional, communicative, social and functional activity level. Despite advances in the treatment of the hyperacute and acute stroke, patients often continue to require rehabilitation for persisting deficits related to spasticity, upper and lower extremity dysfunction, shoulder and central pain, mobility and gait, dysphagia, vision, perception, and communication. Each year in Canada 62,000 people experience a stroke or transient ischemic attack. Among stroke survivors, over 6500 individuals access in-patient stroke rehabilitation and stay a median of 30 days (inter-quartile range 19 to 45 days).[1] Costs to the Canadian health care system are significant—as much as $3.6 billion—as a result of both hospital expenses and loss of productivity.[2]

Stroke rehabilitation begins soon after the initial stroke event; once the patient is medically stable and can identify goals for rehabilitation and recovery. It can be offered in a range of settings, including acute and post-acute care, inpatient rehabilitation units, outpatient and ambulatory care clinics, community clinics, programs and recreation centers, early supported discharge (ESD) services, and outreach teams. Specially trained rehabilitation team members (e.g., physicians, physiotherapists, occupational therapists, speech-language therapists, and nurses) assist individuals in recovering from their post stroke deficits using a variety of rehabilitation interventions.[3] The length of stay and services required depend on the individual and their needs, as well as the resources available within the particular setting. Although most rehabilitation and recovery occurs within the first three months after stroke onset, stroke recovery can occur over a more extended period of time, with some patients continuing to make new gains many months and even years later. Timely initiation of rehabilitation can help improve patient outcomes and allow individuals to continue to live, work and engage in their community.

Reports on stroke rehabilitation in Canada have shown that there is variability in the provision of services in terms of type of therapy, timing, and intensity.[1] In Canada, stroke patients arrive to inpatient rehabilitation in a median of 12 days from stroke onset (IQR 7–25 days), with a median total admission Functional Independence Measure® (FIM®)[4] score of 74 points (IQR 56–91 points). The median length of stay for inpatient rehabilitation is 31 days, with patients gaining a median of 21 points (IQR 11–33 points gained) on the FIM®, resulting in a gain of 0.67 points per day (IQR 0.33–1.13) of inpatient rehabilitation. Almost 90% of patients are discharged having met their rehabilitation goals, and 71% return directly home. There have been reports in the literature indicating that individuals with severe stroke may have limited access to rehabilitation. In Canada, examination of administrative data found that almost half of all stroke patients admitted to inpatient rehabilitation had moderate functional deficits, just over a third showed severe deficits and the remainder experienced milder degrees of deficits.

The field of research in stroke rehabilitation is very active and new evidence continues to emerge, at a rate more rapid than many other areas of stroke care. A recent study examining all randomized controlled trials published in stroke rehabilitation during 1970–2012 reported that approximately 35% had been published between 2008 and 2012.[5] Moreover, interventions that aimed to improve motor outcomes accounted for nearly 60% of the total number of studies.

The findings reflect the high prevalence of these issues post stroke and reflect the priority patients place on mobility and use of their upper extremities. The most current evidence supporting many stroke rehabilitation interventions and therapies have been considered for this guideline update.

This is the fifth update of the *Canadian Stroke Best Practice Recommendations* (*CSBPR*). They have been developed to provide up-to-date evidenced-based guidance across the stroke continuum of care, including separate modules for Stroke Prevention;[6] Hyperacute Stroke Care;[7] Acute Inpatient Stroke Management;[8] Stroke Rehabilitation; Mood, Cognition and Fatigue following Stroke;[9] Transitions of Care following Stroke; and Telestroke.[10] The updated stroke rehabilitation recommendations apply to stroke survivors of all ages and degrees of stroke severity, and address 12 areas: initial stroke rehabilitation assessment; stroke rehabilitation units; delivery of inpatient stroke rehabilitation; outpatient and community-based rehabilitation; management of the arm and hand following stroke; mobility, balance and lower limb management; dysphagia and malnutrition; visual-perceptual deficits; central pain; language and communication; life roles and activities; and, a new section on pediatric stroke rehabilitation. The CSBPR are targeted towards all health care professionals involved in the patient's circle of care, namely the patient, family, informal caregiver(s), working closely with the interprofessional rehabilitation team at all points along the recovery continuum. It is anticipated that disseminating and promoting the implementation of these recommendations will help to increase clinician knowledge, streamline care, reduce practice variations, optimize efficiency and ultimately improve patient outcomes after stroke within Canada and globally.

This publication describes a summary of the methodology followed to develop these recommendations and the recommendations for each of the 12 sections identified above. Additional supporting information may be found on the CSBPR website (www.strokebestpractices.ca), including a comprehensive methodology manual, detailed rationales for the recommendations with supporting evidence, health systems implications, suggested performance measures, implementation resources (i.e., evaluation, outcome measures, decision tools and templates for standing orders), a summary of the evidence, and detailed evidence tables. Readers are encouraged to access the CSBPR website for this additional information.

Guideline development methodology

The *CSBPR* development and update process follows a rigorous framework adapted from the Practice Guideline Evaluation and Adaptation Cycle.[11] An interprofessional group of rehabilitation experts were convened to participate in reviewing, drafting, and revising all recommendation statements. Members who have extensive experience in the topic area were selected, who are considered leaders and experts in their field, have been involved in clinical trials or publications on the topics addressed in this module, and those who have experience appraising the quality of research evidence. Individuals who have experienced a stroke or their family members are also included as group members and/or external reviewers. The interprofessional writing group included stroke physiatrists (physical medicine and rehabilitation specialists), occupational therapists, physiotherapists, speech language pathologists, a dietitian, nurses, a recreation therapist, stroke survivors, epidemiologists, clinical researchers, and education experts. This interprofessional approach ensured that the perspectives and nuances of all relevant health disciplines were considered in the development of the recommendations, and mitigated the risk of potential or real conflicts of interest or bias from individual members. Other experts outside the writing group were consulted for very specific issues such as pediatric stroke.

A systematic literature search was conducted to identify research evidence for each topic area addressed in the Stroke Rehabilitation module. All literature searches were conducted by the staff of the Evidence Based Review of Stroke Rehabilitation research group,[12] who have expertise performing systematic literature reviews, and who are not directly involved in active research or the writing group to ensure objective selection of evidence. Updated literature searches built on previous reviews and included set time frames from 2012 to 2015, which overlapped the previous search time frame by six months to ensure high catchment of key articles within that time frame.

The writing group was provided with comprehensive evidence tables that include summaries of all high-quality evidence identified through the literature searches. The writing group discussed and debated the value of the evidence and through consensus developed a final set of proposed recommendations. Through their discussions, additional research was identified and added to 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.[13] When developing and including "C-Level" recommendations, consensus was obtained among the writing group and validated through the internal and external review process. This level of evidence was used judiciously, and only when there was a lack of stronger evidence for topics considered important system drivers for stroke care (e.g., screening practices). Recommendations with

Table 1. Summary of criteria for levels of evidence reported in the Canadian stroke best practice recommendations (update 2015).[13]

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.

Note: For a more detailed description of the methodology on the development and dissemination of the *CSBPR* please refer to the Canadian Stroke Best Practice Recommendations Overview and Methodology documentation available on the Canadian stroke best practices website at www.strokebestpractices.ca.

this level of evidence may also be made in response to requests from a range of healthcare professionals who seek guidance and direction from the experts in the absence of strong evidence on certain topics that are faced on a regular basis. In some sections, the expert writing group felt there was additional information that should be included within the documentation, but these statements did not meet the criteria to be stated as recommendations; therefore they were included as clinical considerations, with the goal of providing additional guidance or clarity in the absence of evidence.

After completion of the draft update to the recommendations, the Rehabilitation module underwent an internal review by the *Canadian Stroke Best Practices Advisory Committee*, and an external review by 20 Canadian and international experts in stroke rehabilitation who were not involved in any aspects of the guideline development. All feedback was reviewed and addressed by the writing group members and members of the advisory committee to ensure a balanced approach to addressing suggested edits. All recommendations are accompanied by additional supporting information including a rationale, system implications, performance measures, implementation tools and a written summary of the evidence (found at www.strokebestpractices.ca/index.php/stroke-rehabilitation).

What is new for rehabilitation in update 2015

The 2015 update of the stroke rehabilitation guidelines features several additions that reflect new research areas and stronger evidence for some existing topics. While we have summarized major changes to the guidelines here, not all adaptations, additions, and deletions have been described. Specialized stroke care, provided by an interdisciplinary team in a unique stroke unit, continues to be strongly supported. A significant addition throughout the rehabilitation guidelines is the inclusion of the patient and caregiver(s) as an important part of the rehabilitation team. It was recognized that their participation plays an important role in the development and execution of rehabilitation goals. Guidelines pertaining to rehabilitation assessment, stroke rehabilitation units, falls education, and dysphagia education specifically include the patient/caregiver(s) for this updated guideline edition. While the fourth edition of the CSBPR highlighted the importance of high-level initial assessment, this fifth edition now provides strategic direction in terms of what specific areas should be evaluated (e.g., function, safety, cognition, depression, role participation, etc.). One of the most significant changes to the recommendations reflects new research on rehabilitation therapy intensity, whereby more intensive therapy after the first 24 h results in better outcomes. Similarly, new findings have strengthened the evidence for continued care through outpatient services. ESD has been studied extensively and a number of patient selection criteria have been identified to assist clinicians in decision making. Recent studies have upgraded all of these criteria for ESD to higher levels of evidence. It was also recommended that ESD is best completed by the same team that manages the patient in the hospital, reflecting the importance of continuity of care.

Since rehabilitation may take place over months or years, the evidence for many areas addressing specific therapies was separated into two time frames of study:

early rehabilitation (<6 months post stroke) versus *late* rehabilitation (>6 months post stroke) treatment. This more accurately reflects the state of the evidence, and should help inform clinicians on the strength of evidence and efficacy for therapies and interventions over time. Several new guidelines were proposed for the interventions of the upper limb including strength training, repetitive transcranial magnetic stimulation, and transcranial direct current stimulation. While splinting was previously not recommended, a caveat was included in this edition such that they may be used when appropriate and on an individualized basis. Regarding complex regional pain syndrome (CRPS), starting doses and treatment scheduling for oral corticosteroids were clarified. As a result of increased interest in novel rehabilitation therapies, several new guidelines were proposed that pertained to interventions for improving gait and mobility, such as aerobic exercise parameters, self-directed physical activity, electromechanical-assisted gait training devices, balance training, strength training, virtual reality, mental practice, and biofeedback. Additionally, important changes were made to recommendations on medical complications, such as dysphagia. Lastly, a new section on pediatric stroke rehabilitation has been added to reinforce the specific needs of children who have had a stroke.

Stroke Rehabilitation Best Practice Recommendations, Update 2015

PART A: Organization of a stroke rehabilitation system for optimal service delivery

Section 1. Initial stroke rehabilitation assessment. Complete stroke care delivery in the early days and weeks following an acute stroke has been shown to have a significant positive impact on stroke outcomes.[14] Comprehensive assessments of a patient's cognitive and functional status in the first few days following a stroke are essential to developing individualized plans of care and recovery. The goal of the first interprofessional assessment a patient receives after admission for stroke is to identify impairments in physical, functional, cognitive, and communication functioning which will guide decisions on rehabilitation services and therapies required, and potential discharge needs. New criteria have been developed on Eligibility and Admission Criteria for Stroke Rehabilitation, and are presented in Table 2.

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, other physicians with expertise/core training in stroke rehabilitation, occupational therapists, physiotherapists, speech-language pathologists, 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, and rehabilitation therapy assistants (Evidence level C).
   c. All professional members of the rehabilitation team should have specialized training in stroke care and recovery (Evidence Level C).
   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 C).

ii. Initial screening and assessment should be commenced within 48 h of admission by rehabilitation professionals in direct contact with the patient (Evidence Level C).
   a. Initial assessment would include: an evaluation of patient function, safety, physical readiness, and ability to learn and participate in rehabilitation therapies (Evidence Level C).
   b. Issues related to transition planning should be considered during the initial 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; tools should be adapted for use with patients who have communication differences or limitations where required (Evidence Level B).

iv. For patients who do not initially meet criteria for rehabilitation, rehabilitation needs should be reassessed weekly during the first month and at intervals as indicated by their health status thereafter (Evidence Level C).

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, including evaluation of safety (cognition, fitness to drive), swallowing, communication and mobility, should be completed by a clinician with expertise in stroke rehabilitation

Table 2. Eligibility and admission criteria for stroke rehabilitation

General inclusion criteria for stroke rehabilitation
• All acute or recent stroke patients (less than one year post-stroke) ***or*** *patient* greater than one year post stroke who requires:
▪ inpatient or outpatient interprofessional rehabilitation to achieve functional goals that will prevent hospital admission and/or improve independence;
▪ interdisciplinary rehabilitation assessment, treatment, or review from staff with stroke experience/expertise (including disciplines such as physical therapy, occupational therapy, speech-language pathology, nursing, psychology, and recreation therapy);
▪ and, whose stroke etiology and mechanisms have been clarified and appropriate prevention interventions started.
• The patient is **medically stable**:
▪ A confirmed diagnosis of stroke has been identified, although the mechanism or etiology may not be initially clear, such as in cryptogenic stroke; these situations should not cause delays in access to rehabilitation;
▪ all medical issues and/or co-morbidities (e.g. excessive shortness of breath, and congestive heart failure) have been addressed;
▪ at the time of discharge from acute care, acute disease processes and/or impairments are not precluding active participation in the rehabilitation program;
▪ patient's vital signs are stable;
▪ all medical investigations have been completed ***or*** a follow-up plan is in place at time of referral and follow-up appointments made by time of discharge from acute care.
• The patient demonstrates at least a minimum level of function, which includes:
▪ patient has the stamina to participate in the program demands/schedule;
▪ the patient is able to follow at minimum one-step commands, with communication support if required;
▪ the patient has sufficient attention, short term memory, and insight to progress through rehabilitation process.
• Patient demonstrates by their post-stroke progress the potential to return to premorbid/baseline functioning ***or*** to increase post-stroke functional level with participation in rehabilitation program.
• Goals for rehabilitation can be established and are specific, measurable, attainable, realistic and timely.
• The patient or substitute decision-maker has consented to treatment in the program and demonstrates willingness and motivation to participate in the rehabilitation program (Exceptions: patients with reduced motivation/initiation secondary to diagnosis e.g. depression).
• Patient **is ready to participate in rehabilitation**:
▪ patient meets the criteria of medical stability as defined in guideline above;
▪ patient is able to meet the minimum tolerance level of the rehabilitation program as defined by its admission criteria;
▪ there are no behavioral issues limiting the patient's ability to participate at the minimum level required by the rehabilitation program.
General exclusion criteria for stroke rehabilitation
• Severe cognitive impairment preventing patient from learning and participating in therapy;
• Patient already receives treatment elsewhere and needs are being met;
• Behaviour is inappropriate putting self or others at risk (i.e. aggressive, etc.);
• Terminal illness with expected short survival;
• Not willing to participate in program.

(continued)

Table 2. Continued

Determining if a patient is a suitable candidate for *outpatient* rehabilitation:
• Patient meets the criteria for rehabilitation candidacy, medical stability, and rehabilitation readiness as defined above.
• The patient's current medical, personal care, or rehabilitation needs can be met in the community
• The patient can attend therapy alone or if assistance is required (i.e., for feeding or toileting) a caregiver is available to attend therapy sessions.
• The patient is able to tolerate, and organize their own transportation (where necessary) to and from the program. People with communication limitations such as aphasia may require assistance with transport organization.
Characteristics to consider in planning rehabilitation of stroke patients
(for considerations for pediatric stroke rehabilitation, refer to Table 3).
Stroke characteristics:
• Initial stroke severity
• Location, etiology and type of stroke (ischemic versus hemorrhagic)
• Functional deficits and functional status—using FIM ® Instrument, Barthel Index, Rankin Score, and/or Alpha FIM ® Instrument scores
• Types of therapy required based on assessment of deficits (e.g., OT, PT, SLP, and others as required)
• Cognitive status—patient is able to learn and actively participate in rehabilitation
• Time from stroke symptom onset.
Additional patient characteristics:
• Medical stability
• Rehabilitation goals can be identified by patient and/or health care team in order to increase independence in all activities of daily living. Some examples of goals may include: transfer unassisted, walk independently with aids, use involved arm, improve communication skills, and provide personal self-care
• Adequate tolerance and endurance to actively participate in stroke rehabilitation therapy
• Age and pre-stroke frailty
• Existing co-morbidities such as dementia, palliative care status for another medical condition/terminal illness
• Caregiver availability for patients with severe impairment is important
System characteristics:
• Efficient referral process for rehabilitation.
• Rehabilitation professionals knowledgeable about stroke should be responsible for reviewing intake applications.
• Family members and informal caregivers should be included as part of the rehabilitation process, including decisions regarding inpatient and/or outpatient rehabilitation.
• Standards for time from receipt of referral to decision regarding intake (suggest 24–48 h).
• Available services and resources at different inpatient rehabilitation sites within a geographic region; types and levels of rehabilitation services available at those sites.
• Presence of an ESD program and criteria for patient appropriateness for ESD.

The above criteria have been developed as part of the *CSBPR* to provide guidance and increase consistency on key elements that should be considered in decision-making regarding stroke rehabilitation for individual patients. Criteria for access to rehabilitation services should be agreed upon by all relevant stakeholders in each region, be clearly stated and communicated to all referral sites to improve patient access and admission to stroke rehabilitation programs in an efficient and transparent manner. This applies to all rehabilitation settings, including inpatient rehabilitation, out-patient and community-based rehabilitation, and home-based rehabilitation.

before the patients leave the emergency department or primary care setting (Evidence Level C).

b. Additional screening should be conducted within 2 weeks of stroke onset, including impairment, functional activity limitations, role participation restrictions, environmental factors and screening for onset of depression (Evidence Level C).

vi. Once a patient who has experienced a stroke has undergone assessments, a standardized approach should be used to determine the appropriate setting for rehabilitation (inpatient, outpatient, community, and/or home-based settings) (Evidence Level C).

vii. Criteria for admission to any rehabilitation setting should be standardized and communicated to all referring centers and services (Evidence Level C). Refer to Table 2 for key elements of rehabilitation admission criteria.

Section 2: Stroke rehabilitation unit care. The benefits of specialized stroke unit care are substantial, both in terms of improving activities of daily living and reducing disabilities.[15] As compared to general rehabilitation units, coordinated and organized rehabilitation care in a stroke unit has been shown to reduce mortality and hospital length of stay and to increase functional independence and quality of life.[3,16] Within a stroke unit, care is provided by an experienced interprofessional stroke team (including physicians, nurses, physiotherapists, occupational therapists, speech therapists, etc.) dedicated to the management of stroke patients,[3,15–17] and often within a geographically defined space.[18] For every 100 patients receiving organized inpatient interprofessional rehabilitation, an extra five return home in an independent state.[3]

Recommendations.

2.1 Stroke rehabilitation unit care

i. All patients 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 interprofessional rehabilitation team consisting of physicians (physiatrist, neurologist, or other physician with expertise/core training in stroke rehabilitation), nurses, physiotherapists, occupational therapists, speech-language pathologists, social workers, and clinical dietitians (Evidence Level A).

d. Additional members of the interprofessional team may include pharmacists, discharge planners or case managers, (neuro) psychologists, palliative care specialists, recreation and vocational therapists, therapy assistants, spiritual care providers, peer supporters and stroke recovery group liaisons (Evidence Level B).

e. Patients, families and caregivers should have early and active involvement in the rehabilitation process (Evidence Level B).

f. The interprofessional 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. Patient, family and caregiver education 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).

j. Pediatric acute and rehabilitation stroke care should be provided on a specialized pediatric unit (Evidence Level B), including the same core group of interprofessional team members as those for adults, with the addition of educators and child-life workers (Evidence Level B).

ii. Patients 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 (i.e., where interprofessional care is provided to patients disabled by a range of disorders including stroke), where a physiatrist, occupational therapist, physiotherapist and speech-language therapist are available on the unit or by consultation, is the next best alternative (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.

2.2 Stroke rehabilitation team. *Note: Applicable for all stroke rehabilitation settings (acute care hospital,*

ambulatory clinic, community-based services and programs)

2.2 Stroke rehabilitation should be delivered by a full complement 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 C).

i. The interprofessional rehabilitation team should assess patients within 48 h of admission and 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 interprofessional meeting per week to discuss the progress and problems, rehabilitation goals, and discharge arrangements 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 use standardized, valid assessment tools to evaluate the patient's stroke-related impairments, functional activity limitations, and role participation restrictions, and environment (Evidence Level C). Tools should be adapted for use in patients with communication differences or limitations due to aphasia.

Section 3: Delivery of inpatient stroke rehabilitation. The timeliness and intensity of inpatient rehabilitation interventions as well as the environment in which they are provided have been found to be significant predictors of patient outcomes post stroke.[3] Early rehabilitation results in improved outcomes as does more intensive task-specific therapy. Repetition of meaningful or novel activities enhances learning and recovery. An important element of stroke rehabilitation care is interdisciplinary goal setting and discharge planning involving the patient and family.[19] The most notable change to these recommendations from the previous edition is the results of the AVERT trial, which examined the effectiveness of a protocol of more intensive, early out-of-bed activity.[20] The study by the AVERT Trial Collaboration Group (2015) randomized 2104 adults (1:1) to receive early mobilization, a task-specific intervention focused on sitting, standing, and walking activity, initiated within 24 h of stroke onset, or to usual care for 14 days (or until hospital discharge).[47] Significantly fewer patients in the early mobilization group had a favorable primary outcome, defined as mRS 0-2, at three months (46% vs. 50%; adjusted OR = 0.73, 95% CI 0.59–0.90, p = 0.004). These results have been carefully reviewed and incorporated into these guidelines.

Recommendations

i. All patients with stroke should receive rehabilitation therapy as early as possible once they are determined to be rehabilitation ready and they are medically able to participate in active rehabilitation (Evidence Level A), within an active and complex stimulating environment (Evidence Level C).
ii. Frequent, out-of-bed activity in the very early time frame (within 24 h of stroke onset) is not recommended (Evidence Level B). Mobilization may be reasonable for some patients with acute stroke in the very early time frame and clinical judgment should be used (Evidence Level C).
   a. All patients admitted to hospital with acute stroke should start to be mobilized early (between 24 h and 48 h of stroke onset) if there are no contraindications (Evidence Level B).
   b. Contraindications to early mobilization include, but are not restricted to, patients who have had an arterial puncture for an interventional procedure, unstable medical conditions, low oxygen saturation, and lower limb fracture or injury.
iii. Patients should receive a recommended three hours per day of direct task-specific therapy, five days a week, delivered by the interprofessional stroke team (Evidence Level C); more therapy results in better outcomes (Evidence Level A).
iv. 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).
v. The team should promote the practice and transfer of skills gained in therapy into the patient's daily routine (Evidence Level A), and in the community (Evidence Level C).
vi. It is recommended that patients be given opportunities to repeat rehabilitation techniques learned in therapy and implement them while supervised by stroke rehabilitation nurses (Evidence Level C).
vii. Therapy should include repetitive and intense use of novel tasks that challenge the patient to acquire the necessary skills needed to perform functional tasks and activities (Evidence Level A).
viii. It is recommended that rehabilitation plans be patient-centered, based on shared decision-making, culturally appropriate, and incorporate the agreed-upon goals and preferences of the patient, family, caregivers and the healthcare team (Evidence Level C).

ix. Stroke rehabilitation unit teams should conduct at least one formal interprofessional meeting per week, during which rehabilitation problems are identified, goals are set, progress is monitored, and support after discharge is planned (Evidence Level B).
x. Elements of the rehabilitation care plan that should be considered for inclusion are a pre-discharge needs assessment to ensure a smooth transition from rehabilitation back to the community (Evidence level B). Elements of discharge 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 and training to assist the patient with activities of daily living and increasing the patient's level of independence (Evidence Level B).
   d. Patients and families should be introduced to resources which will enable self-management and the ability to navigate through the health care system (Evidence Level B).
xi. Note there is early evidence supporting the stroke navigator role post discharge to support both people with stroke and their caregivers to become self-directed in their health care and navigate the health care system in a timely fashion with the aim of diminishing future health problems and associated economic impact. Patients in stroke rehabilitation should be considered for referral to stroke navigators where these roles are available (Evidence Level B).

Section 4: Outpatient and community-based stroke rehabilitation. Outpatient therapy is often prescribed following discharge from acute in-patient care, in-patient stroke rehabilitation units and/or may be required several months or years later for survivors with ongoing rehabilitation goals. Continuing therapy may include hospital-based "day" hospital programs, community-based programs, or home-based rehabilitation, depending on resource availability and patient considerations. The Outpatient Service Trialists (2002) identified 14 studies that randomized patients with stroke, who were living at home prior to stroke and were within one year of stroke onset, to receive specialized outpatient therapy-based interventions or usual care (often no additional treatment).[19] Service interventions examined included those that were outpatient based. Outpatient therapy was associated with a reduced odds of a poor outcome (OR = 0.72 95% CI 0.57–0.92; p = 0.009) and increased personal activity of daily living scores (SMD = 0.14, 95% CI 0.02–0.25; p = 0.02). For every 100 residents with stroke in the community receiving therapy-based rehabilitation services, 7 (95% CI 2–11) patients would be spared a poor outcome, assuming 37.5% would have had a poor outcome with no treatment.

ESD is a form of rehabilitation designed to accelerate the transition from hospital to home through the provision of rehabilitation therapies delivered by an interprofessional team, in the community. Patients who are recovering from milder strokes and are recipients of ESD programs have been shown to achieve similar outcomes compared with patients who receive a course of inpatient rehabilitation.[21] ESD was associated with a reduction in the odds of death or the need for institutional care (OR = 0.78, 95% CI 0.61 to 1.00, p = 0.049), death or dependency, (OR = 0.82, 95% CI 0.67 to 0.97, p = 0.021) improvement in performance of extended ADL (SMD = 0.14, 95% CI 0.02 to 0.26, p = 0.024) and satisfaction with services (OR = 1.6, 95% CI 1.08 to 2.38, p = 0.019). An important finding of this meta-analysis was the subset of stroke patients who were treated in the community by the therapists who treated them in the hospital achieved the greater significant benefit while others subsets where there was a handoff of care did not show a significant difference.[21]

Recommendations.

4.1 Outpatient & Community-Based Rehabilitation

i. Stroke survivors with ongoing rehabilitation goals should continue to have access to specialized stroke services after leaving hospital (Evidence Level A). This should include in-home community-based rehabilitation services (like "Early Supported Discharge" teams) or facility-based outpatient services (Evidence Level A).
ii. Outpatient and/or community based rehabilitation services should be available and provided by a specialized interprofessional team, when needed by patients, within 48 h of discharge from an acute hospital or within 72 h of discharge from inpatient rehabilitation (Evidence Level C).
iii. Outpatient and/or community-based services should be delivered in the most suitable setting based on patient functional rehabilitation needs, participation-related goals, availability of family/

social support, patient and family preferences which may include in the home or other community settings (Evidence Level C).

iv. Outpatient and/or community- based rehabilitation services should include the same elements as coordinated inpatient rehabilitation services:
   a. An interprofessional 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 should be provided for a minimum of 45 minutes per day (Evidence Level B) per discipline, 2 to 5 days per week, based on individual patient needs and goals (Evidence Level A) for at least 8 weeks (Evidence Level C).
   d. Patients and families should be involved in their management, goal setting, and transition planning (Evidence Level A).

v. At any point in their recovery, stroke survivors who have experienced a change in functional status and who would benefit from additional rehabilitation services should be offered a further trial of outpatient rehabilitation if they meet the requirements outlined in *Table 2: Eligibility and Criteria for Stroke Rehabilitation* (Evidence Level B).

4.2 ESD

i. ESD services are an acceptable form of rehabilitation for a select group of patients when available and provided by a well-resourced, coordinated specialized interprofessional team (Evidence Level A).
ii. ESD services must be provided within 48 h of discharge from an acute hospital or within 72 h of discharge from inpatient rehabilitation (Evidence Level C).
iii. 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).
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).
v. Where possible, it should be provided by the same team that provided inpatient rehabilitation to ensure smooth transition (Evidence Level A).

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

Note about Evidence Grading System: *For the purposes of these therapy and intervention recommendations the strength of evidence is reported based on time from stroke onset, where appropriate based on currently available research. For these recommendations, "**early**" refers to strength of evidence for therapies applicable to patients who are less than 6 months post stroke, and "**late**" refers to strength of evidence for therapies applicable to patients who are more than 6 months from index stroke event.*

Section 5: Management of the upper extremity following stroke. Arm and hand function is frequently reduced following stroke, limiting stroke survivors' ability to perform activities of daily living. Unfortunately, a large number of stroke survivors with initial arm weakness may not regain normal function; however, many therapeutic techniques have been developed for those individuals who have impaired or absent arm movement which in turn have been shown to result in significant therapeutic gains.

Recommendations.

5.1: Management of the Upper Extremity following Stroke

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 activities of daily living (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. **Range of movement** exercises (passive and active assisted) should be provided that includes placement of the upper limb in a variety of appropriate and safe positions within the patient's visual field (Evidence Level C). Refer to Recommendation 5.3 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** (CIMT) should be considered for a select group of patients who demonstrate at least 20 degrees of active wrist extension and 10 degrees of active finger extension, with minimal sensory or cognitive deficits (Evidence Level: Early-Level A; Late-Level A).
v. **Mirror therapy** should be considered as an adjunct to motor therapy for select patients. It may help to improve upper extremity motor function and ADLs. (Evidence Level: Early-Level A; Late-Level A).
vi. It is uncertain whether sensory stimulation (e.g., transcutaneous electrical nerve stimulation (TENS), acupuncture, muscle stimulation, biofeedback improves upper extremity motor 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 (GRASP) suitable for use during hospitalization and at home (Early-Evidence Level B; Late—Evidence Level C).
ix. **Strength training** should be considered for persons with mild to moderate upper extremity function in both subacute and chronic phases of recovery. Strength training does not aggravate tone or pain (Evidence Level A).
x. **Bilateral arm training** does not appear to be superior to unilateral arm training in improving upper extremity motor function. (Evidence Level B).

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. The need for special equipment (such as wheelchair trays) should be evaluated on an individual basis. Once provided, patients should be reassessed as appropriate to determine if changes are required or equipment can be discontinued with the aim of achieving independent function (Evidence Level C).
iii. Functional dynamic orthoses are an emerging therapy tool that may be offered to patients to facilitate repetitive task-specific training (Evidence Level B).
iv. Repetitive Transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) may be considered as an adjunct to upper extremity therapy (Evidence Level B (rTMS); Evidence Level A (tDCS)).

5.2: Range of Motion and Spasticity in the Shoulder, Arm and Hand

Spasticity, defined as a velocity dependent increase of tonic stretch reflexes (muscle tone) with exaggerated tendon jerks can at times be painful, interfere with functional recovery and slow rehabilitation efforts. If not managed appropriately, stroke survivors may experience a loss of range of motion at involved joints of the arms, which can result in contracture.[22,23]

Recommendations

i. Spasticity and contractures may be prevented or treated 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 in the literature (Evidence Levels: Early-Level A; Late-Level B); however, optimal protocols for utilizing splinting for improvement or preservation of tissue length and spasticity management have not yet been determined.
   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 provided (Evidence Level C).
ii. Chemodenervation using botulinum toxin can be used to increase range of motion and decrease pain for patients with focal and/or symptomatically distressing spasticity (Evidence Levels: Early-Level C; Late-Level A).
iii. Oral medications can be prescribed for the treatment of disabling spasticity:
   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 but has not been studied in this population (Evidence Levels: Early-Level C; Late-Level C). *Note: Baclofen initial dosing should be low and titrated upwards slowly as tolerated by patients*.
c. Benzodiazepines should be avoided due to sedating side effects, which may impair recovery (Evidence Level: Early-Level C; Late-Level C).

iv. The presence of spasticity should not limit the use of strength training in the arm (Evidence Level: Early-Level C; Late-Level C).

5.3: Management of Shoulder Pain and CRPS following Stroke

The incidence of shoulder pain following a stroke is reportedly high with as many as 29 percent of adult hemiplegic stroke patients reporting shoulder pain within the first year after stroke.[24] Causes of shoulder pain may be due to the hemiplegia itself, injury or acquired orthopedic conditions due to compromised joint and soft tissue integrity. Shoulder pain may inhibit patient participation in rehabilitation activities, contribute to poor functional recovery and can also mask improvement of movement and function. Hemiplegic shoulder pain may contribute to depression and sleeplessness and reduce quality of life.

A. Prevention of Hemiplegic Shoulder Pain and Subluxation

i. Joint protection strategies should be used during the early or flaccid stage of recovery to prevent or minimize shoulder pain. These include:
a. Positioning and supporting the arm during rest (Evidence Level B).
b. Protecting and supporting the arm during functional mobility (Evidence Level C).
c. Protecting and supporting the arm during wheelchair use by using a hemi-tray or arm trough (Evidence Level C).
d. The use of slings remains controversial beyond the flaccid stage, as disadvantages outweigh advantages (such as encouraging flexor synergies, discourages arm use, inhibiting arm swing, contributing to contracture formation, and decreasing body image) (Evidence Level C).

ii. For patients with a flaccid arm (i.e., Chedoke-McMaster Stroke Assessment <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 beyond 90 degrees of shoulder flexion or abduction, unless the scapula is upwardly rotated and the humerus is laterally rotated (Evidence Level A).

v. Healthcare staff, patients and family should be educated to correctly 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 should include evaluation of tone, strength, changes in length of soft tissues, alignment of joints of the shoulder girdle, levels of pain and orthopedic changes in the shoulder (Evidence Level C).

C. Management of Hemiplegic Shoulder Pain

i. Treatment of hemiplegic shoulder pain related to limitations in range of motion includes **gentle** stretching and mobilization techniques, and typically involves increasing external rotation and abduction. (Evidence Level B).
a. Active range of motion should be increased gradually in conjunction with restoring alignment and strengthening weak muscles in the shoulder girdle (Evidence Level B).

ii. If there are no contraindications, analgesics (such as acetaminophen or ibuprofen) can be used for pain relief (Evidence Level C).

iii. 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).

iv. 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).

D. Hand Edema

i. For patients with hand edema, the following interventions may be considered:
a. Active, active-assisted, or passive range of motion exercises in conjunction with arm elevation (Evidence Level C).
b. Retrograde massage (Evidence Level C).
c. Gentle grade 1–2 mobilizations for accessory movements of the hand and fingers (Evidence Level C).

E. CRPS (Also known as Shoulder-Hand Syndrome or Reflex Sympathetic Dystrophy)

i. **Prevention**: Active, active-assisted, or passive range of motion exercises should 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 range of motion (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 of CRPS:** 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: MOBILITY, BALANCE AND TRANSFERS

Stroke frequently affects balance and in hemiplegia/hemiparesis the use of the legs. Walking is a function valued by patients as it is important for performing activities of daily living. Basic abilities such as standing and transferring safely are initially addressed, followed by increasing ambulation in most cases. To ambulate safely, patients may require assistive devices such as a cane or walker. For walking to be a feasible alternative to wheelchair mobility outside of the home, critical elements include having a reasonable walking speed, endurance and balance. Unfortunately, some individuals may not achieve independence in walking and may require a wheelchair, especially for longer distances. A Cochrane review by Pollock et al. (2007) examined the efficacy of various treatment approaches for lower limb rehabilitation.[25] The results from 21 RCTS were included. The authors reported that a mixed approach, including neurophysiological and motor learning approaches, was significantly more effective than no treatment or placebo control for improving functional independence (standardized mean difference = 0.94, 95% CI 0.08–1.80). Nevertheless, the authors concluded that there was insufficient evidence that any single approach had a better outcome than any other single approach or no treatment control.

Recommendations.

A. General Considerations

i. Patients should engage 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 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 walking distance and speed and sit to stand (Evidence Level: Early-Level A; Late-Level A).

iii. Treadmill-based gait training (with or without body weight support) can be used to enhance walking speed, and distance walked when overground 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 (RAS) could 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 A).

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

viii. Biofeedback could be used as an adjunct to improve gait and balance (Evidence Level B).

C. Balance

i. For patients with balance disorders post stroke, balance training should be offered (Evidence Level A).
   a. Therapists should consider both voluntary and reactive balance control within their assessment and treatment (Evidence Level C).
   b. Effective interventions include trunk training/seated balance training (early and late), task oriented intervention with or without multisensory intervention (late), force platform biofeedback (early and late) (Evidence Level A); Tai Chi (late), aquatic therapy (late), structured, progressive, physiologically based therapist-supervised home exercise program (early), cycling training (early), and partial body weight support treadmill training (early) (Evidence Level B).

D. Aerobic Training

i. Once medically stable, patients should be screened, by appropriately qualified health care professionals, for participation in aerobic exercise.

a. A medical history and physical examination should be performed to identify factors that require special consideration or constitute a contraindication to exercise (Evidence Level: Early-Level B; Late-Level B).
b. An exercise stress test with electrocardiograph, 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). 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 (Evidence Level: Early-Level A; Late-Level A) and reduce risk of stroke recurrence (Evidence Level: Early-Level C; Late-Level C).
a. To achieve a training effect, patients should participate in aerobic exercise at least 3 times weekly for a minimum of 8 weeks, progressing as tolerated to 20 minutes 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).

E. Gait Aids

i. 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).
ii. 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).
iii. 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).

SECTION 6.2: LOWER LIMB SPASTICITY FOLLOWING STROKE

Few studies have been published examining the prevention or treatment of contractures using antispastic pattern positioning, range of motion exercises, stretching and/or splinting in the lower extremity, although all are accepted treatments. Kluding et al. (2008) reported that eight sessions of functional task practice combined with ankle joint mobilizations, provided over four weeks, resulted in increased ankle range of motion, compared with a group that received therapy only, in the chronic stage of stroke.[26] The participants in the intervention group gained 5.7 degrees in passive ankle range of motion compared with 0.2 degree degrees in the control group ($p < 0.01$). The use of Botulinum toxin–type A (BTX-A) for the focal treatment of spasticity in the lower extremity is not as well-studied compared with the upper extremity. A meta-analysis (Foley et al. 2010),[27] which included the results from 8 studies reported a moderate increase in gait speed associated with BTX-A ($SMD = 0.193 \pm 0.081$, 95% CI 0.033 to 0.353, $p < 0.018$). In a recent randomized controlled trial, Picelli et al. (2014)[28] compared three different treatments for focal spasticityin chronic stroke patients. Individuals were randomized to receive ultrasound, transcutaneous electrical stimulation, or botulinum toxin. Picelli et al. (2014)[28] reported that patients receiving botulinum toxin had significantly greater improvement of focal spasticity (modified Ashworth Scale) compared to individuals in the other treatment groups.

Recommendations

i. Antispastic pattern positioning, range-of-motion exercises and/or stretching may be considered for prevention or treatment of spasticity and contractures (Evidence Level: Early-Level C; Late-Level B).
ii. Ankle splints used at night and during assisted standing may be considered for prevention of ankle contracture in the hemiparetic lower extremity (Evidence Level C).

iii. Chemodenervation using botulinum toxin can be used to reduce spasticity, increase range of motion, and improve gait, for patients with focal and/or symptomatically distressing spasticity (Evidence Level: Early-Level C; Late-Level A).
iv. Oral medications can be prescribed for the treatment of disabling spasticity:
  i. Tizanidine can be used to treat more generalized, disabling spasticity. (Evidence Levels: Early-Level C; Late-Level B).
  ii. Baclofen can be used as a lower cost alternative to treat more generalized disabling spasticity (Evidence Levels: Early-Level C; Late-Level C).
  iii. Benzodiazepines should be avoided due to sedating side effects, which may impair recovery (Evidence Level: Early-Level C; Late-Level C).
v. The presence of spasticity should not limit the use of strength training in the leg (Evidence Level: Early-Level C; Late-Level C).
vi. Intrathecal Baclofen should be considered for specific cases of severe, intractable and disabling/painful spasticity (Evidence Level: Late-Level B)

6.3: FALLS PREVENTION AND MANAGEMENT

The risk of falling is increased following stroke due to leg weakness, impaired balance, visual disturbances, cognitive impairment and sensory loss. During inpatient rehabilitation the reported incidence of falls has been reported to range from 25% to 39%. Upon return to the community, the risk increases further. Forster & Young (1995)[29] reported that up to 73% of persons had fallen within 6 months of discharge from hospital following stroke, although serious injuries were not reported frequently. Observational studies by Maeda et al. (2009)[30] and Said et al. (2013)[31] suggest that patients of an older age are at higher risk of falls ($p < 0.05$ and $p = 0.039$, respectively). The interprofessional care team must be cognizant of the risk for falls and ensure appropriate assessments and interventions are in place.

i. Following stroke, all patients should be screened for fall risk by an experienced clinician at admission, at all transition points, and/or whenever there is a change in health status (Evidence Level C). Suggested Screening/Assessment Tools for Risk of Falling Post Stroke are available at www.strokebestpractices.ca. Refer to section 6.2 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., osteoporosis and low vitamin D levels) (Evidence Level B).
iii. Those identified as being at risk for falls should undergo a comprehensive interprofessional assessment that includes medical and functional history and evaluation of mobility, vision, perception, cognition, and cardiovascular status (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 their 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. External hip protectors should be considered in stroke patients who are identified as high risk for falls (Evidence Level B).
v. If a patient experiences a fall, 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).

Section 7: Assessment and management of dysphagia and malnutrition following stroke. The published estimates of the incidence of stroke-related dysphagia vary widely from 19% to 65% in the acute stage of stroke, depending on the lesion location, timing and selection of assessment methods. The presence of dysphagia is important clinically because it has been associated with increased mortality and medical complications, especially pneumonia.[32,33] The risk of pneumonia has been shown to be 3 times higher when patients are dysphagic. Stroke-related pneumonia is fairly common with estimates that range from 5% to 26%, depending on diagnostic criteria. Patients with dysphagia may not receive sufficient caloric intake, which may result in malnutrition which in turn limits therapy participation and results in poorer outcomes. Lifestyle modifications such as increased exercise may help improve an individual's nutritional and physiological status.[34]

Recommendations.

7.1 Dysphagia

i. Patients should be screened for swallowing deficits as soon as they are alert and ready for trialing oral intake (e.g. medications, food, liquid) using a valid screening tool by an expert in dysphagia, ideally a speech-language pathologist (SLP); if an SLP is not available this should be done by another appropriately trained professional (Evidence Level B).
ii. Abnormal results from the initial or ongoing swallowing screens should prompt a referral to a speech-language pathologist, occupational therapist, dietitian or other trained dysphagia clinician for more detailed bedside swallowing assessment and management of swallowing, feeding, nutritional and hydration status (Evidence Level C). 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, MBS) or fiberoptic endoscopic examination of swallowing (FEES), should be performed on all patients considered at risk for pharyngeal dysphagia or poor airway protection, based on results from the bedside swallowing assessment (Evidence Level B).
iv. Restorative swallowing therapy and/or compensatory techniques to optimize the efficiency and safety of the swallow, with reassessment as required, should be considered for dysphagia therapy (Evidence Level C).
   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, texture modification and a rigorous program of oral hygiene (Evidence Level B).
v. Patients, families and caregivers should receive education on swallowing and feeding recommendations (Evidence Level C).
vi. To reduce the risk of 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

i. Patients should be screened for premorbid malnutrition within 48 h of admission using a valid screening tool.
   a. Patients should be rescreened for changes in nutritional status 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 should 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 that may affect nutrition should be referred to a dietitian for recommendations:
   a. To meet nutrient and fluid needs orally while supporting alterations in food texture and fluid consistency recommended by a speech-language pathologist or other trained professional (Evidence Level B);
   b. For enteral nutrition support in patients who cannot safely swallow or meet their nutrient and fluid needs orally.
   c. The decision to proceed with 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 interprofessional team (Evidence Level B).

Section 8: Rehabilitation of visual perceptual deficits. Visual perceptual disorders are a common clinical consequence of stroke, and it is estimated that approximately 21% of patients will experience related issues post stroke.[35] Perceptual deficits or disorders may affect any of the sensory modalities, resulting in disorders that may include visual, tactile, location, auditory, spatial, object (object agnosia), prosopagnosia, and color processing, among others.[36]

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 (visuo-spatial impairment, agnosias, body schema disorders and apraxias) should be assessed using validated tools (Evidence Level C). Tools should be adapted for use with patients who have communication limitations such as aphasia.
iii. Treatment of neglect can include visual scanning techniques, phasic alerting, cueing, imagery, virtual reality, hemispheric (limb) activation and trunk rotation (Evidence Level C).

iv. Remedial-based techniques could include prisms, eye patching (Evidence Level C), repetitive transcranial magnetic stimulation (rTMS) (Evidence Level B), and neck muscle vibration (Evidence Level C).
v. Patients with suspected limb apraxia should be treated using errorless learning, gesture training and graded strategy training (Evidence Level B).
vi. Mirror therapy may be considered as an intervention for unilateral inattention (Evidence Level B).

Section 9: Rehabilitation to improve central pain. Central post-stroke pain (CPSP) is a rare neurological disorder in which the body becomes hypersensitive to pain as a result of damage to the spinothalamic tract (STT), although injury to the STT in the vast majority of cases does not result in CPSP. It reportedly affects 2% to 5% of stroke patients. The primary symptoms are pain and loss of sensation, usually in the face, arms, and/or legs. Pain or discomfort may be felt after being mildly touched (allodynia) or even in the absence of a stimulus. The pain may worsen by exposure to heat or cold and by emotional distress. CPSP can dramatically hinder a patient's ability to perform ADLs, interfere with sleep and reduce quality of life. Fortunately, the condition is rare.

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 (Evidence Level C).
   b. Patients should receive a tricyclic antidepressant (e.g., amitriptyline) or an SNRI (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: Rehabilitation to improve language and communication. Aphasia is defined as a disorder of language resulting in the loss of ability to communicate orally, through signs, or in writing, or the inability to understand such communications. Aphasia is a common consequence of stroke in both the acute and chronic phases and is commonly and almost exclusively seen with left hemispheric strokes. Acutely, it is estimated that between 21 and 38% of stroke patients suffer from aphasia.[37] The presence of aphasia has been associated with general decreased response to stroke rehabilitation interventions and an increased risk for mortality.[38,39] Aggressive management of aphasia through therapy helps to improve both language and broader recovery.[40]

Recommendations

i. It is recommended that all health care providers working with persons with stroke across the continuum of care be trained about aphasia, 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).
ii. It is recommended that all health care providers working with persons with stroke across the continuum of care be trained about other communication disorders that may result from stroke including: dysarthria, apraxia of speech and cognitive communication deficits (Evidence Level C).
iii. All stroke patients should be screened for communication disorders using a simple, reliable, validated tool (Evidence Level C).
iv. Patients with any suspected communication deficits should be referred to a Speech-Language Pathologist (SLP) for assessment in the following areas using valid and reliable methods: comprehension, speaking, reading, writing, gesturing, use of technology, pragmatics (e.g. social cues, turn-taking, body language, etc.) and conversation (Evidence Level C).
v. Persons with aphasia should have early access to a combination of intensive language and communication therapy according to their needs, goals and impairment severity (Evidence Level B).
vi. 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, and constraint induced language therapy (Evidence Level B);
   c. use of non-verbal strategies, assistive devices and technology (e.g., I-Pads, Tablets, other computer-guided therapies) which may be incorporated to improve communication (Evidence Level C).

d. Use of computerized language therapy to enhance benefits of other therapies (Evidence Level C).

vii. Treatment for aphasia should include group therapy and conversation groups. Groups can be guided by trained volunteers and caregivers overseen by an SLP to supplement the intensity of therapy during hospitalization and/or as continuing therapy following discharge (Evidence Level B).

viii. Treatment to improve functional communication should include Supported Conversation techniques for potential communication partners of the person with aphasia (Evidence Level A).

ix. All information intended for patient use should be available in aphasia-friendly formats (e.g., patient education material should be available in audio/visual format). This includes materials such as educational information, information on diagnostic imaging procedures, consent forms and information regarding participation in stroke rehabilitation research, and assessment tools. (Evidence Level C).

x. Families of persons with aphasia should be engaged in the entire process from screening through intervention, including family support and education, and training in supported communication (Evidence Level C).

xi. The impact of aphasia on functional activities, participation and QoL, including the impact on relationships, vocation and leisure, should be assessed and addressed as appropriate from early post-onset and over time for those chronically affected. (Evidence Level C).

Section 11: Resumption of life roles and activities following stroke. Stroke survivors often experience motor, cognitive and psychosocial changes that impact their ability to resume pre stroke pursuits. Return to driving, vocation, sexual activity and leisure activities have each been cited as important rehabilitation goals for patients and evidence indicates that the resumption of these activities are associated with increased quality of life.[41–44] Furthermore, given increases in the number of individuals working past traditional retirement age and in the incidence of stroke amongst younger individuals, issues related to the resumption of these life roles and activities may be increasingly relevant to a growing proportion of stroke survivors.[45] In Canada, the number one patient concern in our stroke rehabilitation outpatient clinics (where medical follow-up occurs) is return to driving.

Recommendations

A. *Return to Driving*

i. Patients should be told to stop driving for at least one month after stroke, in accordance with the Canadian Council of Motor Transport Administrators (CCMTA) Medical Standards for Drivers (Evidence Level C).

ii. Patients who have experienced one or multiple TIAs should be instructed not to resume driving until a comprehensive neurological assessment (including sensorimotor function and cognitive ability) shows no residual loss of functional ability, discloses no obvious risk of sudden re-occurrence, and any underlying cause has been addressed with appropriate treatment, in accordance with the Canadian Council of Motor Transport Administrators (CCMTA) Medical Standards for Drivers (Evidence Level C).

iii. After one month, patients interested in returning to driving should be screened, ideally by an occupational therapist, using valid and reliable methods for any residual sensory, motor, or cognitive deficits (Evidence Level B):
   a. Sensory assessment should focus on vision, visual fields, visual attention and reading comprehension;
   b. Motor assessment should focus on strength, coordination and reaction time;
   c. Cognitive assessment should focus on perception, problem solving, speed of decision making and judgment

iv. For patients who have relevant residual neurological deficits related to driving ability, a full comprehensive driving evaluation, including a government-sanctioned on-road assessment, is recommended to determine fitness to drive (Evidence Level B).

v. Patients can be referred to training programs, such as simulator based training, to help prepare for a road test or the resumption of driving (Evidence Level B).

B. Return to Vocation

i. Patients, especially those <65 years of age, should be asked about vocational interests (i.e., work, school, volunteering) and be assessed for their potential to return to their vocations (Evidence Level C). This initial screening should take place early in the rehabilitation phase, and become included in the individualized patient goal setting and planning for rehabilitation needs.

ii. A detailed cognitive assessment including a neuropsychological evaluation, where appropriate, is recommended to assist in vocational planning (Evidence Level C).

iii. School age stroke survivors in the community should have ongoing assessment of educational

and vocational needs throughout their development (Evidence Level C).
iv. Resumption of vocational interests should be encouraged where possible. A gradual resumption should occur when appropriate (Evidence Level C).
v. Patients should receive vocational rehabilitation services, as appropriate, for advice on relevant issues such as health and disability benefits and legal rights (Evidence Level C).
vi. Employers and education providers should be encouraged to provide work/school modifications and flexibility to allow patients to return to work/school (Evidence Level C).

C. Sexuality

i. Patients should be given the opportunity to discuss sexuality and sexual functioning with their healthcare provider. Discussion should occur during acute care, rehabilitation and as the patient transitions back into the community. Verbal and written information should be provided and adapted to patients who have communication limitations such as aphasia (Evidence Level C).
ii. Patients and/or partners should be offered education sessions that address expected changes in sexuality, strategies to minimize sexual dysfunction, and frequently asked questions (Evidence Level C).

D. Leisure Activity

i. Patients should be given the opportunity to discuss pre-stroke leisure pursuits and be assessed for rehabilitative needs to resume these activities. Participation in leisure activities should be encouraged (Evidence Level B).
ii. Patients who experience difficulty engaging in leisure activities should receive targeted therapeutic interventions (Evidence Level: Adult-Level A; Pediatric-Level C).
iii. Children affected by stroke should be offered treatment aimed at achieving play and leisure related skills that are developmentally relevant and appropriate in their home, community, and school environments (Evidence Level C).
iv. Patients should be offered information regarding leisure activities in the community and/or be referred to relevant agencies. Use of peer support groups should be encouraged (Evidence Level C).

Section 12: Pediatric stroke rehabilitation. Stroke happens at any age. Current rates for stroke in children are >1 in 2,500 live births (among newborns, defined as age 0 to 28 days), and 2–5/100,000 among children age 28 days to 18 years.[46] Stroke in infants and children has become increasingly recognized and some areas of Canada are offering specialized pediatric stroke care. The primary cause of stroke in children, unlike in adults, is not cardiovascular disease or atherosclerosis, and a large percentage go undiagnosed despite extensive workup. There are very different pathophysiologies that lead to stroke in neonates and children, as well as developmental factors that are involved in the growing and maturing brain. Stroke in children is a different disease process than in adults and children affected by stroke require an individualized rehabilitation approach that is ongoing throughout their entire development. Rehabilitation services for children post-stroke have certainly not been subjected to the depth and breadth of research that is so clear in the adult literature. However, we do know that children have an important frequency of physical, cognitive and mental disability after stroke. It is important now that systems of care be developed to meet the ongoing rehabilitation needs of children who have had a stroke.

This section includes a set of recommendations specific to children aged newborn to 18 years old that have experienced a stroke. Recommendations are only included for areas where there is research evidence or strong expert consensus on approaches to assessment or treatment of children who have experienced a stroke. General principles and the organization of stroke rehabilitation that have been described in earlier sections of this module also apply to children undergoing stroke rehabilitation, and are therefore not repeated here. Refer to Table 3 for age groups included in pediatric stroke and considerations in providing pediatric stroke rehabilitation.

Recommendations.

SECTION 12.1: ORGANIZATION AND ASSESSMENT FOR PEDIATRIC STROKE REHABILITATION

A. Assessment for Rehabilitation

i. All children with stroke should have an initial assessment to determine the severity of stroke and rehabilitation needs, conducted by medical professionals as soon as possible after diagnosis (Evidence Level B).
ii. Pediatric acute and rehabilitation stroke care should be provided on a specialized pediatric unit so that care is formally coordinated and organized (Evidence Level B).
iii. Clinicians should consider standardized, valid assessment tools to evaluate the patient's stroke-related impairments, functional activity limitations, role participation restrictions, mood and behavior changes, and environmental restrictions (Evidence Level C).

Table 3. Considerations in pediatric stroke rehabilitation

Pediatric populations:
There are three populations of pediatric patients with brain injury due to a cerebrovascular lesion (stroke) to consider for rehabilitation, based on age and presentation:
• Children (1 month–18 years) with acutely diagnosed arterial ischemic stroke, cerebral sinovenous thrombosis or hemorrhagic stroke (diagnosed acutely and hospitalized at an acute care hospital);
• Neonates (term birth to 1 month age) with acutely diagnosed arterial ischemic stroke, cerebral sinovenous thrombosis, or hemorrhagic stroke (diagnosed acutely as stroke and hospitalized at an acute care hospital);
• Presumed Pre-perinatal Ischemic Stroke (PPIS) with diagnosis in later infancy, typically with recognition of congenital hemiparesis (usually diagnosed as out-patient).
Considerations in planning for stroke rehabilitation in children:
• Many of the principles and recommendations contained in earlier sections of the Canadian Stroke Best Practices Stroke Rehabilitation module apply to people with stroke at any age and should be reviewed for their relevance to treating children with stroke. *Refer to Sections 1 to 11 of this module for additional information.*
• It is important to emphasize that children who have had a stroke may "grow into their disability". The full impact of a stroke in a child may not be known for years as the child grows and matures and reaches various developmental stages. There may be ongoing and emerging rehabilitation needs throughout growth and development. Therefore children who have experienced a stroke require long-term monitoring and follow-up throughout maturation to ensure optimal achievement of developmental, functional and psychosocial potential.
• Childhood stroke affects the whole family and parental guilt or blame is common. The whole family unit should be considered in setting up pediatric stroke rehabilitation programs and support networks.
• Dedicated pediatric stroke rehabilitation programs are scarce in Canada and globally. In areas where stroke rehabilitation programs are not available for children, they often have their rehabilitation needs addressed in cerebral palsy clinics (younger children) or acquired brain injury rehabilitation programs (older children). Where possible, stroke specific services should be accessed.
• Rehabilitation goals are similar to those for adults with stroke (such as walking and communication); they also include additional goals such as educational and vocational rehabilitation, re-integration into play roles, growth and development, and developmental psychology. The focus in rehabilitation of children with stroke is more often "new" learning (habilitation) rather than relearning (rehabilitation) depending on age at time of stroke.
• The child with stroke may often be able to reside at home with their parents/guardians and attend outpatient rehabilitation.
• Many stroke rehabilitation approaches defined for adults are applicable to children, with adaptations to the younger age.
• Newer evidence-based techniques, such as constraint induced movement therapy and some of the emerging robotic therapies are appropriate for children as well as traditional function-oriented therapy and splinting as needed.
• Pediatric programs should integrate closely with the child's school for continuity of programs and therapy plans, as well as with other coaches and extracurricular activities (both inpatient and outpatient options).

iv. Individualized rehabilitation plans should be developed and regularly updated based on review of patient status and progress through developmental milestones (Evidence Level C). Ideally, these reviews should take place annually.
v. Once a child who has experienced a stroke has undergone assessments, the appropriate setting for rehabilitation (inpatient, outpatient, community, school, and/or home-based settings) may be determined (Evidence Level C).
vi. At any point in their recovery, pediatric stroke survivors who have experienced a change in functional status, and those who would benefit from additional rehabilitation services, should be offered outpatient support (Evidence Level B).

B. Pediatric Stroke Rehabilitation Team

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

i. Stroke rehabilitation should be delivered by a full complement of health professionals, experienced

in providing post-stroke pediatric care, regardless of where services are provided, to ensure consistency and reduce the risk of complications (Evidence Level B).

a. The core team should include clinicians with expertise/core training in developmental pediatrics and pediatric stroke rehabilitation, including physicians (such as physiatrists and specialized pediatricians), occupational therapists, physical therapists, speech-language pathologists, nurses, social workers, psychologists, and dietitians (Evidence Level B).
b. The parent(s) and other family members are also included as part of the core team (Evidence Level C).
c. Additional team members may include recreation therapists, vocational therapists, educational therapists, childhood educators, child-life workers, kinesiologists, orthotists, and rehabilitation therapy assistants (Evidence level C).

SECTION 12.2: STROKE REHABILITATION THERAPY FOR CHILDREN

A. General Principles

i. Children who have had a stroke should engage in training that is meaningful, engaging, repetitive and progressively adapted, age appropriate, task-specific and goal-oriented in an effort to enhance motor control and restore sensorimotor function (Evidence C).
ii. Training should encourage the use of patients' affected limb during functional tasks and be designed to simulate activities of daily living appropriate to the patient developmental level (Evidence Level C).
iii. Objective, functionally relevant outcome measures should be applied before and after interventions and interpreted in a blinded fashion whenever possible to determine benefit for individual patients (Evidence Level C).
iv. Therapy should be guided by functionally relevant goals determined by the child and family under the guidance of a knowledgeable therapist (Evidence Level C).

B. Specific Therapies for Arm and Hand

i. **Range of motion** exercises (passive and active assisted) should be provided that includes placement of the upper limb in a variety of appropriate and safe positions within the patient's visual field (Evidence Level C).
ii. **Hand and wrist splints** and other splints should be considered in appropriate patients, and be customized to individual patients (Evidence Level C). A plan for monitoring these devices should be put in place (Evidence Level C).
iii. **Traditional or modified constraint-induced movement therapy** (CIMT) should be considered for suitable pediatric patients with stroke with upper limb impairment to reduce motor impairment and improve upper extremity function (Evidence Level A).
iv. **FES** may be considered to increase awareness of extremity, reduce motor impairment and improve upper extremity function (Evidence Level C).
v. **Mirror Therapy** should be considered as an adjunct to motor therapy for select patients. It may help to improve grasp and pinch strength. (Evidence Level C).
vi. Chemodenervation using **Botulinum Toxin Type A** may be considered to increase range of motion for patients with focal and/or symptomatically distressing upper limb spasticity or dystonia (Evidence Levels C).
vii. **Repetitive Transcranial Magnetic Stimulation (rTMS)** may be considered as an experimental adjunct to upper extremity therapy within a clinical trial (Evidence Level C).
viii. **Surgical interventions** such as tendon repositioning to promote more functional joint mechanics should be considered in select patients (Level C).

C. Lower Limb Mobility

i. **Range of motion** exercises (passive and active assisted) should be provided as well as physical activity and gait training to promote ambulation (Level C).
ii. **Ankle-foot orthoses** and other splints should be considered in appropriate patients, and be customized to individual patients (Evidence Level C).
iii. Chemodenervation using **Botulinum Toxin Type A** may be considered to increase range of motion for patients with focal and/or symptomatically distressing lower limb spasticity (Evidence Levels C).
iv. **Surgical interventions** such as tendon repositioning to promote more functional joint mechanics may be considered in select patients (Level C).

D. Adaptive and Assistive Devices

i. Adaptive devices including splints and orthoses 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. The need for special equipment (such as wheelchair trays, walkers) should be evaluated on an individual basis. Once provided, patients should be reassessed as they grow and develop to determine if changes are required or equipment can be discontinued with the aim of achieving independent function (Evidence Level C).

SECTION 12.3: LIFE ROLES, ACTIVITIES AND FAMILY WELLNESS

A. Return to School

i. School age stroke survivors in the community will require ongoing assessment of educational and vocational needs throughout their development (Evidence Level C).
ii. Resumption of education should be encouraged where possible and when appropriate (Evidence Level C).
iii. School-aged children affected by stroke should receive educational rehabilitation and support services to assist with function and safety in the classroom, as appropriate, and individualized educational plans should be created when required to meet the needs of a child who has experienced a stroke (Evidence Level C).

B. Leisure Activity

i. Children affected by stroke should be offered treatment aimed at achieving play and leisure related skills that are developmentally relevant and appropriate in their home, community, and school environments (Evidence Level C).
ii. Children affected by stroke and their families should be offered information regarding leisure activities and adaptive programs in the community and/or be referred to relevant agencies. Use of peer support groups should be encouraged (Evidence Level C).

C. Family Wellness

i. Simple educational interventions aimed at reducing or eliminating misplaced maternal guilt or parental blame should be provided (Evidence Level B):
   a. Parents, and mothers in particular, should be educated regarding the causes of perinatal and childhood stroke and that virtually none are preventable by the parents or otherwise (Evidence Level B);
   b. Mother's should be directly and repeatedly reminded that they are not responsible: ''This is not your fault'' (Evidence Level B).
ii. Families of children who have had a stroke should be offered information and support regarding:
   a. adjustment to changes in physical needs of the child and possible increased dependency (Evidence Level B);
   b. changes in social roles of family members, leisure activities, impact on other family members (e.g., living spouse or partner, other children), and potential resource issues (Evidence Level B).

Summary

The 2015 update of the *Canadian Stroke Best Practice Recommendations: Stroke Rehabilitation Guidelines* provides a comprehensive set of principles pertaining to the organization of the stroke rehabilitation system, as well as specific areas of stroke recovery, interventions and clinical care. Achieving optimal outcomes in stroke rehabilitation and recovery at any age starts with early post stroke rehabilitation assessment, and the development of an individualized rehabilitation plan. These plans should incorporate patient goals, environmental factors (e.g., social supports, living arrangements), current functional, cognitive and emotional deficits, and potential for recovery. The plan should clearly describe the types of therapies required based on the results of clinical assessments across all domains of rehabilitation. Throughout the rehabilitation and recovery process, the individualized plan must be regularly reassessed and revised to reflect patient progress and evolving goals. These assessments happen through patient-provider interactions and are further discussed at regular meetings of the interprofessional care team. The rehabilitation system must be built to enable these discussions to occur and increase continuity and consistency in care.

The efficacy of integrated stroke rehabilitation units has been well established; however, optimizing care is heavily dependent on adherence to these guidelines and the availability of local resources, such as access to rehabilitation facilities, programs and stroke recovery experts. The evidence base for clinical rehabilitation interventions post stroke continues to rapidly expand and supports the importance of rehabilitation in the recovery process post stroke. This update has incorporated many specific interventional guidelines supported by strong levels of evidence. In addition to these, the benefit of increased therapy intensity and continued care via outpatient services have been highlighted.

Clinical uptake of rehabilitation guidelines is tremendously challenging and must be made a priority in all jurisdictions, reflected in system changes such as using guideline adherence to help determine funding. Coinciding with this shift, many of the guideline

recommendations have been made more prescriptive, allowing for adherence to be more easily measured. The next step is to improve data collection mechanisms, and encourage contributions to existing validated administrative rehabilitation datasets for ongoing monitoring of the impact of these system changes. As guidelines are refined to reflect the evolving evidence base, and recommendations are better integrated and implemented into clinical practice consistently, the needs and goals of stroke survivors and their families will be better met.

The *CSBPR* continue to be a work in progress and are regularly updated every two to three years in order to integrate newly released data to help maximize patient outcomes from this disabling disease. They are developed and presented within a continuous improvement model and are written for health system planners, funders, administrators, and healthcare professionals, all of whom have important roles in the optimization of stroke prevention, care and recovery, and who are accountable for results. Several implementation tools are provided to facilitate uptake into practice (available at www.strokebestpractices.ca), and are used in combination with active professional development programs. By monitoring performance, the impact of adherence to best practices can be assessed and results then used to direct ongoing improvement. Incorporating changes to clinical practice takes time and needs to be prioritized with funding, infrastructure and resources. Researchers are encouraged to examine the guidelines and focus their efforts on areas in need of either some (in the case of no evidence) or stronger research evidence (where evidence exists but is not strong). For example, McIntyre et al. (2014) found that for every six interventional RCTs studying changes to motor outcomes, there was just one RCT studying changes to cognitive outcomes.[47] Results of recent stroke quality monitoring activities continue to support the value of adopting evidence-based best practices in organizing and delivering stroke care in Canada and globally.

Author contributions

Debbie Hebert (first author) and Robert Teasell (senior author) are chairs of the Stroke Rehabilitation 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 *CSBPR* and this manuscript, coordinated the external review process, and is a writer of supplementary documentation. Ev Glasser provided editorial and coordination support to the writing group during the development process and is a writer of supplementary documentation. Stephen Bagg, Sean Dukelow, Maridee Garnhum, Mary-Lou Halabi, Ester Kang, Marilyn MacKay-Lyons, Rosemary Martino, Matthew Mayer, Annie Rochette, Sarah Rowe, Nancy Salbach, Brenda Semenko, Bridget Stack, Luchie Swinton, Valentine Weber, and Sue Verrilli, are all members of the Stroke Rehabilitation expert writing group and contributed by reviewing, analyzing and discussing the evidence and collectively finalizing the wording of all included recommendations. Adam Kirton and Peter G. Rumney co-chair the pediatric stroke rehabilitation subgroup and lead the development of the pediatric section of these rehabilitation recommendations. Gabrielle DeVeber, John Andersen, Karen Barlow, Caitlin Cassidy, Marie-Emmanuelle Dilenge, Darcy Fehlings, Ryan Hung, Laura Lenz, Annette Majnemer, Jacqueline Purtzki, Mubeen Rafay, Lyn K. Sonnenberg, and Ashleigh Townley were members of the pediatric stroke rehabilitation expert subgroup. Mark Bayley and Dariush Dowlatshahi are senior advisors to the stroke rehabilitation writing group and contributed significantly to the methodology and recommendation development and provided review and edits to the overall documents. Amanda McIntyre, Jerome Iruthayarajah, Shannon Janzen and Norine Foley conducted the evidence reviews and prepared all evidence tables for the writing groups, evidence summaries, and tables of psychometric properties of rehabilitation outcome measures.

Acknowledgements

The authors wish to acknowledge and thank the many people who provided internal and external review and feedback on earlier drafts of the *Canadian Stroke Best Practice Recommendations Stroke Rehabilitation* guideline update 2015, including: the evidence review team at St. Joseph's Healthcare-Parkwood Institute, Amanda McIntyre, Marina Richardson, Shannon Janzen, and Taeweon Lee; members of the Canadian Stroke Best Practices and Quality Advisory Committees, Dr. Mark Bayley, Dr. Eric E. Smith, Dr. Edward Harrison, Dr. Robert Cote, Dr. Michael Hill, Dr. Dar Dowlatshahi, Dr. Gord Gubitz, Dr. Alexandre Poppe, Dr. Sam Yip, Dr. Denyse Richardson, Dr. Colleen O'Connell, Dr. Jai Shankar, Dr. Alan Bell, Beth Linkewich, Dawn Tymianski, Barbara Campbell, Christina Papoushek, Dr. Eddy Lang, Farrell Leibovitch, Dr. Michael Kelly, Barbara Ansley, Dug Andrusiek, Dr, Stephen Phillips, Dr. Moira Kapral, Dr. Michael Sharma, Dr. Andrew Demchuk, Dr. Devin Harris, Dr. Thomas Jeerakithil and Dr. Sol Stern; external reviewers for the 2015 update of the Stroke Rehabilitation recommendations: Dr. Lara Boyd, Andrea Cole-Haskayne, Dr. Drew Dawson, Dr. Joyce Fung, Dr. Jocelyn Harris, Shannon Hebblethwaite, Dr. Tal Jarus, Dr. Aura Kagan, Dr. Nathania Liem, Anita Menon, Phyllis Paterson, Dr. Michelle Ploughman, Dr. Preeti Raghavan, Dr. Howard Rocket, Nina Simmons-Mackie, Donelda Sooley, Dr. Joel Stein, Dr. Alexandre Thiel, Katie White, Elaine Widgett, and Paul Wright; and the Heart and Stroke Foundation mission team, communications team, and French translators including Ev Glasser, Stephanie Lawrence, Mary Elizabeth Harriman, Beverly Powell-Vinden, Christelle Desgranges-Farquhar and Roula Abboud.

Declaration of conflicting interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or

publication of this article: Mark Bayley works at the Toronto Rehabilitation Institute which owns stakes in Myndtec; however, the device produced by this company is not directly recommended in these guidelines; Sean Dukelow receives research funding from the Heart and Stroke Foundation, the Canadian Institute for Health Research, and Allergan; Rosemary Martino holds the copyright on a dysphagia screening tool, which is included in a broader list of available dysphagia screening tools available on the CSBPR website; Nancy Salbach is an advisory member on the Collaborative for the TIME project involving a group of educators, researchers and healthcare professionals interested in promoting group, task-oriented exercise programs for people with balance/mobility limitations; Robert Teasell receives unrestricted grant funding from Allergan, and has been an invited speaker on their behalf regarding the long-term rehabilitation management of stroke including spasticity. The following coauthors do not have any conflicts of interest to report: John Andersen, Stephen Bagg, Karen Barlow, Caitlin Cassidy, Gabrielle deVeber, Marie-Emmanuelle Dilenge, Dariush Dowlatshahi, Darcy Fehlings, Norine Foley, Maridee Garnhum, Ev Glasser, Mary-Lou Halabi, Debbie Hebert, Ryan Hung, Jerome Iruthayarajah, Shannon Janzen, Ester Kang, Adam Kirton, Laura Lenz, Patrice Lindsay, Marilyn MacKay-Lyons, Annette Majnemer; Matthew Mayer, Amanda McIntyre, Jacqueline Purtzki, Mubeen Rafay, Annie Rochette, Sarah Rowe, Peter G. Rumney, Brenda Semenko, Bridget Stack, Lyn K. Sonnenberg, Luchie Swinton, Ashleigh Townley, Valentine Weber, Sue Verrilli.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: The development of the *CSBPR* is funded in its entirety by the Heart and Stroke Foundation, Canada. No funds for the development of these guidelines come from commercial interests, including pharmaceutical and device companies. All members of the recommendation writing groups and external reviewers are volunteers and do not receive any remuneration for participation in guideline development, updates and reviews. All participants complete a conflict of interest declaration prior to participation and these are updated at the time of publication.

References

1. Together against a rising tide: advancing stroke systems of care. Heart and Stroke Foundation of Canada, Ottawa, Canada, www.strokebestpractices.ca/wp-content/uploads/2014/06/HSF_SMReport2014E_Final.pdf (2014, accessed 24 March 2016).
2. Krueger H, Lindsay P, Cote R, et al. Cost avoidance associated with optimal stroke care. *Stroke* 2012; 43: 2198–2206.
3. Stroke Unit Trialists C. Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst Rev* 2013;9.
4. United States Department of Defence. Functional independence measurement user manual, Version 1.0, www.va.gov/vdl/documents/Clinical/Func_Indep_Meas/fim_user_manual.pdf (accessed 24 March 2016).
5. McIntyre A, Richardson M, Janzen S, Hussein N and Teasell R. The evolution of stroke rehabilitation randomized controlled trials. *Int J Stroke* 2014; 9: 789–792.
6. Coutts SB, Wein T, Lindsay MP, et al; Heart and Stroke Foundation Canada Canadian Stroke Best Practices Advisory Committee. Canadian Stroke Best Practice Recommendations: secondary prevention of stroke guidelines, update 2014. *Int J Stroke* 2015; 10: 282–291.
7. Casaubon LK, Boulanger J-M, Blacquiere D, et al. Canadian stroke best practice recommendations: hyperacute stroke care guidelines, update 2015. *Int J Stroke* 2015; 10: 924–940.
8. Casaubon LK, Boulanger J-M, Blacquiere D, et al. Canadian stroke best practice recommendations: acute inpatient stroke care guidelines, update 2015. *Int J Stroke* 2016; 11: 239–252.
9. Eskes GA, Lanctôt KL, Lindsay P, et al. Canadian stroke best practice recommendations: mood, cognition and fatigue following stroke practice guidelines, update 2015. *Int J Stroke* 2015; 10: 1130–1140.
10. Lindsay P, Taralson C, Silver F, et al. Canadian stroke best practice recommendations: telestroke guidelines and toolkit, update 2013, www.strokebestpractices.ca (accessed 24 March 2016).
11. 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 healthcare organizations. *JOGNN* 2002; 3: 599–611.
12. Teasell R, et al. Evidence-based review of stroke rehabilitation, www.ebrsr.com (accessed 1 April 2015).
13. Guyatt GH, Cook DJ, Jaeschke R, et al. Grades of recommendation for antithrombotic agents: American College of Chest Physicians evidence-based clinical practice guidelines (8th ed.) [published erratum in *Chest* 2008;134:473]. *Chest* 2008; 133(6 Suppl): 123S–131S.
14. Evans A, Harraf F, Donaldson N and Kalra L. Randomized controlled study of stroke unit care versus stroke team care in different stroke subtypes. *Stroke* 2002; 33: 449–455.
15. Zhang WW, Speare S, Churilov L, Thuy M, Donnan G and Bernhardt J. Stroke rehabilitation in china: a systematic review and meta-analysis. *Int J Stroke* 2014; 9: 494–502.
16. Foley N, Salter K and Teasell R. Specialized stroke services: a meta-analysis comparing three models of care. *Cerebrovasc Dis* 2007; 23: 194–202.
17. Saposnik G, Hassan KA, Selchen D, Fang J, Kapral MK and Smith EE. Stroke unit care: does ischemic stroke subtype matter? *Int J Stroke* 2011; 6: 244–250.
18. Langhorne P and Pollock A. What are the components of effective stroke unit care? *Age Ageing* 2002; 31: 365–371.
19. Outpatient Service Trialists Group. Therapy-based rehabilitation services for stroke patients at home. *Cochrane Database Syst Rev* 2003;CD002925.
20. Trial Collaboration Group AVERT. Efficacy and safety of very early mobilisation within 24 h of stroke onset (AVERT): a randomised controlled trial. *Lancet* 2015; 386: 46–55.

21. Fearon P and Langhorne P. Services for reducing duration of hospital care for acute stroke patients. *Cochrane Database Syst Rev* 2012; 9: CD000443.
22. Horsley SA, Herbert RD and Ada L. Four weeks of daily stretch has little or no effect on wrist contracture after stroke: a randomised controlled trial. *Aust J Physiother* 2007; 53: 239–245.
23. Turton AJ and Britton E. A pilot randomized controlled trial of a daily muscle stretch regime to prevent contractures in the arm after stroke. *Clin Rehabil* 2005; 19: 600–612.
24. Adey-Wakeling Z, Arima H, Crotty M, et al; SEARCH Study Collaborative. Incidence and associations of hemiplegic shoulder pain post stroke: prospective population-based study. *Arch Phys Med Rehabil* 2015; 96: 241–247.
25. Pollock A, Baer G, Pomeroy V, et al. Physiotherapy treatment approaches for the recovery of postural control and lower limb function following stroke. *Cochrane Database Syst Rev* 2007;CD001920.
26. Kluding PM, Dunning K, O'Dell MW, et al. Foot drop stimulation versus ankle foot orthosis after stroke: 30-week outcomes. *Stroke* 2013; 44: 1660–1669.
27. Foley N, Murie-Fernandez M, Speechley M, et al. Does the treatment of spastic equinovarus deformity following stroke with botulinum toxin increase gait velocity? A systematic review and meta-analysis. *Eur J Neurol* 2010; 17: 1419–1427.
28. Picelli A, Dambruoso F, Bronzato M, Barausse M, Gandolfi M and Smania N. Efficacy of therapeutic ultrasound and transcutaneous electrical nerve stimulation compared with botulinum toxin type a in the treatment of spastic equinus in adults with chronic stroke: a pilot randomized controlled trial. *Top Stroke Rehabil* 2014; 21(Suppl 1): S8–S16.
29. Forster A and Young J. Incidence and consequences of falls due to stroke: a systematic inquiry. *BMJ* 1995; 311: 83–86.
30. Maeda N, Kato J and Shimada T. Predicting the probability for fall incidence in stroke patients using the Berg Balance Scale. *J Int Med Res* 2009; 37: 697–704.
31. Said CM, Galea MP and Lythgo N. People with stroke who fail an obstacle crossing task have a higher incidence of falls and utilize different gait patterns compared with people who pass the task. *Phys Ther* 2013; 93: 334–344.
32. Hinchey JA, Shephard T, Furie K, et al. Formal dysphagia screening protocols prevent pneumonia. *Stroke* 2005; 36: 1972–1976.
33. Lakshminarayan K, Tsai AW, Tong X, et al. Utility of dysphagia screening results in predicting poststroke pneumonia. *Stroke* 2010; 41: 2849–2854.
34. Kono Y, Yamada S, Yamaguchi J, et al. Secondary prevention of new vascular events with lifestyle intervention in patients with noncardioembolic mild ischemic stroke: a single-center randomized controlled trial. *Cerebro Dis* 2013; 36: 88–97.
35. Rower F and VIS Group UK. Visual perceptual consequences of stroke. *Strabismus* 2009; 17: 24–28.
36. Bowen A, Knapp P, Gillespie D, Nicolson DJ and Vail A. Non-pharmacological interventions for perceptual disorders following stroke and other adult-acquired, non-progressive brain injury. *Cochrane Database Syst Rev* 2011;CD007039.
37. Dickey L, Kagan A, Lindsay MP, Fang J, Rowland A and Black S. Incidence and profile of inpatient stroke-induced aphasia in Ontario, Canada. *Arch Phys Med Rehabil* 2010; 91: 196–202.
38. Gialanella B and Prometti P. Rehabilitation length of stay in patients suffering from aphasia after stroke. *Top Stroke Rehabil* 2009; 16: 437–444.
39. Paolucci S, Matano A, Bragoni M, et al. Rehabilitation of left brain-damaged ischemic stroke patients: the role of comprehension language deficits. *A matched comparison*. Cerebrovasc Dis 2005; 20: 400–406.
40. Brady MC, Kelly H, Godwin J, and Enderby P. Speech and language therapy for aphasia following stroke. *Cochrane Database Syst* 2012.Rev, 5, CD000425.
41. Gabriele W and Renate S. Work loss following stroke. *Disabil Rehabil* 2009; 31: 1487–1493.
42. Finestone HM, Guo M, O'Hara P, et al. Driving and reintegration into the community in patients after stroke. *PMR* 2010; 2: 497–503.
43. Carlsson GE, Forsberg-Warleby G, Moller A and Blomstrand C. Comparison of life satisfaction within couples one year after a partner's stroke. *J Rehabil Med* 2007; 39: 219–224.
44. Boosman H, Schepers VP, Post MW and Visser-Meily JM. Social activity contributes independently to life satisfaction three years post stroke. *Clin Rehabil* 2011; 25: 460–467.
45. George MG, Tong X, Kuklina EV and Labarthe DR. Trends in stroke hospitalizations and associated risk factors among children and young adults, 1995–2008. *Ann Neurol* 2011; 70: 713–721.
46. Lynch JK. Cerebrovascular disorders in children. *Curr Neurol Neurosci Rep* 2004; 4: 129–138.
47. McIntyre A, Richardson M, Janzen S, et al. The evolution of stroke rehabilitation randomzied controlled trials. *Int J Stroke* 2014; 9: 789–792.